The Physical Educator Vol. 74 • pp. 476–496 • 2017
https://doi.org/10.18666/TPE-2017-V74-I3-7329

PEDAGOGY

Physical Education Student Teachers' Technology Integration Self-Efficacy

Jennifer M. Krause

Abstract

Pre- and in-service physical education teachers have evaluated themselves as not being very well prepared or proficient in technology use. Thus, better preparation of PE teachers to integrate technology is necessary. In this study, I examined the effects of technology-related mastery experiences, vicarious experiences, and social persuasion on preservice PE teachers' self-efficacy to integrate technology during student teaching. The participants, 60 (32 females, 28 males) student teachers, completed the Computer Technology Integration Survey for Physical Education prior to and at the conclusion of the student-teaching experience. Student teachers' self-efficacy to integrate technology into physical education significantly improved over the course of student teaching, and positive relationships existed between experiences with technology (i.e., mastery experience, vicarious experience, and social persuasion) and self-efficacy to integrate technology.

Recent information on the availability, influence, and applications of educational technology has presented physical educators with opportunities and demands to integrate technology into the teaching and learning environment. The challenge for physical educators to respond to the needs of children of the new millennium has been growing (Gard & Wright, 2005). The technologies available that could benefit students and teachers in physical educa-

Jennifer M. Krause is an assistant professor of Sport Pedagogy, School of Sport and Exercise Science, University of Northern Colorado. Please send author correspondence to jennifer.krause@unco.edu

tion (PE) classes, if applied appropriately, could meet the needs of these children. To use these technologies properly and to their full potential with students, teachers must first be proficient with using them. National organizations and governing bodies associated with teacher education have recognized the importance of educational technology integration, which has led to the establishment and constant revision of educational technology standards (Council for the Accreditation of Educator Preparation, 2013; International Society for Technology in Education [ISTE], 2008; National Association for Sport and Physical Education, 2008; National Board for Professional Teaching Standards, 2013). NASPE (2008) established a standard within planning and implementation dedicated to technology within the National Standards for Initial Physical Education Teacher Education, stating that PE teachers "demonstrate knowledge of current technology by planning and implementing learning experiences that require students to appropriately use technology to meet lesson objectives" (p. 2). The intent of this standard was to ensure that teacher candidates develop knowledge of and ability to implement current technologies to enhance learning with several outcomes. Physical education teacher education (PETE) programs have been held accountable for technology integration since 2001 with regard to accreditation, and therefore, accredited PETE programs must demonstrate how they meet this technology standard in preservice classes and field experiences.

Because of this demand, PE literature has been thoughtful in including strategies associated with technology integration in PE. Strategies on how to incorporate technologies, such as heart rate monitors and pedometers (Dunn & Tannehill, 2005; Nichols, Davis, McCord, Schmidt, & Slezak, 2009), tablets and smartphones (Cummiskey, 2011), and exergames (Mears & Hansen, 2009) into PE are abundant. With standards in place, PETE programs are tasked with an increasingly essential responsibility to produce technology-savvy PE teachers. It is evident that there are high expectations for teachers in terms of their ability to integrate technology effectively into their teaching. Still, there is a concern that today's teachers are not prepared to do so. Despite the availability of ideas and preparation plans, as well as having the importance of standards in place, many pre- and in-service PE teachers have evaluated themselves as not being well prepared or proficient in technology use and have noted that better preparation of PE teachers is necessary (Gibbone, Rukavina, & Silverman, 2010; Jones, Bulger, Illg, & Wyant, 2012; Liang, Walls, Hicks, Clayton, & Yang, 2006; Woods, Goc Karp, Miao, & Pearlman, 2008). Many technologies are available that could be beneficial in PE classes. To introduce and utilize these technologies properly to their full potential, teachers must first be proficient with using them. Teachers' perceived self-efficacy, or beliefs about their abilities to integrate technology, may play a major role in this process.

Self-Efficacy Theory

Bandura (1997) described perceived self-efficacy as one's "beliefs in one's capabilities to organize and execute the courses of action required to produce given attainments" (p. 3). The beliefs that preservice teachers have about their ability to integrate technology into their teaching therefore may influence future implementation as expected by the standards. In past studies, in- and preservice teachers evaluated themselves as not being well prepared to be proficient with integrating technology into their teaching. Researchers have listed a multitude of barriers to successful integration (Gibbone et al., 2010; Liang et al., 2006).

Preservice teachers' self-efficacy toward technology may be influenced by their knowledge, skills, and experiences with various technologies. According to Bandura (1986), self-efficacy beliefs are affected by several sources including (a) mastery experiences, (b) vicarious experiences, and (c) social persuasion (Figure 1). For example, a student teacher (ST) may observe (vicarious experience) a cooperating teacher (CT) successfully infuse pedometers in a fitness unit during which students increased physical activity, set goals, and kept track of their steps. This observation could then transfer to the ST's beliefs about his or her ability to do the same task and will have a positive effect. As a result, the ST may feel confident that infusing pedometers in his or her classes will also be successful. On the contrary, if an ST observes a CT unsuccessfully attempt to conduct a class in which the students wear heart rate monitors, the ST may interpret the unsuccessful integration as being too difficult to attempt on his or her own and therefore avoid doing so. The same idea applies to the other sources of self-efficacy, whereby an ST may have a successful or unsuccessful mastery experience integrating certain technologies or may receive positive or negative feedback about his or her capabilities to integrate technology, which therefore directly affects the self-efficacy level. Given the context of the student-teaching placement, in which preservice teachers have the greatest opportunity for mastery and vicarious experiences in an authentic, school-based setting, I focused on the influence of sources on self-efficacy beliefs about technology integration in PE. Knowledge about how preservice PE teachers are being prepared to integrate technology into their teaching, especially during the student-teaching experience, is important for pinpointing which sources, such as mastery or vicarious experiences or social persuasion, might be most useful in establishing higher levels of self-efficacy.

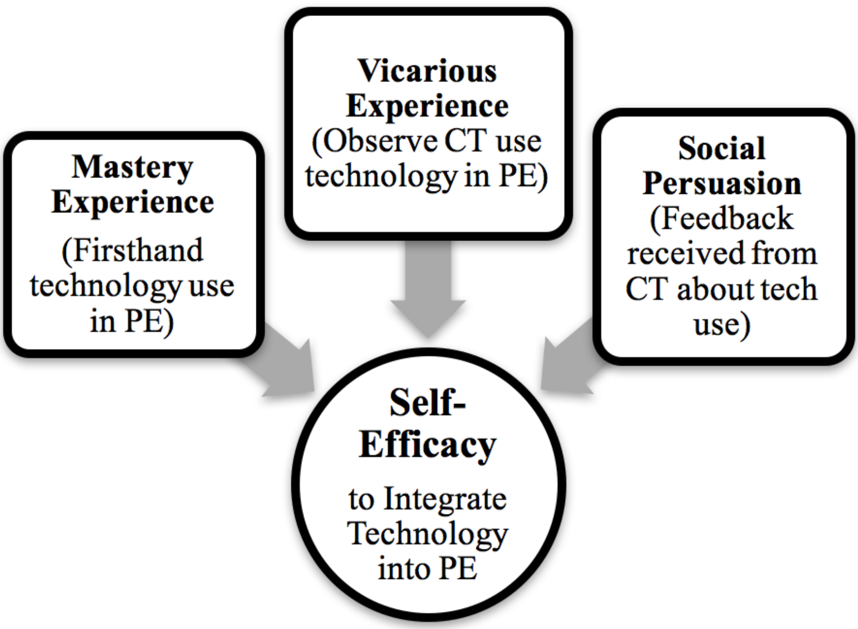

Figure 1. The relationship between the sources of self-efficacy and self-efficacy to integrate technology into physical education for preservice teachers. PE = physical education; CT = cooperating teacher.

Research on Technology Integration

Although a considerable amount of research on preparing preservice teachers to use and integrate technology has been done, there has been a lack of research on how PE preservice teachers perceive their ability to integrate technology into PE settings and, more important, what influences their perceptions. It was important in this study to assess preservice PE teachers' self-efficacy to integrate technology into their teaching, because a person's self-efficacy has been found to have a strong relationship with choice behavior, motivation, and persistence (Bandura, 1986). Researchers have applied self-efficacy theory in several areas, including sport, academic, and work performance and teacher efficacy. Study results in these areas suggest a positive relationship exists between the sources of self-efficacy and self-efficacy levels (Moritz, Feltz, Fahrbach, & Mack, 2000; Multon, Brown, & Lent, 1991; Stajkovic & Luthans, 1998).

Investigating the possible relationship between technology integration self-efficacy and the student-teaching experience with regard to the sources of self-efficacy may inform PETE preparation programs of the importance of selecting and providing experiences that foster positive efficacious beliefs and therefore improved choice behavior, motivation, and persistence among preservice teachers. Preservice PE teachers are exposed to technology now more than ever. Self-efficacy to integrate this technology into PE may have a viable effect on whether preservice teachers integrate technology appropriately or at all when they become in-service teachers. Bandura (1997) declared that self-efficacy beliefs are most in flux early in learning and tend to become fairly stable and resistant to change once set. For preservice teachers, who have few mastery experiences to draw upon, other sources of self-efficacy may be relevant in their self-assessments of efficacy, including vicarious experience and social persuasion. Insight into the influences through empirical studies on preservice PE teachers' self-efficacy through their student-teaching experience plays an important role in reforming the issues with technology training and in shaping technology curriculum development in PETE programs.

The purpose of this study was to explore preservice PE teachers' self-efficacy to integrate technology into their student-teaching experiences. I sought to explore primarily how preservice PE teachers perceive their self-efficacy to integrate technology into PE at the beginning and end of their student-teaching experiences and potential differences between their levels of self-efficacy at these times. In addition, I aimed to determine whether a relationship existed between preservice teachers' degree of self-efficacy and technology integration experiences as measured by the sources of self-efficacy or other demographic factors in student teaching and, if so, which sources of self-efficacy were most influential to the level of self-efficacy to integrate technology.

Method

Participants and Setting

STs (n = 104) from nine colleges and universities who were enrolled in PETE programs in the Mid-Atlantic region of the United States were invited to participate in the study. A response rate of 71% yielded a sample of 60 participants (32 females, 28 males; $M_{age} = 22.77$, $SD_{age} = 1.8$; 95% Caucasian). Of the STs, 77% were enrolled in a bachelor's degree program, 22% were enrolled in a master's degree program, and 1% were enrolled in a program solely for teacher certification; all students were seeking PreK–12 licensure in physical education. There were no significant differences among undergraduate and graduate students in any tests, so I combined them into one group for this study. STs were assigned to either an elementary (56.7%) or a secondary (43.3%) grade level student-teaching placement in accordance with the procedures of their program. All participants provided informed consent in compliance with the university's institutional review board.

Instrumentation

In this study, I used a quantitative survey, the Computer Technology Integration Survey for Physical Education (CTIS-PE). The CTIS-PE was given to STs as a pretest (CTIS-PE-1) prior to beginning student teaching and posttest (CTIS-PE-2) at the end of their first student-teaching placement. The CTIS-PE-1 consisted of items related to (a) self-efficacy to integrate technology in PE, (b) personal demographic information, and (c) technology integration competency. I adapted the self-efficacy portion of the CTIS-PE survey from the previously validated Computer Technology Integration Survey

(Wang, Ertmer, & Newby, 2004). I used this 16-item, five-response Likert scale survey to measure preservice teachers' self-efficacy beliefs for technology integration. Participants were asked to rate their current level of confidence with statements regarding technology use (e.g., "I feel confident that I can select appropriate technology for instruction based on curriculum standards") on a scale of 1 to 5, with 1 = *strongly disagree,* 2 = *disagree,* 3 = *neither agree nor disagree,* 4 = *agree,* and 5 = *strongly agree*. The wording of the survey ("I feel confident…") met Bandura's (1986) recommendations for the construction of self-efficacy scales and was closely related to NASPE (2008) and ISTE (2008) standards for technology integration. To address the intended PE ST population appropriately, I made a few minor revisions of the instrument. These revisions helped to ensure that the language in the instrument was parallel to that of a physical educator. Experts with experience in the combined areas of self-efficacy, PE, and survey instrumentation reviewed the survey for content and construct validity. Cronbach's alpha reliability estimates for this study were .953 (CTIS-PE-1) and .951 (CTIS-PE-2). In addition, the internal consistency of the technology training measure was .873.

The CTIS-PE-1 includes demographic items such as age, gender, race, program level (e.g., bachelor, master), and student-teaching grade level of the first placement. The CTIS-PE-1 also asked participants to rate their level of technology integration competency derived from their PETE program on a scale of 1 to 4, with 1 = *untrained (little or no experience learning the tool)*, 2 = *trained (have been taught or learned on own)*, 3 = *highly trained (consider self to be highly competent in the tool)*, and 4 = e*xpert (have successfully used the tool in teaching PE)*. I selected the technology integration knowledge tools from the Physical Education Technology Use Survey for Physical Education Teachers (Woods et al., 2008) because of their specific uses for PE. The final question asked STs to select the environment(s) in which they learned to integrate technology in PE during their PETE program. Selections included (a) single general technology course, (b) PE-specific technology course, (c) infusion throughout several methods courses, (d) practicum or other school-based field experience, (e) professional conference or workshop, and (e) other.

The CTIS-PE-2 consists of items related to (a) self-efficacy to integrate technology in PE (posttest for self-efficacy), (b) school placement demographic information, and (c) technology integration experiences from their first 6- to 8-week student-teaching experience. This instrument requested participants to supply information about any technology integration requirements and expectations that they had gained from others about student teaching. In addition, the CTIS-PE-2 asked participants to rate their level of success with integrating technology in PE during their first student-teaching placement, on a five-item Likert scale from *very unsuccessful* to *very successful*. The technology integration experiences were based on three sources of self-efficacy: (a) mastery experiences, (b) vicarious experiences, and (c) social persuasion (presented in the form of feedback from others). Participants also provided demographic information about their student-teaching placement including (a) school level; (b) total number of students in the school; (c) school socioeconomic status; (d) community environment; (e) average number of students per PE class; and (f) CT age, gender, and number of years teaching. Finally, participants indicated the number and frequency of use of technologies such as pedometers, video cameras, and computers that were available to the PE departments at their first student-teaching placements.

Data Collection and Analysis

I made personal visits to all nine colleges and universities to recruit participants approximately 1 week prior to the start of the first student-teaching placement, at which time STs who agreed to participate completed the CTIS-PE-1. I requested that all participants supply a valid e-mail address on the initial questionnaire. Then via e-mail I contacted those who supplied this information on a schedule specific to their student-teaching placement. I sent the link for the online CTIS-PE-2 to the participants via e-mail during the last week of their first student-teaching placement. Participants' first student-teaching placement lasted 6 to 8 weeks, depending on the college or university schedule.

I analyzed data using SPSS (version 20). I used descriptive statistics and paired *t* tests (significance levels at $\alpha \leq .05$) to analyze demographic and individual response item data on the CTIS-PE instruments. I used hierarchical multiple regression to analyze the possible relationship between sources of self-efficacy and the overall self-efficacy scores.

I calculated self-efficacy scores from the CTIS-PE-1 and CTIS-PE-2 questionnaires and averaged for each scale. The higher the score was, the more confident the preservice teachers were about their ability to integrate technology into student teaching. To determine the levels of self-efficacy, I averaged responses from the self-efficacy scale. To determine if there was a difference in self-efficacy scores from the beginning to the end of student teaching, I calculated a paired samples *t* test. I analyzed self-efficacy scores, sources of self-efficacy scores (i.e., mastery experience, vicarious experience, and social persuasion), and demographic factors by conducting Pearson's correlational analyses to determine possible relationships.

I performed hierarchical multiple regression to determine how well the three sources of self-efficacy explained the variance in self-efficacy to integrate technology. I placed mastery experience in Step 1 of the model, followed by vicarious experience in Step 2 and social persuasion in Step 3. I selected the placement order of variables in the steps with reference to Bandura's (1986) theory that described mastery experience as the most influential source of self-efficacy, followed by vicarious experience and then social persuasion. Finally, I performed a hierarchical multiple regression to determine if mastery experience explained any of the variance after controlling for significantly correlated demographic variables (i.e., technology training).

Results

Descriptive Information on Participants and Their Placements

STs reported levels of training with technology as untrained ($n = 1$), trained ($n = 26$), highly trained ($n = 30$), and expert ($n = 3$). Overall, STs fell between trained and highly trained with technology prior to beginning their placements ($M = 2.49$, $SD = .552$). I also collected demographic data with regard to the student-teaching placements. STs were placed in rural (45%), suburban (37%), and urban (18%) schools. Classes averaged 23.65 students ($SD = 4.27$) and 51.4 min ($SD = 22.84$). I also collected CT characteristics for age ($M = 41.88$, $SD = 10.21$), gender (48.3% female, 51.7% male), and years teaching ($M = 17.07$, $SD = 9.98$). For the availability of technology tools at placements, as indicated by participants, the most widely available technologies across schools (n = number of schools where the technology was available) were computers for teacher use ($n = 50$), computers for student use ($n = 33$), pedometers ($n = 30$), and video cameras ($n = 30$). Of the schools that had provided technology tools, on average they had 22 computers for student use ($SD = 12.0$), 25 pedometers ($SD = 10.0$), and eight digital video cameras ($SD = 8.0$). On a daily basis, 66.7% of STs used computers for teaching, 13.3% used pedometers, and 10.7% used computers with students. Finally, participants reported levels of success for each source of self-efficacy. Of the 60 participants, 88.3% reported having mastery experiences, 88.3% reported having vicarious experiences, and 78.3% reported receiving feedback from others regarding use of technology at their school placements. Based on a 5-point scale, participants rated their mastery experiences ($M = 4.32$, $SD = .80$), vicarious experiences ($M = 4.21$, $SD = .970$), and social persuasion ($M = 4.21$, $SD = .907$) as successful. Participants who reported no experience were not included in analysis for that variable.

Change in Self-Efficacy Beliefs

STs reported a slight but significant increase in self-efficacy to integrate technology in PE over the course of one 6- to 8-week student-teaching placement. I analyzed the self-efficacy scores from the CTIS-PE-1 and CTIS-PE-2 using a paired samples t test. I found a statistically significant increase in self-efficacy scores ($N = 60$) from the beginning ($M = 3.90$, $SD = .581$) to the end ($M = 4.12$, $SD = .069$), $t(59) = 3.04$, $p < .01$, of the first student-teaching placement (two-tailed). The mean increase in self-efficacy scores was .223 with a 95% confidence interval from .370 to .076. The eta-squared statistic ($\eta^2 = .14$) indicated a large effect size according to Cohen's (1988) guidelines for interpretation, indicating a substantial difference in the self-efficacy scores before and after student teaching.

Relationships Among Sources of Self-Efficacy and Other Factors

I computed correlations to identify the relationships among the three sources of self-efficacy and the criterion variable of self-efficacy to integrate technology in PE calculated from the CTIS-PE-2. I performed preliminary analyses to ensure no violation of the assumptions of normality and linearity. Of the Pearson product–moment correlations computed on sources of self-efficacy, all of the predictor variables displayed strong, positive correlations and were statistically significant at the $p < .01$ level. The correlation coefficients for each predictor variable with self-efficacy and with one another indicate strong correlations, according to Cohen (1988). Mastery experience produced a correlation of $r = .465$, $n = 52$. Vicarious experience produced a correlation of $r = .433$, $n = 52$. Social persuasion produced a correlation of $r = .412$, $n = 46$. The statistics for each source (i.e., mastery, vicarious, social persuasion) indicated a score drawn from the number of STs who reported experiencing each variable.

In addition, I computed correlations to identify relationships between demographic factors, technology training, school placement factors, and technology availability and with self-efficacy scores. Pearson product–moment correlations computed on these variables showed that self-efficacy had a strong relationship with the level of technology training ($r = .499$, $p < .01$). No other variables (e.g., age, gender, race, program, school placement) produced significant correlations with self-efficacy or one another. Table 1 presents results of significantly related variables in an intercorrelation matrix, along with means and standard deviations.

Table 1
Means, Standard Deviations, and Intercorrelations for Self-Efficacy, Source, and Training Measures

Measure	*M*	*SD*	1	2	3	4	5
1. Self-Efficacy	4.12	.54	–				
2. Mastery	4.32	.80	.47**	–			
3. Vicarious	4.21	.97	.43**	.63**	–		
4. Social Persuasion	4.21	.91	.41**	.64**	.59**	–	
5. Technology Training	2.50	.55	.46**	.14	.18	.13	–

Note. Self-efficacy measure was taken from CTIS-PE-2.
**$p < .01$ (2-tailed).

Predictors of Self-Efficacy

I conducted a hierarchical linear multiple regression analysis to assess the ability of the sources of self-efficacy (mastery experience, vicarious experience, and social persuasion) to predict levels of STs' self-efficacy (CTIS-PE-2) to integrate technology into PE. I conducted preliminary analyses to ensure no violation of the assumptions of normality, linearity, multicollinearity, and homoscedasticity. I entered mastery experience at Step 1 on account of Bandura's (1997) self-efficacy theory, which states that mastery experience is the strongest predictor of self-efficacy. Mastery experiences also had the strongest relationship with self-efficacy ($r = .499$) among all other variables in the previous correlation analysis in this study. Mastery experience explained 21% of the variance in self-efficacy. I entered vicarious experience at Step 2, which explained an additional 4.4% of the variance in self-efficacy after controlling for mastery experience. I entered social persuasion at Step 3, which explained an additional 1% of the variance in self-efficacy after controlling for mastery and vicarious experiences.

All three models were statistically significant ($p < .01$); however, the only model that included a statistically significant variable was the first model, which included mastery experience ($\beta = .46$, $p < .01$) as the only predictor. After entry of mastery experience at Step 1, the model explained 21% of the variance in self-efficacy, $F(1, 40) = 10.61$, $p < .01$. In this case, Steps 2 and 3 did not contain statistically significant variables. The three independent variables in this regression model were strongly correlated, with Pearson's r values ranging from .59 to .64, as shown in the correlations matrix; therefore, there is greater shared variance that is statistically removed when they are all included in the models from Step 2 and Step 3. Table 2 shows the results of the multiple regression analysis.

Table 2

Hierarchical Regression Analysis Summary for Source Variables Predicting Preservice Teachers' Self-Efficacy (N = 42)

Step and predictor variable	**B**	***SE* B**	**β**	R^2	ΔR^2
Step 1: Mastery experience	.33	.10	.46**	.21**	
Step 2: Vicarious experience	.166	.11	.28	.25**	.04
Step 3: Social persuasion experience	.09	.12	.14	.26**	.01

**$p < .01$.

I again used hierarchical multiple regression to assess the ability of mastery experience to predict levels of self-efficacy, after controlling for the influence of prior technology training (Technology Training Scale from CTIS-PE-1). I again conducted preliminary analyses to ensure no violation of assumptions for multiple regression. I entered technology training at Step 1, which explained 19% of the variance in self-efficacy. After entry of mastery experience at Step 2, the model as a whole explained 36% of the total variance, $F(2, 49) = 14.0$, $p < .001$. Mastery experience explained an additional 17% of the variance in self-efficacy, after controlling for technology training, R^2 value change = .17, F statistic change (1, 49) = 13.15, $p < .01$. In the final model, both of the control measures were statistically significant, with mastery experience recording a higher beta value ($\beta = .42$, $p < .01$) than technology training ($\beta = .39$, $p < .01$). Table 3 shows the results.

Table 3
Hierarchical Regression Analysis Summary for Technology Training and Mastery Experience Predicting Preservice Teachers' Self-Efficacy (N = 52)

Step and predictor variable	B	*SE* B	β	R^2	ΔR^2
Step 1: Technology training	.45	.13	.39**	.19**	
Step 2: Mastery experience	.29	.08	.42**	.36***	.17**

***p* < .01. ****p* < .001

Discussion

Difference in Self-Efficacy Beliefs

In this study, I measured self-efficacy beliefs toward integrating technology in PE at the beginning and end of the first student-teaching placement. STs began their experiences with positive self-efficacy to integrate technology ($M = 3.9$). This result is not consistent with results from with previous studies with preservice teachers. Liang et al. (2006) reported that PE majors at the pre-student-teaching stage in their careers did not highly estimate their ability to integrate technology, with a majority of the participants (51.3%) reporting in the "minimally (need help)" category. The second occurrence of the self-efficacy measure in this study, obtained from the CTIS-PE-2 questionnaire, indicated that STs completed their first student-teaching placement experience with significantly higher self-efficacy beliefs (M = 4.1) to integrate technology in PE than when they first began. This result is also inconsistent with results in previous research on preservice PE teachers' beliefs about their ability to integrate technology. Liang et al. (2006) also measured the perceived ability of preservice PE teachers at the point of initial licensure, just after completion of their student-teaching experience. This resulted in a majority of the participants (61.1%) reporting in the "minimally (need help)" category. These comparisons, however, should be approached with caution because the measures for ability were not equal and Liang et al. compared two groups, rather than one group at two points. In this case, there is no way to know if those preservice teachers' beliefs would have changed over time. In addition, it was unclear whether the participants in Liang et al.'s (2006) study represented all or only a portion of the PE majors, whereas the participants in this study were volunteers and may have elected to be a part of the study because they were more likely to use technology.

Aside from previous research with preservice teachers, this study can also be compared with research including in-service teachers. For example, Woods et al. (2008) investigated the technology use and competencies of in-service PE teachers. The results of Woods et al.'s study had similarities and differences to the results of this study. In the in-service teachers study, Woods et al. reported PE teachers' perceptions of their own competency with individual technology tools for general education and for PE. Woods et al reported frequencies and found that teachers felt more competent with technologies related to general education than those related specifically to PE. The teachers reported a range of competencies in PE-related technologies. The results of this study should be compared with the results of Woods et al.'s study with caution. The major constructs of the two studies, self-efficacy and competence, although many times used interchangeably, are different. The overall theme, however, of both studies is similar. The preservice teachers in this study rated themselves to be confident in their ability to integrate technology in PE. This result is consistent with some of the individual results of Woods et al.'s study.

Results of this portion of the study should be approached with caution. The teachers in Liang et al.'s (2006) study and Woods et al.'s (2008) study were not as confident in their ability to integrate technology as those in this study. It is important to recognize that with the fast growth and use of technology in society, today's preservice teachers may have more experience with technologies and therefore may be more technology-savvy than teachers in earlier studies, as noticeable in their technology training levels. The preservice teachers in Liang et al.'s (2006) study did not have any technology training in their programs prior to the study. Although there was a statistically significant increase in self-efficacy in this study, there may still be the question of whether 0.2 points is a meaningful difference. The participants in this study were volunteers, and those who chose to complete the questionnaires may have been more likely to use technology successfully. In addition, the change in self-efficacy may have been due to participants having completed questionnaires throughout their placements or answering the questions in a socially desirable way rather than by what was true. Finally, I treated the data for the self-efficacy scale as continuous. If I had treated the data as categorical and analyzed the frequency by rating, the results could have shown no difference in scores. In addition, I selected measures and tests to maintain fidelity to the analysis of the original self-efficacy scale (Wang et al., 2004).

Relationship Between Self-Efficacy Beliefs and Sources

The Pearson's *r* correlation analyses indicated that self-efficacy to integrate technology was highly correlated with mastery experience, vicarious experience, and social persuasion, with regard to technology integration during student teaching. In addition, each of the sources of self-efficacy was highly correlated with the other. One hierarchical multiple regression indicated that mastery experience accounted for 21% of the variance in self-efficacy, with vicarious experience and social persuasion adding only an additional 5% that was not statistically important. The lack of a statistically significant additional variance explanation by vicarious and social persuasion experiences may be misleading. Correlational analyses indicated a strong, positive relationship among the three sources of self-efficacy, and although not meeting the levels of multicollinearity, the variables may have influenced one another. It is clear that the variables are related, but they are so closely related that one will not add any extra explanation of variance to the results.

Based on the results of an additional multiple regression, mastery experience explained 17% of the variance in self-efficacy, when controlling for prior technology training. Combined, these two variables explained 36% of the variance in self-efficacy. These quantitative analyses resulted in further investigation of the variables, as discussed in the following section.

Bandura (1986, 1997) hypothesized that self-efficacy beliefs develop, can be instilled, and can be strengthened as people interpret information from several sources: (a) enactive mastery experiences, (b) vicarious experiences, and (c) verbal/social persuasion. The most powerful source of self-efficacy is mastery experience, defined as one's interpretations of his or her own previous, authentic experiences performing a particular task. Bandura (1997) suggested a successful mastery experience will improve one's personal efficacy and an unsuccessful mastery experience will weaken it, especially if a firm sense of efficacy has yet to be constructed. For the preservice teachers in this study, Bandura's self-efficacy theory appears to hold true to some degree. Self-efficacy increased over the course of the student-teaching placement and mastery experience explained a significant amount of the variance in self-efficacy to integrate technology. In addition, a majority of STs indicated having successful mastery ($M = 4.32$), vicarious ($M = 4.21$), and social persuasion ($M = 4.21$) experiences with technology integration during their ST placements. These successful experiences were consistent with Bandura's explanation that strong self-efficacy antecedents will strengthen one's self efficacy and adverse efficacy antecedents will weaken one's self-efficacy (Bandura, 1986, 1997). In this study, it may be concluded that the strong, positive experiences or antecedents may have strengthened the preservice teachers' self-efficacy to integrate technology, to some extent.

Most of the results of these analyses were consistent with the results of some previous studies investigating the relationship between sources of self-efficacy and self-efficacy beliefs. Martin, McCaughtry, Kulinna, Cothran, and Faust (2008) investigated the effects of a yearlong mentoring-based professional development program on PE teachers' self-efficacy to use pedometers and computers. After participants were engaged in mastery experiences and given regular social persuasion, they substantially increased their self-efficacy. A majority of the other technology-related studies in the literature involving sources of self-efficacy included only one source: vicarious experience. For example, Wang et al. (2004) investigated how vicarious experiences and goal setting affected preservice teachers' judgments of self-efficacy for technology integration. They found that preservice teachers who were exposed to vicarious experiences that were related to successful technology integration with and without goal setting had significantly greater increases in self-efficacy judgments for technology integration than did those who were not exposed to vicarious experiences.

The result that training was a significant predictor of self-efficacy aligns with the notion that several factors influence teachers to use technology, including availability and access to technology, teacher preparation and training, leadership, and time to learn and prepare for technology integration (Franklin, 2008). Evidence suggests, however, that teachers' beliefs about their ability, or self-efficacy to integrate technology in teaching, may be a significant factor in determining technology integration levels (Albion, 1996; Oliver & Shapiro, 1993), as was the case in this study, with mastery experiences explaining more variance in overall self-efficacy. These results involving training should be approached with caution. The 10 questions that investigated technology training had participants provide their perceived training levels, not their actual levels of competence. Because a standard training measure was not available, I constructed a measure that reflected technologies that were presented in other PE literature. It would be ideal to construct a valid, reliable, and standard measure of technology competency for future investigations in PE.

The remaining unexplained variance in self-efficacy may have been affected on a practical level. For example, placement demographics such as school level, access, and frequency and duration of meetings, although not showing statistical significance, may have affected whether preservice teachers utilized technology and how often. In addition, the CTs' behavior, attitudes, and direction of technology use may have had an effect. Expectations from the university or college program, university supervisor, and CT may have also had an effect. This variable was originally investigated on the CTIS-PE-2; however, the data retrieved from this question were unusable. It appeared as if participants did not fully understand the question, even though it was accepted in the pilot study. In addition, classroom management skills of the preservice teachers may have affected whether they could feasibly distribute and use the technology in conjunction with pedagogy and content or with large groups of students.

Conclusion

The results from this study suggest several conclusions regarding preservice PE teachers' self-efficacy to integrate technology during student teaching. STs began student teaching with positive self-efficacy beliefs to integrate technology in PE, and their self-efficacy levels increased by the end of their first student-teaching placement. In addition, student-teaching mastery experiences, vicarious experiences, and social persuasion about technology integration during their student-teaching placement, as well as prior technology training, were highly related to their self-efficacy levels. Each of these variables, with mastery experience with technology during student teaching and prior technology training having individual significance, predicted STs' self-efficacy to integrate technology, to some degree. STs had access to a variety of technologies during their ST placements and a majority of their experiences were successful.

The results of this study inform the PETE community of the possibility of mastery experiences, vicarious experiences, and social persuasion affecting self-efficacy to integrate technology, to some degree. There may be practical implications for PETE programs involved in preparing teachers to use and integrate technology for teaching and learning in PE. Program coordinators and fellow PETE faculty may plan their professional preparation programs to include training plans involving a multitude of opportunities for mastery experiences with technology in the context of teaching PE. In addition, faculty modeling and other vicarious learning experiences may be included. Regular, constructive social persuasion to preservice teachers may also be helpful in building their confidence. PETE faculty who are tasked with student-teaching placement responsibilities may attempt to place students with CTs who successfully employ, when appropriate, technology tools in their planning, teaching, and assessment and who will serve as good models for STs. Also, selecting schools with or even assisting schools with obtaining technology tools for instruction may be beneficial not only to the school but also to the STs because more opportunities for technology integration practice will be in place. Additionally, the findings of this study may encourage PETE faculty to incorporate classes specific to technology in PE or infuse technology throughout the coursework in their programs. Finally, PETE programs may create or revise requirements for STs with regard to the frequency or quality of technology integration practice during the student-teaching experience, which would then encourage more attempts, or mastery experience with technology, and therefore encourage proper training ahead of time.

In the future, researchers should investigate self-efficacy as a potential predictor of future behavior with regard to technology integration in PE, as hypothesized by Bandura (1997). In addition, because of CTs major influence in the student-teaching placement, an investigation of CTs' attitudes and behaviors toward technology may be warranted. Finally, because the results of this study show that technology training has a significant influence on self-efficacy, it may be important to investigate PETE programs that claim to be preparing students well to integrate technology in PE teaching and learning, to establish a model for others.

References

Albion, P. R. (1996). Student teachers' use of computers during teaching practice in primary classrooms. *Asia-Pacific Journal of Teacher Education, 24,* 63–73. https://doi.org/10.1080/1359866960240106

Bandura, A. (1986). *Social foundations of thought and action: A social cognitive theory.* Englewood Cliffs, NJ: Prentice Hall.

Bandura, A. (1997). *Self-efficacy: The exercise of control.* New York, NY: Freeman.

Cohen, J. W. (1988). *Statistical power analysis for the behavioral sciences* (2nd ed.). Hillsdale, NJ: Lawrence Erlbaum Associates.

Council for the Accreditation of Educator Preparation. (2013). *CAEP accreditation standards*. Retrieved June 20, 2014, from http://caepnet.files.wordpress.com/2013/09/final_board_approved1.pdf

Cummiskey, M. (2011). There's an app for that: Smartphone use in health and physical education. *Journal of Physical Education, Recreation, & Dance, 82*(8), 24–30. https://doi.org/10.1080/07303084.2011.10598672

Dunn, L., & Tannehill, D. (2005). Using pedometers to promote physical activity in secondary physical education. *Strategies, 19*(1), 19–25. https://doi.org/10.1080/08924562.2005.11000384

Franklin, C. A. (2008). Factors determining elementary teachers' use of computers. *Principal, 8*(3), 54–55.

Gard, M., & Wright, J. (2005). *The obesity epidemic: Science, morality, and ideology*. Basingstoke, United Kingdom: Routledge.

Gibbone, A., Rukavina, P., & Silverman, S. (2010). Technology integration in secondary physical education: Teachers' attitudes and practice. *Journal of Educational Technology Development and Exchange, 3*(1), 27–42. https://doi.org/10.18785/jetde.0301.03

International Society for Technology in Education. (2008). *ISTE standards for teachers.* Retrieved June 20, 2014, from http://www.iste.org/standards/standards-for-teachers

Jones, E. M., Bulger, S. M., Illg, K., & Wyant, J. (2012). Modified Delphi investigation of instructional technology in PETE. *Global Journal of Health and Physical Education Pedagogy, 1,* 295–310.

Liang, G., Walls, R. T., Hicks, V. L., Clayton, L. B., & Yang, L. (2006). Will tomorrow's physical educators be prepared to teach in the digital age? *Contemporary Issues in Technology and Teacher Education, 6*(1), 143–156.

Martin, J. J., McCaughtry, N., Kulinna, P., Cothran, D., & Faust, R. (2008). The effectiveness of mentoring-based professional development on physical education teachers' pedometer and computer efficacy and anxiety. *Journal of Teaching in Physical Education, 27,* 68–82. https://doi.org/10.1123/jtpe.27.1.68

Mears, D., & Hansen, L. (2009). Active gaming: Definitions, options, and implementation. *Strategies, 23*(2), 26–29. https://doi.org/10.1080/08924562.2009.10590864

Moritz, S. E., Feltz, D. L., Fahrbach, K. R., & Mack, D. E. (2000). The relation of self-efficacy measures to sport performance: A meta-analytic review. *Research Quarterly for Exercise and Sport, 71,* 280–294. https://doi.org/10.1080/02701367.2000.10608908

Multon, K. D., Brown, S. D., & Lent, R. W. (1991). Relation of self-efficacy beliefs to academic outcomes: A meta-analytic investigation. *Journal of Counseling Psychology, 38,* 30–38. https://doi.org/10.1037/0022-0167.38.1.30

National Association for Sport and Physical Education. (2008). *National standards for initial physical education teacher education.* Retrieved October 25, 2013, from http://www.ncate.org/LinkClick.aspx?fileticket=9jpRd%2B5aH84%3D&tabid=676

National Board for Professional Teaching Standards. (2013). *NBPTS physical education standards* (2nd ed.). Retrieved from http://www.nbpts.org/sites/default/files/documents/certificates/NB-Standards/PE_NB_Standards.pdf

Nichols, R., Davis, K. L., McCord, T., Schmidt, D., & Slezak, A. M. (2009). The use of heart rate monitors in physical education. *Strategies, 22*(6), 19–23. https://doi.org/10.1080/08924562.2009.10590845

Oliver, T. A., & Shapiro, E. (1993). Self-efficacy and computers. *Journal of Computer-Based Instruction, 20,* 81–85.

Stajkovic, A. D., & Luthans, F. (1998). Self-efficacy and work-related performance: A meta-analysis. *Psychological Bulletin, 122,* 240–261. https://doi.org/10.1037/0033-2909.124.2.240

Wang, L., Ertmer, P. A., & Newby, T. J. (2004). Increasing preservice teachers' self-efficacy beliefs for technology integration. *Journal of Research in Technology in Education, 36,* 231–250. https://doi.org/10.1080/15391523.2004.10782414

Woods, M. L., Goc Karp, G., Miao, H., & Perlman, D. (2008). Physical educators' technology competencies and usage. *The Physical Educator, 65,* 82–99.