

Physical Education Teacher Perceptions of Technology-Related Learning Experiences: A Qualitative Investigation

Jun-Hyung Baek
University of Maine

Emily Jones
Illinois State University

Sean Bulger and Andrea Taliaferro
West Virginia University

Purpose: The purpose of this study was to examine in-service physical education teachers' perceptions of and perceived value of technology-related learning across three formal training experiences (pre-service education, in-service continuing professional development, and graduate education). **Methods:** Twelve teachers enrolled in a graduate-level physical education teacher education program at a rural mid-Atlantic university participated in the study. Participants completed the Stage of Adoption of Technology survey (Christensen, 1997) and engaged in individual semi-structured interviews. **Results:** Six learning sources and four themes relative to participants' perceptions of and perceived value of technology learning experiences emerged from the interview which include (a) absence of technology in K-12 PE, (b) technology-centric experience, (c) broadened awareness through observation, and (d) growth through hands-on experience. **Conclusion:** The findings align with and extend to previous research that suggests technology experiences must be dynamic, authentic, and tailored for individuals at different stages of technology adoption.

Keywords: instructional technology, physical education teacher education, stages of technology adoption, technology-related learning experience

Due to the growth of technology's role in education, today's teachers face challenges to meet the unique needs of students who have never thought about life without the internet, computers, or cellular phones (Krause, Franks, & Lynch, 2017). In response to this issue, educational organizations such as Society of Health and Physical Educators [SHAPE America] (2017) and International Society for Technology in Education [ISTE] (2017) have established technology-related standards indicating the knowledge and skills necessary for teachers to integrate technology. These standards have challenged physical education teacher education (PETE) programs to restructure or enhance existing curricula to prepare teachers with the appropriate knowledge, skills, and dispositions to incorporate technology effectively into instruction (Jones, Bulger, & Wyant, 2012). However, findings from previous studies have indicated that pre- and in-service physical education (PE) teachers do not feel sufficiently prepared to incorporate technology into their classroom in meaningful ways (Gibbone, Rukavia, & Silverman, 2010; Juniu, Shonfeld, & Ganot, 2013). Although these findings highlight the importance of developing quality PETE and professional development programs (PDP) to

better equip pre- and in-service PE teachers with skills and knowledge to integrate technology, there has been limited empirical evidence, to date, of programs' efficacy and effectiveness to achieve the stated objectives.

With an ever-growing number of technologies available to consumers, physical educators have explored and adopted relevant technologies for use within the gymnasium. Technologies that are adapted by PE teachers include, but are not limited to, fitness, physical activity monitors, handheld computers, mobile devices, desktop, mobile applications, active gaming systems, etc. (Beighle, Morgan, & Pangrazi, 2004; Phillips, Rodenbecka, & Clegga, 2014). Emerging dialogue within the field suggests the potential implications of technology-enhanced pedagogy in terms of instructional practice, student learning, and solving pedagogical and instructional challenges (Casey, Goodyear, & Armour, 2017). Several recent studies have suggested favorable outcomes for technology-enhanced PE environments on student variables such as motivation and knowledge (Legrain, Gillet, Gernigon, & Lafreniere, 2015) and physical activity (PA) levels in classroom settings (Melton, Bland, Harris, Kelly, & Chandler, 2015). Nonetheless, widespread use of technology in PE classrooms remains limited and is primarily for management or communication (Juniu et al., 2013; Kretschmann, 2015). This may be a function of the challenges that pre- and in-service teachers report during technology integration, which include restricted budgets, teacher-to-student ratios, inadequate training and technical support, lack of knowledge, pedagogical beliefs, and the skill and confidence of

Baek is with the Exercise Science, School of Kinesiology, Physical Education and Athletic Training, University of Maine, Orono, ME. Jones is with the School of Kinesiology and Recreation, Illinois State University, Normal, IL. Bulger and Taliaferro are with the College of Physical Activity and Sport Sciences, West Virginia University, Morgantown, WV. Address author correspondence to Jun-Hyung Baek at junhyung.baek@maine.edu.

teachers to adapt technology into their pedagogy (Ertmer, 1999; Gibbone et al., 2010).

Barriers to Technology Integration

Barriers to technology integration have been formally categorized into two types: *first order* and *second order* barriers. First order barriers refer to external obstacles to teachers' usage of technology, which include: lack of access to technologies, budget, insufficient time to learn technological skills, inadequate technical and administrative support, and class size (Ertmer, 1999; Gibbone et al., 2010). Studies (Gibbone et al., 2010; Kopcha, 2012) indicated that pre- and in-service teachers frequently consider limited budget and access to technologies as the most significant barriers to technology integration.

Inadequate training has been identified as another barrier to technology integration for teachers. Studies (Gibbone et al., 2010; Juniu et al., 2013) found that pre- and in-service teachers did not receive proper training to have the adequate skills and competence to instruct with technology in PE settings, which appears to have a minimal impact on the skill, knowledge, and beliefs of teachers. Lack of time to explore technology has been the most frequently mentioned barrier by teachers (Kopcha, 2012). Kopcha (2012) stated that teachers are less likely to think of incorporating technology, regardless of access, if they do not have enough time to plan and examine the technology. Although first order barriers are manageable, pre- and in-service teachers have reported difficulties in overcoming these barriers (Hixon & Buckenmeyer, 2009).

Second order barriers refer to internal factors such as pedagogical beliefs and attitudes, knowledge, skills, and self-efficacy. Although both types of barriers impede technology integration efforts, second order barriers (those internal to the teacher) have been reported not only to be more challenging to remove, but also more critical to address if technology integration is to take place (Ertmer, 1999, 2005; Hixon & Buckenmeyer, 2009).

Teachers' pedagogical beliefs and attitudes toward teaching and learning with technology are constructed during a formative period (K-12 years), also known as the "apprenticeship socialization period." During this time, informal learning about teaching occurs through the observation of those in the role of teacher, and personal teaching values, beliefs, and philosophies begin to develop. Researchers have begun to consider how attitudes and beliefs related to technology use in the classroom are also constructed during this period (Ertmer & Ottenbreit-Leftwich, 2010; Wyant, Jones, & Bulger, 2015). Wyant et al. (2015) suggested that existing beliefs of pre-service PE teachers that were constructed during the apprenticeship period may, in fact, contribute to the shaping of beliefs about technology use in PE classroom and subsequent teaching behaviors.

Teachers' knowledge concerning technology also has a significant impact on pedagogical decision-making and what role, if any, technology plays in the planning, delivery, or evaluation of student learning. Mishra and Koehler (2006) proposed a framework titled Technological Pedagogical Content Knowledge (TPACK), which emphasizes construction of three knowledge types: (a) *technological knowledge* (TK) – understanding of various technologies that can support teaching, (b) *pedagogical knowledge* (PK) – understanding of pedagogical methods that facilitate learning, and (c) *content knowledge* (CK) – understanding of discipline-specific content. Each construct represents a foundational knowledge type for teachers. According to Mishra and Koehler (2006), for teachers to educationally meaningful apply

technology into teaching, teachers should not only have the foundational knowledge types, but also use them either in a pair or triadic fashion by understanding the dynamic interaction and relationship of each of the three knowledge types (Technological Content Knowledge: TCK, Technological Pedagogical Knowledge: TPK, and Technological Pedagogical Content Knowledge: TPACK).

Despite the value of each knowledge type within the TPACK framework, many university courses and PDPs still focus primarily on TK (Mishra & Koehler, 2006) and spend minimal time requiring pre- and in-service teachers to think about how they might apply their technology skills to teaching situations (TPK) (Hur, Cullen, & Brush, 2010). TK is necessary, but alone it is not sufficient to allow teachers to infuse technology into their pedagogy (Ertmer & Ottenbreit-Leftwich, 2010). Mishra and Koehler (2006) posited that effective and efficient technology integration require the teacher to have a clear understanding of (a) how theoretical concepts can be changed by using technology (TCK), (b) what makes the concept difficult or easy to learn (PCK), and (c) how technologies can help to teach or learn the concept better (TPK). If any of these knowledge types are missing, teachers may find it difficult to incorporate technology in a manner that enhances teaching and learning.

Strategies to Train Pre- and In-Service Teachers for Technology Integration

Educational researchers have outlined and evaluated a variety of strategies used in teacher education programs (TEP) to prepare pre- and in-service teachers to navigate first and second order technology integration barriers (Brush et al., 2003; Harris, Mishra, & Koehler, 2009; Kay, 2006). Such methods have included single courses focusing on technology integration, access to technology, infusion of technology across TEP curricula, use of modeling, field-based experience, use of mentor teachers, collaboration between universities and public schools, faculty education about technology integration, use of multimedia, workshops, and a combination of these strategies (Kay, 2006). Brush et al. (2003) implemented a combination approach, including modeling and field-based technology integration, to train elementary pre-service teachers. This study found positive changes in knowledge, attitudes, and perceptions regarding technology integration. Hur et al. (2010) implemented a different combination strategy (multimedia and modeling) to help pre-service teachers to have a better idea of how to integrate technology in a classroom setting. This strategy allowed pre-service teachers to experience the technology-integrated classroom and developed their knowledge, confidence, and motivation regarding technology integration.

Although there are a considerable number of studies on technology integration training in the field of general education, there have been few studies to date which have examined the methods that PETE programs or PE-focused PDP used to train pre- and in-service teachers to address and overcome barriers to educationally meaningful technology integration in the gymnasium. An empirical study conducted in the field of PE (Wyant et al., 2015) explored the effectiveness of a single course on applying multiple technology integration training approaches (e.g., hands-on learning, access to technology, and modeling). These approaches were effective in developing pre-service PE teachers' knowledge, particularly TK and TPK, and positive attitudes toward technology integration in PE classes. However, the existence of only one study on technology integration training provides insufficient evidence

of the type and quality of instruction needed to ensure that pre- and in-service PE teachers feel adequately prepared.

Teachers' Developmental Stages of Technology Integration

Researchers (Christensen, 1997; Holland, 2001) suggested that teachers are at various stages in their knowledge and use of technology when attempting to integrate technologies, and these stages are developmental. Christensen (1997) suggested that teachers move through six developmental stages to be confident technology users: awareness, learning to process, understanding and application of the process, familiarity and confidence, adaptation to other contexts, and a creative application to new context (See Table 1). Similarly, Holland (2001) claimed that teachers learn to integrate technology in teaching through five developmental stages as they learn to use new technologies and tools: nonreadiness, survival, mastery, impact, and innovation (See Table 2). Although these two scholars' ideas does not exactly correspond, the general idea and underlying principles of the models are the same. In this study, the idea of Christensen (1997) was used only for sampling, and the idea of Holland (2001) was utilized to provide recommended technology integration training in the implication section. According to Holland (2001), teachers may move from any stage and progress to each stage at their own pace, but they can come back to an earlier stage at any time because they may have high knowledge and experiences with some technologies but not with others. Despite understanding teachers' developmental stages of technology integration is important for an appropriate technology integration training, there have been no studies on appropriate technology integration training for PE teachers in different stages of technology adoption.

In the field of physical education, there are abundant conceptual and descriptive papers regarding strategies to integrate

Table 2 Developmental Stage of Technology Integration

Developmental Stages	Characteristics
Non-readiness	- Lacks technology knowledge - Lacks technology skill - Fear of using technology
Survival	- Limited technology knowledge - Narrow view of instructional tech role in classroom - Easily discouraged - Adverse to technology
Mastery	- Proficient in one technology - Focuses on technology, not application or pedagogy - Limited use of instructional technology
Impact	- Difficulty managing students when technology present - Explores strategies to enhance student learning with technology
Innovation	Pursues and refines pedagogy with technology

Note. Adapted from Holland, P. (2001). Professional development in technology: Catalyst for school reform, *Journal of Technology and Teacher Education*, 9(2), 254–267.

technology, but limited studies have discussed training strategies to prepare pre- and in-service PE teachers to integrate technology. Studies by Jones, Baek, and Wyant (2017) and Wyant et al. (2015) suggest that the use of action research and a single course focused on technology as strategies that facilitate pre-service PE teachers' technology integration effort. However, the lack of research within this area in PETE settings has made the effective preparation of pre- and in-service PE teachers for technology integration difficult. Thus, there is a need to explore effective training methods to be used to equip technologically competent pre- and in-service PE teachers for successful technology integration.

The purpose of the study was to explore in-service physical educators' technology integration learning experiences across three formal learning situations (undergraduate and graduate PETE program and in-service professional development) and perceptions of these experiences. Research questions guiding the study included: (1) what types of technology-related learning experiences do physical educators recall across three formal learning situations and what are the characteristics of those recalled experiences? and (2) how do physical educators at varying stages of technology integration perceive their learning experiences to have influenced their attitudes, beliefs, knowledge, and skills in using technology in a PE setting.

Methods

Participants and Setting

Second and third-year students ($N=19$) enrolled in a three-year graduate level PETE program at a rural, mid-Atlantic university, were eligible and invited to participate in the study. All participants had completed a four credit hour graduate course focused on instructional technology in sport and PE as a degree requirement before the current study. Therefore, each had the potential to

Table 1 Stage of Adoption of Technology Survey Description

Stages	Description
Stage 1: Awareness	I am aware that technology exists but have not used it—perhaps I'm even avoiding it.
Stage 2: Learning the process	I am currently trying to learn the basics. I am often frustrated using computers. I lack confidence when using computers.
Stage 3: Understanding and application of the process	I am beginning to understand the process of using technology and can think of specific tasks in which it might be useful.
Stage 4: Familiarity and confidence	I am gaining a sense of confidence in using the computer for specific tasks. I am starting to feel comfortable using the computer.
Stage 5: Adaption to other contexts	I think about the computer as a tool to help me and am no longer concerned about it as technology. I can use it in many applications and as an instructional aid.
Stage 6: Creative application to new contexts	I can apply what I know about technology in my classroom. I am able to use it as an instructional tool and integrate it into the curriculum.

Note. Adapted from Christensen, R. (1997). Effect of technology integration education on the attitudes of teachers and their students" by Christensen, Unpublished doctoral dissertation, 104.

provide rich information regarding their technology-related learning experiences within the graduate program. The course had been designed and delivered by a PETE faculty member with a background in pedagogy and instructional design. Course outcomes included: (a) introducing students to a variety of instructional technologies in sport and physical education settings and (b) illustrating technology integration strategies focused on instructional efficiencies, student learning, and professional engagement.

A single-item survey, The Stage of Adoption of Technology (SAT) (Christensen, 1997), was utilized to determine participants' perceived level of technology adoption. The SAT survey describes six different stages of technology adoption that teachers move through as they become more confident technology users: (a) awareness, (b) learning the process, (c) understanding and application of the process, (d) familiarity and confidence, (e) adaptation to other contexts, and (f) creative application to new contexts (see Table 1). The reliability of the SAT survey has demonstrated a high test-retest reliability estimate (.91) (Christensen & Knezek, 2001). Participants were asked to read the description of each stage of technology adoption on the survey, select one stage that best describes them, and provide reasons for their selection. All eligible participants ($N=19$) voluntarily completed the SAT survey. Among them, twelve participants (male = 11 and female = 1) with varying knowledge and use of technology in their classroom were randomly selected based on the results of the SAT survey (See Table 3). Since there were not many participants in stage 1, 2, and 3, participants in these stages were purposefully selected. The other participants in stage 4, 5, and 6 were randomly selected within each stage, and no more than four participants in each stage were selected. All twelve participants agreed to participate in the semi-structured interview. The rationale behind this sampling was that differing levels of technology usage and knowledge among participants might provide a broader, more diverse range of perspectives on participants' technology-related learning experiences. The participants had graduated from an undergraduate PETE program between 2007 and 2012. The average age of participants was thirty years and five months, and the average years of teaching experience was three years and eight months (range 1–7 years). At the time of data collection, all

participants were employed physical educators within public schools across the United States and enrolled in the same PETE master's program concurrently (See Table 3).

Data Collection

Qualitative research methods were appropriate to answer the research questions related to experiences of in-service PE teachers. Specifically, a semi-structured interview using a narrative approach was a primary data source, which was used to understand in-service PE teachers' technology-related learning experiences across the three formal learning situations. Twenty open-ended questions in the interview was used to address participants' technology-related learning experiences in three learning situations. The interview questions were created with careful consideration to the elements of a "narrative" interview, including a particular focus on people, action, certainty, and context (Bold, 2011). The four elements are crucial considerations when attempting to understand participants' experiences and perceptions regarding the issue at hand in a deep and meaningful manner (Bold, 2011).

Participants' learning experiences were divided into three formal training experiences (undergraduate, in-service, and graduate school) for the interview. Participants were asked to describe their learning experiences from each chapter in as much detail as possible. For example, participants were asked "across your undergraduate PETE program, please list all technology-related learning experience you had. Please tell me the learning experiences that were the most influential to you. This would include courses or learning tasks that had a significant impact on your knowledge, skills, beliefs, or confidence necessary to use technology." For the follow-up question, participants were asked to answer the following question: "Please describe the experiences in detail, like exactly when it happened, where it happened, what happened, who was involved, what you did with the technology, and what you were thinking and feeling at that moment." These detailed descriptions allowed to understand critical factors (e.g., social and cultural factors) (Clandinin, 2006) which influenced participants' experiences with and values, beliefs, and attitudes towards technology integration in their PE classes. The interview questions were

Table 3 Participant Demographics

Participant (pseudonym)	Gender	Undergraduate Graduation Year	Years of Teaching	Age	Stage of Adoption of Technology	Geographic Region
Jacob	Male	2009	5	29	1	South
Daniel	Male	2009	2	26	2	South
Ethan	Male	2013	3	25	3	South
Annie	Female	2014	1	25	4	South
Michael	Male	2007	7	29	4	South
William	Male	2011	2	43	4	South
Alexander	Male	2010	3	27	5	South
Joseph	Male	2012	3	45	5	West
Matthew	Male	2012	2	26	6	South
Ryan	Male	2010	7	38	6	South
Christopher	Male	2010	5	27	6	Northeast
Anthony	Male	2009	5	27	6	Northeast

Note. Geographic region designation was informed by the United States Census Bureau (Retrieved from http://www.census.gov/econ/census/help/geography/regions_and_divisions.html)

piloted with three PE teachers for clarity and to further develop appropriate probing prompts. Minor revisions were made to the interview guide as a result of the pilot test.

Data Collection Procedure

Following IRB approval, the lead researcher obtained a list of potential participants from the PETE faculty who taught the graduate-level course and sent an electronic cover letter describing the study aims and confidentiality procedures to potential participants ($N=19$). All potential participants were asked to complete the SAT survey and all completed it. Based on the results of the SAT survey, the researcher purposefully selected and contacted twelve participants ($n=12$) with varying degrees of technology use by email and scheduled one-on-one face-to-face semi-structured interviews while they were on campus for summer courses. The interview guide was attached to the introductory email for participants to review. The interviews were conducted by two researchers who did not have relationships with participants prior to the study. The researchers were trained for the interview prior to the study. Interviews with each participant were performed once, and each interview lasted approximately 60–90 minutes. To build rapport, several strategies were implemented. First, the researchers reiterated the purpose of the study and rationale for the research topic. Second, the researchers reminded them why their stories are important. Third, the researchers showed interest by becoming an active listener. In return for study participation, participants received a \$20 gift card.

Data Analysis

Data were analyzed through two phases. In phase one, SAT survey results were used to select twelve participants ($n=12$) in various stages of technology adoption. The survey results were analyzed based on the description of each stage in the SAT survey. In phase two, all interviews were transcribed verbatim by a professional transcriber to ensure accuracy. The transcribed interviews were analyzed by three researchers who have a degree in PE and have knowledge of and experience with qualitative research. Prior to data analysis, the researchers met several times for data analysis training. Inductive content analysis was used to identify patterns and themes emerged from the data. Three levels of analyses including a) open coding, b) axial coding, and c) selective coding were performed to gather a detailed picture of the information obtained during the data collection process (Corbin & Strauss, 2008). For example, researchers read through the transcript independently without judging the content to gain a general sense of the data. In the re-reading, important information related to research questions was highlighted, and codes that were influenced by two theories (Ertmer, 1999; Mishra & Koehler, 2006) were assigned to the important information (e.g., learning activity and perceptions and feeling about the learning experiences). The codes were organized in an electric coding book. Researchers met several times to discuss and compare their codes, identify emerging patterns, and establish themes. Also, discussion ensued until an agreement was reached, and a constant comparison technique was utilized to examine the consistency and relatedness of the data (Glaser & Strauss, 1967).

To enhance the trustworthiness of the data, several recommended strategies, including a) member checks, b) investigator triangulation, and c) peer debriefing, were employed (Pitney & Parker, 2009). Member checks were accomplished by sending

participants a transcription of their interview and asking them to indicate the extent to which the transcript accurately represented their experiences, perceptions, feelings, and thoughts regarding the research questions. Multiple analyst triangulation and peer debriefing sessions were also performed to establish trustworthiness. For example, multiple analysts read through the transcripts and identified important information related to the research questions by assigning codes (e.g., events related to learning about technology and feelings associated with such learning experiences). After coding approximately ten percent of the interview data, peer debriefing sessions were performed to compare and contrast codings, to create categories and identify connections between categories, and to create themes emerged from the data.

Results

Findings are organized by the research question: (1) what types of technology-related learning experiences do physical educators recall across each formal learning situation and what are their characteristics, and (2) how do physical educators with various levels of technology integration perceive their learning experiences in terms of their attitudes, beliefs, knowledge, and skills related to using technology in a PE setting.

Technology-Related Learning Experiences

The qualitative analysis revealed seven sources of technology-related learning experiences across the three learning situations (see Table 4). At the undergraduate level, participants described three learning sources that contributed to their technology-learning: *sport and exercise science coursework*, *discipline-specific pedagogy coursework*, and *general teacher education*. During in-service professional development, participants described two learning sources: *school-wide technology workshops* and *discipline-specific technology workshops*. Finally, at the graduate level, participants described two learning sources: *discipline-specific pedagogy coursework* and *discipline-specific technology coursework*. Information regarding the seven learning sources is described in Table 4.

Perceptions of Learning Experiences

Four overarching themes regarding technology-related learning experiences across three learning situations emerged from the data. These include (a) absence of technology in K-12 PE, (b) technology-centric experience, (c) broadened awareness through observation, and (d) growth through hands-on experience.

Absence of technology in K-12 PE. Although the focus of the present investigation was on participants' technology-related learning experiences in three learning situations, all participants consistently brought up their past PE experience during K-12 years, which seemed to have a significant impact on their perspective and beliefs about technology in PE settings. During interviews, all participants consistently used the phrases "never seen" and "never used" to describe the virtual absence of technology in their own experience within K-12 PE classes. For example, Ryan stated, "there was no technology in the physical education that I had in high school. . . We never really had any chance to incorporate technology into class." This absence of technology during the K-12 years appeared to lead participants to believe technology was "a tool taking away activity time" or "not a necessary component of physical education." Chris noted:

Table 4 Characteristics of Technology-Related Experience Learning Sources

Mediated Learning Situation	Learning Source	Characteristics
Undergraduate PETE Program	Sport and exercise science coursework	• Discipline-specific technologies presented within exercise physiology, biomechanics, and motor development courses • Application of discipline specific technology used to fulfill class assignments
	Discipline-specific pedagogy coursework	• Use of digital video and audio technologies to analyze student and teaching behaviors in instructional methods, curriculum, and sport pedagogy courses • Use of movement analysis tools and software to analyze skill performance
	General Teacher Education Coursework	• Word processing and production software programs presented used to fulfil class assignments • Focused on function and operation aspect of the programs in computer competency courses • Primary instructional methods and strategies employed: Lecture and modeling
Professional Development Programs	School-wide technology workshops	• Introduction to educational websites and software programs • Subject-specific instructional resources provided for math, reading, and language arts educators • Focused on features and functions of the websites and software programs
	Discipline-specific technology workshops	• Introduction to technologies conducive to physical education settings • Primary instructional method and strategy employed: Lecture • Focused on teaching function and operational aspect of technology • Introduction to basic ideas for technology integration in the gymnasium
Graduate PETE program	Discipline-specific technology coursework	• Introduction to technologies conducive to physical education settings • Primary instructional methods and strategies employed: Didactic lecture; Self-exploration Hands-on application; Peer modeling
	Discipline-specific pedagogy coursework	• Use of presentation software and digital video technologies • Use of digital video technologies to analyze teaching behaviors

“I felt like it [technology] would take away from activity time when I was a freshman. My prior experience in physical education as a student [K-12], I feel like my Phys Ed teachers were very, very good at getting me moving. They had not used very much technology at all”.

Similarly, Annie indicated her negative view of technology use in PE class, and she noted:

“When I came in [to the PETE program], I wasn’t used to it. I had never seen it [technology in PE class]. I used it myself, but I had never seen my PE teacher use it. I was like, that’s not something I would want to do. I’m here to teach PE. I’m here to teach kids how to play sports and be active and live healthy lifestyles, not teach them how to use technology.”

Such comments demonstrate that lack of technology-integrated PE experience during K-12 years could be a substantial threat to teachers’ views and perceived value of technology in PE settings.

Technology-centric experience. The interview data revealed that the primary focus of technological learning sources in undergraduate and PDPs were generally on TK rather than on the technology’s role in teaching and learning in PE (e.g., TCK, TPK, and TPACK). Nine participants stated that regardless of the type of technology, instructors of the undergraduate course(s) or PDPs spent a significant amount of time introducing the functions and operational aspects of the technologies themselves, instead of their practical or useful applications to teaching. A participant noted, “[the course] was just to teach you how to use them, not to use them for teaching or anything” (Ethan). Similarly, Anthony remarked, “they did teach us how to use it [technology], but we never had to go into a classroom and actually use it with the

students. It was more of the knowledge base for us to improve our students’ skill performance.” These techno-centric, basic function approaches to teaching the use of technologies appeared to lead to dissatisfied and unfulfilled professional learners. The following quotations nicely illustrated the sentiments of participants:

“They [workshop presenters] were great with the technology as how it pertained to them, but they couldn’t show us how to use it, where it would be beneficial for us. . . They [specific workshops] were informative, but they didn’t really show me anything that I could use in my [PE] class.” (William)

Limited information covered in the general teacher education (GTE) courses and school-wide workshops appeared to have a limited impact on participants’ ability, willingness, or effort to make a conceptual connection between the technologies engaged with and the teaching functions associated with delivering physical education. When reflecting on the influence of technology-related learning experience on their professional teaching practices, participants frequently used phrases such as “[I] never thought I would use Excel [in my teaching]” and “I didn’t think about applying it [to my teaching],” which indicated participants’ inability to connect the features and functions of general technologies to pedagogies. This inability prompted some participants to seek technologies that aligned more closely with the movement-focused learning outcomes of PE. Participants frequently described technologies they learned from GTE courses and school-wide workshops as “irrelevant” to the PE context or included “nothing about PE.” These techno-centric experiences lacked discussion of how instructional content and pedagogy can be influenced by technology, which appeared to contribute to beliefs that their learning experiences were “not useful,” “boring,” or “not eye opening.”

Broadened awareness through observations. Across the three learning situations, all participants had opportunities to observe others (e.g., professors, instructors of PDPs, or peers) integrating technology in PE and sport-based contexts. The opportunity to watch others integrating technology into teaching played a positive role in broadening their perspectives, beliefs, and knowledge of technology and its application in PE settings (TK, TCK, TPK, and TPACK). A comment of Michael demonstrates a positive impact of observation on his perspective and attitude toward technology use in PE setting. Michael remarked:

"I didn't realize that how much current Phys Ed teachers are using technology. Until that point [graduate course], I had understood that people were learning about it and they're saying that they were using it. But I'd never seen it applied. So to see actually applying the things that they were learning, using, and doing was a really neat way to know that technology is actually being used as opposed to just learning about them and then thrown back on the shelf. Taking the tech class opened me up to a whole new world that technology is positive and it does bring a lot to the table as far as physical education goes. . . [after watching my peers' technology integration] I felt like I needed to get with it because if these people were doing awesome things with technology, why aren't I? I got to say 'hey, you know this is how I can use it. This is how you use that technology, and this is how it's going to improve your program, ' and I'm all about improving my program, so I use technology a little bit now.'" (Michael)

Nine participants placed value on the knowledge of others. They indicated that peer observations enhanced their knowledge and awareness of technology's use, function, and potential contributions to pedagogy and content. Prior to peer observations, participants described themselves as "*ignorant*" or "*narrow-minded*" about technology in teaching PE. However, these opinions seemed to change as a result of interactions and observations of peers within a graduate-level discipline-specific technology course. Participants' remarks elucidate increased awareness of technology's role in teaching after trusted peers shared ideas and incorporated technology relative to PE-specific learning outcomes and objectives. Phrases such as "*awesome ideas that I wouldn't get anywhere else*," "*some ideas that I may not have thought of*," and "*many simple ways to use technology*" reflected the positive influence of peer observations on TPK. Jacob said:

"I didn't know how much I could do so that it [seeing my peers integrating technology] was very meaningful to me using like Wii and Xbox in a classroom because I always looked at it as only two people could use it. That's a waste of time in a class of 40 kids. I saw how you could have everyone doing it and just rotate around. . . That was very meaningful because I saw how you could use it for bigger groups than just a one or two players in control."

Growth through hands-on experience. Hands-on experience was impactful on changes in their beliefs, knowledge, skill, and confidence for technology integration. Nine participants described learning sources that included meaningful hands-on experiences within participants' undergraduate and graduate discipline specific coursework. Some of the experiences described were instructor-directed and student-directed; nonetheless having time to experience and explore technologies within discipline-specific contexts appeared optimal. For example,

"In Exercise Physiology class, we used a ton of technology. . . I was like, 'man, this is stuff that I can actually use because it's so scientific. There's a lot of method behind it. . . that [VO2 Max machine] was the most incredible piece of equipment I've ever seen. It was amazing.'" (Daniel)

Although hands-on experiences within discipline-specific contexts can contribute to increasing awareness and beliefs about technology's value itself, experiences themselves do not necessitate the integration of such tools into one's professional practice. When Daniel was asked about his knowledge and confidence regarding technology after the experience, he described:

"I was exposed to it [technology], but having only the chance of using it only once during undergrad, I felt like I hadn't practiced enough. . . I know that it was meaningful, but in terms of me using it, I just wasn't confident. If I had gone through more training, then I would've definitely been more active to use it in class right off the bat.'" (Daniel)

Hands-on experiences that allowed participants to explore technology reportedly had a greater influence on the learners. According to the participants, the graduate-level, discipline-specific technology course required them to select and explore the features, functions, and potential uses of a specific technology within PE; then participants were tasked with planning and delivering a technology-enhanced teaching episode to their peers. This challenged participants to develop a deeper understanding of the technology itself (TK) and its possible application in a PE setting (TPK). Ethan spoke about the experience within the course:

"I really liked the class activities (e.g., self-exploration of technology) because instead of just learning about 1–2 technologies, she made us become the expert of one [technology] and teach [the technology] to our peers. So I became the expert of the flip camera and taught all my peers how to use it, where to buy it, how much it cost, so and so forth. . . I had to do some previous research and had to really dive into what all it takes to use a flip camera."

Along with a technology-enhanced PE lesson segment, participants had to complete a technology action research project which required them to use technology in one of their PE units in their school. This learning activity allowed firsthand observation of the benefits and challenges of technology in PE. Joseph described the learning activity and its impact on his belief and teaching:

"In the one credit follow-up class, we applied it [technology] in our schools, which was the most beneficial part. It forced me to go back and look at what I already did, and pick a technology. She [course instructor] said do not pick a lot. Pick one and focus on that one. Apply that technology into what I do [in my PE class]. That was beneficial because it changed my teaching. I could see my students get better because of the activity."

Seven participants also commented on their enhanced knowledge, confidence, and pedagogy due to the two hands-on experiences. One of the participants, Jacob, noted, "I am now more advanced. I know a lot more information and a lot more resources that I can use. I know how to use it. I definitely have that knowledge now." Similar changes in knowledge, skill, and confidence could be observed in other participants. For example, Mathew depicted the change in his confidence and teaching practice. He remarked:

"I am an advanced technology user in my PE classroom. I'm more confident than I have ever been in implementing those [technologies] because I've had that practice. I've been able to do it on a daily basis or weekly basis in my classes."

Discussion and Conclusion

This current study found an impact of apprenticeship socialization period (K-12 years) on the participants' subsequent beliefs and perceptions toward technology integration in PE settings. In this study, several participants described their negative beliefs and attitudes toward technology use in PE settings before entering an undergraduate PETE program. This belief seemed to be caused by experience and observation of PE teachers who effectively taught without technology. Effective teaching does not require integration of technology, but considering the benefits that technology use could bring when properly used (e.g., objective and accurate physical activity data, feedback, and motivation), instructional technology can be invaluable in enhancing teaching effectiveness and student learning (Jones et al., 2012). Jones et al. (2012) stressed the importance of technology-integrated PE learning experience during K-12 years. According to them,

"One may speculate that observations of meaningful technology integration during acculturation would instill a positive belief toward technology as a valued instructional tool for learners whereas observations of no or obscure technology use may cultivate less favorable perceptions of technology as a tool for learning." (p. 211)

Previous studies also highlighted the importance of the K-12 years (Ertmer, 2005; Ertmer & Ottenbreit-Leftwich, 2010; Hutchinson, 1993; Lortie, 1975). According to these studies, pre-service teachers develop a considerable amount of pedagogical beliefs, value, and the adoption of particular practice including technology from their experiences as K-12 students. What they see, hear, and do as K-12 students has a potential impact on what they learn in their teacher education programs and how they subsequently teach once they become educators themselves (Hutchinson, 1993). If beliefs constructed during K-12 years are not favorable for technology use in the PE setting, then training about technology integration within PETE programs may have a limited impact on pre-service teachers' pedagogical beliefs regarding technology.

Participants in this study consistently pointed out the problem with techno-centric GTE courses and PDPs. The courses and workshops seemed to be good sources for participants to develop TK and confidence concerning technology, but were not sufficient in developing other knowledge types (e.g., TPK, TCK, and TPACK). Developing technical skills and comfort with technology are imperatively necessary for the successful integration of new technology tools because skill and comfort are noted as significant barriers to technology integration (Ertmer, 1999). However, a development of a single knowledge type alone is not sufficient. Rather, meaningful technology integration requires three core knowledge types (TK, PK, and CK) and efficient use of them either in a pair or triadic fashion (TPK, TCK, and TPACK) (Mishra & Koehler, 2006). If there is a deficiency in any of these knowledge types, successful and meaningful technology integration is less likely to occur (Koehler & Mishra, 2009).

Among these knowledge constructs, TPK is particularly important because it involves teachers' understanding of how technology influences teaching and learning (Koehler & Mishra,

2009). Further, the understanding of the pedagogical role of technology in teaching and learning and teachers' beliefs toward technology integration are intertwined (Voogt, Fisser, Pareja Roblin, Tondeur, & van Braak, 2013). If teachers are uncertain about technology's role in their instruction and its value to student learning, they will be less likely to use it (Ertmer, 2005). In the current study, several participants implied negative attitudes toward technology use in teaching PE. According to the comments of participants, techno-centric courses and PDPs did not reflect the unique constraints and challenges of the environment, student learning outcomes, or differentiation of instructional and pedagogical approaches in PE, which might lead them to believe technology is an "unnecessary tool" or "not worth it."

Additionally, TPK is also related to the ability to connect technologies with teaching. As Koehler and Mishra (2009) stated, most software programs and technologies used in education (e.g., personal computing software, podcasts, social media, etc.) are designed for business, communication, or social networking, rather than for teaching or learning functions. To apply technologies into instruction, teachers must think beyond what the technologies can do and how the technologies are commonly used, and reconfigure the tools for a customized pedagogical purpose (e.g., TPK) (Koehler & Mishra, 2009). As discussed earlier, many GTE courses and PDPs experienced by the participants primarily focused on TK rather than TPK, TCK, and TPACK. This approach may be based on the assumption that technology integration will follow if a teacher is merely exposed to educational technologies (Harris et al., 2009). However, learning about instructional technologies (TK) is vastly different than learning what to do with them from an instructional standpoint (TPK and TPACK). The courses used techno-centric approaches missed the value of other knowledge bases (TPK, TCK, and TPACK), which seemed to cause participants' lack of ability to connect technology to their instruction.

Observation of technology-integrated PE lessons appeared to be beneficial to the broadening of the participants' perspectives, beliefs, and knowledge of technology application in PE settings. According to Ertmer (2005), vicarious experiences are powerful and can promote change in beliefs, confidence, and practices. Consistent with this claim, the current study found a positive impact of vicarious experience on expanding awareness of technology's role in teaching and learning (TPK) and self-efficacy. The effect of vicarious experience was greater especially when the individual modeling (e.g., a peer) was perceived to have a similar ability level. This sentiment is supported by the comment of Michael "[after watching my peers' technology integration in a PE setting] I felt like I needed to get with it because if these people were doing awesome things with technology, why aren't I?"

Perspectives on teaching with technology are heavily influenced by an individuals' lived experiences. With limited exposure to technology-enhanced pedagogy, teachers' perspectives are restricted to what they anticipate or assume a technology-rich classroom would look like, which consequently can decrease the likelihood of technology use (Marra, 2004). Given that educational technologies are often incongruent with the environmental constraints of teaching in the gymnasium and movement-oriented learning outcomes, developing TPK in PE teachers is both challenging and important. PE teachers often have difficulty envisioning how technologies can be integrated in PE contexts. To develop TPK, teachers must have a deep understanding of the unique features of their teaching context, the developmental needs of their learners, and the potential benefits and limitations of technologies. Further, they must acknowledge the impact the technology may

have on their instruction and content. Although peer observation of technology use appeared to be effective in expanding participants' awareness of technology in PE, merely seeing others' performance may have a limited impact on teachers' self-efficacy and the perceived value of instructional technology if teachers do not have the opportunity to apply the concepts or technology they have seen into teaching.

Lastly, two types of hands-on technology experiences (self-exploration and hands-on technology application in two different contexts) were reported to impact changes in participants' beliefs, knowledge, and confidence. Through the two hands-on experiences, participants were able to develop TPACK and confidence necessary for effective technology integration. Hands-on technology application experiences within inauthentic environments is important because teaching with technology is complex and requires an understanding of the dynamic relationship between the three knowledge constructs within TPACK (Koehler & Mishra, 2009). However, teachers' learning to integrate technology frequently occurs in isolated environments, which makes it difficult for teachers to make appropriate "decisions about when to use technology, what technology to use, and for what purposes (Lawless & Pellegrino, 2007, p. 581)." These decisions can be best supported when teachers can actively engage in the process of technology application and integration. In this current study, participants were given opportunities to implement technologies in two different settings – a structured university setting and public school. These opportunities required participants to deeply understand the assigned technology and its possible applications to PE settings, which facilitated not only TK development but also the ability to transfer their knowledge and skills to classroom settings (TPK and TPACK) (Lawless & Pellegrino, 2007). Although

hands-on experience is important for teachers, the more important factor is that hands-on experience should occur in a supportive environment (e.g., university setting) to ensure success prior to practicing in the authentic classroom setting, because failure to use technology in the classroom may discourage teachers' future behavior with technology.

In conclusion, results from this study offer insights for PETE programs and PDP providers into what training and supports are effective and meaningful to help teachers change beliefs and knowledge for technology integration. Although there are a number of barriers to technology integration, this study found that many courses and PDPs tend to be techno-centric, which causes them to miss other knowledge types. Even though TK is the most important knowledge to develop, TK alone cannot lead successful technology integration. Thus, various learning activities which can help teachers develop other knowledge types should be provided.

Implications

According to Holland (2001), when providing training in instructional technology, program designers must take into account the level of knowledge and technology use of teachers and address their differing personal learning needs. Findings from this current study extend what Holland suggested by providing greater specificity to the types of learning activities for teachers in different stages of technology adoption (See Table 5).

Learning activities that help develop TK are needed in the early stage of technology adoption (non-readiness) because teachers in this stage are often characterized by their lack of TK and fear of using technology. In this current study, although there was only one participant at the early stage, learning activities such as

Table 5 Recommended Technology Integration Training Strategies for Teachers With Different Stage of Technology Integration

Developmental Stages	Suggested Strategies (Holland, 2001)	Recommendations Based on Findings
Non-readiness	• Train on technology functions • Provide practical examples of technology use in classroom	• Focus on TK – Highlight technology functions – Guided and Self-exploration • Showcase tech-enhanced pedagogy
Survival	• On-going technology assistance • Develop technology knowledge and efficacy	• Develop TPK & TCK – Reflect on technology warrant – Interact with innovative others – Vicarious technology experiences – Provide access to technologies
Mastery	• Foster positive social support • Discipline-specific training • Focus on tech-enhanced pedagogy • Use Guided Discovery for technology assistance/support	• Maintain PK and Build TPACK – Showcase a variety of tech-enhanced pedagogy scenarios – Foster dyads/small-group learning – Teaching with tech simulation
Impact	• Promote peer coaching • Foster reflective practice • Collaborate with others at same SAT • Live observations of technology use • Problem-based pedagogy	• Focus on TPACK – Share management strategies – Promote guided action research – Engage in reflective practices – Foster collaboration among peers
Innovation	• Create collaborative partnerships based on tech-enhanced pedagogy	• Develop TPACK-focused Professional Learning Community

guided self-exploration of technology or formal training on technology were found to be beneficial not only to help participants overcome the fear of using technology but also to develop TK. In particular, focusing only on a single technology rather than having teachers learn a broad range of new technologies was more effective in enhancing participants' familiarity and confidence with technology. This learning activity can allow teachers to not only deeply understand technology but also increases their confidence with technology.

Teachers in the survival stage often have negative beliefs and attitudes toward technology use in PE settings and have little to no ability to connect technology to teaching. This issue is related to lack of TPK and TCK. This current study found that almost all participants did not have the ability to make the conceptual link between technology, pedagogy, and content prior to interacting with and observing others integrating technology into PE setting. However, after observing and interacting with others regarding technology integration, they were able to see how technologies could be incorporated into a PE class. Thus, the following activities would be beneficial to developing TPK and TCK: a) observations of good examples of technology use in a PE setting, b) interaction with others who support innovative instruction with technology, c) reflection on one's current pedagogical beliefs after observation, d) use of co-teaching models to provide immediate help and assistance for technology integration, and e) providing accessibility to technology throughout PETE programs. These learning activities would not only provide teachers with opportunities to develop knowledge bases but also opportunities to challenge their existing beliefs and practice (Ertmer, 2005).

As teachers move to the higher developmental stages of adoption—Mastery, Impact, and Innovation—their solid pedagogical knowledge becomes more important in the construction of TPK and TPACK. Teachers in the higher stages often use technology in a limited manner and have difficulty managing students in the technology-integrated classroom. Teaching methods and classroom management are related to teacher's PK. Choy, Wong, and Gao (2009) stated that teachers who lack PK tend to use limited teaching methods and experience difficulty managing and organizing the classroom, particularly when technology is present. Thus, acquisition of strong PK is a prerequisite for development of TPK and TPACK. The current study found that learning activities, such as peer discussion and coaching, simulation and micro-teaching within a supportive environment, action-research, or problem-based learning, can foster TPK and TPACK by helping broaden the perspective of technology use in teaching.

Limitations and Future Research Directions

There was a limitation in this current study. Since this study was to investigate participants' past learning experiences, memories of participants might be affected by time, which might have influenced participants' interpretation of their learning experiences. Thus, examining pre/in-service PE teachers' feelings and perceptions immediately after their courses or PDPs is recommended in future studies. However, since pre-service PE teachers may not be fully aware of deficiencies in their technology-related courses during undergraduate programs until in-service experience, the interpretation of their perspective on the courses should be carefully conducted. In a future study, it would be valuable to empirically investigate how the suggested learning activities influence pre/in-service teachers' beliefs, knowledge, and professional practice.

References

- Beighle, A., Morgan, C.F., & Pangrazi, R.P. (2004). Using pedometers in elementary physical education. *Teaching Elementary Physical Education, 15*, 17–18.
- Bold, C. (2011). *Using narrative in research*. Thousand Oaks, CA: SAGE Publications.
- Brush, T., Glazewski, K., Rutowski, K., Berg, K., Stromfors, C., Van-Nest, M.H., . . . Sutton, J. (2003). Integrating technology in a field-based teacher training program: The PT3@ ASU project. *Educational Technology Research and Development, 51*, 57–72. doi:10.1007/BF02504518
- Casey, A., Goodyear, V.A., & Armour, K.M. (2017). *Digital technologies and learning in physical education pedagogical cases*. New York, NY: Routledge.
- Christensen, R. (1997). *Effect of technology integration education on the attitudes of teachers and their students* (Unpublished doctoral dissertation). University of North Texas, Denton, TX.
- Christensen, R., & Knezek, G. (2001). Instruments for assessing the impact of technology in education. *Computer in Schools: Interdisciplinary Journal of Practice, Theory, and Applied Research, 18*, 5–25. doi:10.1300/J025v18n02_02
- Choy, D., Wong, A.F.L., & Gao, P. (2009). Student teachers' intentions and actions on integrating technology into their classrooms during student teaching: A Singapore study. *Journal of Research on Technology in Education, 42*, 175–195. doi:10.1080/15391523.2009.10782546
- Clandinin, D.J. (2006). Narrative inquiry: A methodology for studying lived experience. *Research Studies in Music Education, 27*, 44–54. doi:10.1177/1321103X060270010301
- Corbin, J., & Strauss, J. (2008). *Basics of qualitative research: Techniques and procedures for developing grounded theory* (3rd ed.). Thousand Oaks, CA: Sage Publications.
- Ertmer, P.A. (1999). Addressing first-and second-order barriers to change: Strategies for technology integration. *Educational Technology Research and Development, 47*, 47–61. doi:10.1007/BF02299597
- Ertmer, P.A. (2005). Teacher pedagogical beliefs: The final frontier in our quest for technology integration? *Educational Technology Research and Development, 53*, 25–39. doi:10.1007/BF02504683
- Ertmer, P.A., & Ottenbreit-Leftwich, A.T. (2010). Teacher technology change: How knowledge, confidence, beliefs, and culture intersect. *Journal of Research on Technology in Education, 42*, 255–284. doi:10.1080/15391523.2010.10782551
- 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*, 27–42. doi:10.18785/jetde.0301.03
- Glaser, B. & Strauss, A. (1967). *The discovery of grounded theory*. Hawthorne, NY: Aldine Publishing Company.
- Harris, J., Mishra, P., & Koehler, M. (2009). Teachers' technological pedagogical content knowledge and learning activity types: Curriculum-based technology integration reframed. *Journal of Research on Technology in Education, 41*, 393–416. doi:10.1080/15391523.2009.10782536
- Hixon, E., & Buckenmeyer, J. (2009). Revisiting technology integration in schools: Implications for professional development. *Computers in the Schools, 26*, 130–146. doi:10.1080/07380560902906070
- Holland, P. (2001). Professional development in technology: Catalyst for school reform. *Journal of Technology and Teacher Education, 9*(2), 254–267.
- Hur, J.W., Cullen, T., & Brush, T. (2010). Teaching for application: A model for assisting pre-service teachers with technology integration. *Journal of Technology and Teacher Education, 18*, 161–182.

- Hutchinson, G.E. (1993). Prospective teachers' perspectives on teaching physical education: An interview study on the recruitment phase of teacher socialization. *Journal of Teaching in Physical Education*, 12, 344–354. doi:10.1123/jtpe.12.4.344
- International Society for Technology in Education. (2017). *ISTE standards for educators*. Retrieved from <https://www.iste.org/my-profile/standards-download>
- Jones, E.M., Bulger, S.M., & Wyant, J.D. (2012). Moving beyond the stopwatch and whistle: Examining technology use in teacher training. *The Global Journal of Health and Physical Education Pedagogy*, 1, 210–222.
- Jones, E.M., Baek, J.B., & Wyant, J.D. (2017). Exploring pre-service physical education teacher technology use during student teaching. *Journal of Teaching Physical Education*, 36, 173–184. doi:10.1123/jtpe.2015-0176
- Juniu, S., Shonfeld, M., & Ganot, A. (2013). Technology integration in physical education teacher education programs: A comparative analysis. *Actualidades Investigativas Educación*, 13, 218–240.
- Kay, R.H. (2006). Evaluating strategies used to incorporate technology into preservice education: A review of the literature. *Journal of Research on Technology in Education*, 38, 383–408. doi:10.1080/15391523.2006.10782466
- Koehler, M., & Mishra, P. (2009). What is technological pedagogical content knowledge (TPACK)? *Contemporary Issues in Technology and Teacher Education*, 9, 60–70.
- Kopcha, T.J. (2012). Teachers' perceptions of the barriers to technology integration and practices with technology under situated professional development. *Computer & Education*, 59, 1109–1121. doi:10.1016/j.compedu.2012.05.014
- Krause, J.M., Franks, H., & Lynch, B. (2017). Current technology trends and issues among health and physical education professionals. *The Physical Educator*, 74, 164–180. doi:10.18666/TPE-2017-V74-I1-6648
- Kretschmann, R. (2015). Effect of physical education teachers' computer literacy on technology use in physical education. *Physical Educator*, 72, 261–277.
- Lawless, K., & Pellegrino, J.W. (2007). Professional development in integrating technology into teaching and learning: Knowns, unknowns, and ways to pursue better questions and answers. *Review of Educational Research*, 77, 575–614. doi:10.3102/0034654307309921
- Legrain, P., Gillet, N., Gernigon, C., & Lafreniere, M.A. (2015). Integration of information and communication technology and pupils' motivation in a physical education setting. *Journal of Teaching in Physical Education*, 34, 384–401. doi:10.1123/jtpe.2014-0013
- Lortie, D.C. (1975). *School-teacher: A sociological study*. Chicago, IL: The University of Chicago Press.
- Marra, R.M. (2004). An online course to help teachers "use technology to enhance learning": Successes and limitations. *Journal of Technology and Teacher Education*, 12, 411–429.
- Melton, B., Bland, H., Harris, B., Kelly, D., & Chandler, K. (2015). Evaluating a physical activity app in the classroom: A mixed methodological approach among university students. *Physical Educator*, 72, 601–620. doi:10.18666/TPE-2015-V72-I4-7139
- Mishra, P., & Koehler, M. (2006). Technological pedagogical content knowledge: A framework for teacher knowledge. *The Teachers College Record*, 108, 1017–1054. doi:10.1111/j.1467-9620.2006.00684.x
- Pitney, W., & Parker, J. (2009). *Qualitative research in physical activity and the health professions*. Champaign, IL: Human Kinetics.
- Phillips, A., Rodenbeck, M., & Clegg, B. (2014). Apps for physical education: Teacher tested, kid approved! *Strategies*, 27, 28–31. doi:10.1080/08924562.2014.901047
- Society of Health and Physical Educators. (2017). *National standards for initial physical education teacher education*. Reston, VA: Author.
- Voogt, J., Fisser, P., Pareja Roblin, N., Tondeur, J., & van Braak, J. (2013). Technological pedagogical content knowledge: A review of the literature. *Journal of Computer Assisted Learning*, 29, 109–121. doi:10.1111/j.1365-2729.2012.00487.x
- Wyant, J.D., Jones, E.M., & Bulger, S.M. (2015). A mixed methods analysis of a single-course strategy to integrate technology into PETE. *Journal of Teaching in Physical Education*, 34, 131–151. doi:10.1123/jtpe.2013-0114

Copyright of Journal of Teaching in Physical Education is the property of Human Kinetics Publishers, Inc. and its content may not be copied or emailed to multiple sites or posted to a listserv without the copyright holder's express written permission. However, users may print, download, or email articles for individual use.