

## PEDAGOGY



# Physical Educators' Exergaming Integration Experiences, Attitudes, and Self-Efficacy Beliefs

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## Abstract

*Exergaming technologies have emerged in physical education in recent years as an attempt at revitalizing physical activity levels among youth. Research on the effects of exergaming is increasing; however, there is no research on practicing physical education teachers' implementation in the United States. Studies indicate that physical educators have low levels of confidence with regard to technology integration, particularly exergames. Due to exergaming technology's potential impact, it is essential to understand the extent to which physical education teachers implement these technologies. Self-efficacy beliefs, influenced by prior experiences, are powerful motives of behavior. Thus, grounded in self-efficacy theory, this study investigated pedagogical exergaming experiences, attitudes, and self-efficacy beliefs of a nationwide sample of U.S. kindergarten through 12th-grade physical education teachers. Study participants included 402 in-service physical education teachers from 35 states who completed the online Physical Educators' Exergaming Technology Integration, Attitudes, and Self-Efficacy Inventory. Participants reported moderate to high levels of attitude and self-efficacy beliefs, and Pearson correlation coefficients suggested strong, positive relationships between attitude and self-efficacy beliefs ( $r = .56$ ,  $n = 402$ ,  $p < .001$ ) toward integrating exergaming technology in PE. Teachers' prior exergaming integration*

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*into PE experiences was positive overall, yet limited because of barriers such as budget, equipment, training, and administrative support. Overall, results suggest that physical education teachers feel confident and have positive attitudes toward implementing exergaming in physical education, with self-efficacy regarding implementing exergaming in PE correlating strongest with prior successful mastery experience.*

Although the U.S. Department of Health and Human Services (2018a) recommends children and adolescents (ages 6 to 17 years old) accumulate at least 60 daily minutes of moderate to vigorous physical activity (MVPA), less than one quarter of this population meet this guideline (National Physical Activity Plan Alliance [NPAPA], 2018). Moreover, 18.4% of children (6 to 11 years) and 20.6% of adolescents (12 to 19 years) are obese in the United States (Hales et al., 2017). Further, of the 50 U.S. states, only Oregon meets the national recommendations of 150 min at the elementary level and 225 min at the middle school level for weekly physical education time (SHAPE America, 2016). Additionally, technology-related sedentary time with television, computers, mobile devices, and video games contributes to childhood obesity rates and reduced physical activity (PA; U.S. Department of Health and Human Services, 2018b). Despite sedentary technology-related behaviors that facilitate obesity (NPAPA, 2018; Pelletier et al., 2020), technology can be beneficial in physical education classes, if applied appropriately.

Recently, there has been a growing challenge for physical educators to respond to children's needs and interests through integrating technology into physical education (Jenny et al., 2020). The National Standards for Initial Physical Education Teacher Education include standards aimed at students using technology to assist in meeting short- and long-term objectives as well as utilizing technology-related feedback to analyze motor skills and performance (SHAPE America, 2017). PA experts are attempting to meet this challenge by using exergaming, also known as active video gaming or motion-based video gaming, as a unique way to bridge the gap between technology and PA.

## **Exergaming**

Exergames are active video games that require fine and gross motor kinesthetic movements (Kooiman & Sheehan, 2014). Exergames

may include game controller tracking (i.e., Nintendo Wii); wireless motion tracking (i.e., Xbox Kinect); or other devices such as bikes, rowers, dance pads, or steppers. Compared to traditional methods, exergames can be a more acceptable and sustainable method for improving PA (Gao et al., 2020; Williams & Ayres, 2020), can provide positive psychological effects (e.g., improved self-esteem, self-efficacy, satisfaction) for those who are overweight or obese (Andrade et al., 2019), and can improve body mass index scores (Gao et al., 2020; Hernández-Jiménez et al., 2019). Exergaming can facilitate intrinsically motivating PA by providing the user control, challenging the user through varying difficulty game levels, stimulating novel curiosity through new challenges and games, affording creativity in ways in which the user plays and moves, offering constant concurrent feedback to the user via on-screen game-related user data, and providing the user competition against the game or other users (Sheehan & Katz, 2010). Overall, depending on the exergame utilized, exergames typically elicit light to moderate PA and can be an effective tool to supplement physical education curriculum and other frequent or intense sports activities for children and adolescents to attain daily recommended PA levels (Jenny et al., 2020; Ramírez-Granizo et al., 2020; Tamlali & Jemni, 2017). Although much of the past exergaming research has focused on participants' physiological and psychological effects (e.g., Gao et al., 2019; Marks et al., 2015; Parent & Comtois, 2019), few studies have examined implementing video games and exergaming into physical education instruction.

### *Exergaming in Physical Education*

To provide dynamic technology-related pedagogies that attempt to promote health and combat obesity, some physical educators implement video games and exergaming into physical education curriculum. Participating in sedentary sport video games can increase sporting knowledge and facilitate intentions of a person to physically play the authentic sport (Jenny, Chung, et al., 2017; Jenny & Schary, 2014). Moreover, exergaming is a potential curricular addition within online physical education (Goad et al., 2019; Kooiman & Sheehan, 2014). It may facilitate a motivation to exercise and assist with learning rudimentary movement patterns (Medeiros et al., 2017; Medeiros et al., 2020; Quintas et al., 2020), but does

not always require users to perform accurate sport-specific motor movements within the games (Jenny et al., 2018; Jenny, Schary, et al., 2017). Nonetheless, exergames can motivate moderate-intensity PA during physical education class (Zhang et al., 2016); students may enjoy exergames more than traditional physical education activities (Shewmake et al., 2015); exergames can teach basic sports concepts, strategies, and motor movements (Jenny & Schary, 2016); and, if implemented correctly, exergames can be used to effectively augment (not replace) traditional physical education curriculum (Medeiros et al., 2017; Yuksel, 2019).

### *Self-Efficacy Beliefs*

Despite the potential benefits of including exergaming into physical education, teachers often report low levels of self-efficacy with regard to general technology integration into teaching and, specifically, physical education–related technologies (Krause, 2017; Krause et al., 2019; Woods et al., 2008). Self-efficacy beliefs are powerful motives of behavior and can be influenced by mastery and vicarious experiences (Bandura, 1986, 1997). For physical education teachers to successfully and appropriately integrate technology and, in this case, exergaming into their classes, it is important to understand their beliefs regarding this emerging technology. In addition, it is important to investigate the sources of self-efficacy (i.e., mastery, vicarious, and social persuasion effects). According to self-efficacy theory (Bandura, 1997), mastery experiences (i.e., firsthand successful experience with a task), vicarious experiences (i.e., observing someone successfully completing a task, particularly a peer), and social persuasion (i.e., receiving feedback that one can succeed in the task) impact self-efficacy regarding a person’s belief that they can successfully execute a task, such as effectively implementing exergaming in physical education.

### **This Study**

Research investigating physical education teachers and exergaming has primarily only involved preservice physical education teachers’ perceptions of exergames (e.g., Jenny et al. 2013; Yuksel, 2019). One study involving 10 primary level physical education teachers in Spain found that these teachers did not feel sufficiently trained on how to design exergaming PE lessons effectively (Conde-

Cortabitarte et al., 2020). Thus, to our knowledge, there has been no reported research on practicing U.S. physical education teachers' exergaming implementation behaviors or beliefs to date, particularly with a nationwide sample. Because of the potential impact of exergaming on increasing student PA, and for better informed physical education teacher preparation programs, it is important to understand the extent to which in-service teachers are including these behaviors and beliefs in physical education. Therefore, grounded in self-efficacy theory, this study investigated U.S. K–12 physical educators' exergaming experiences, attitudes, and self-efficacy beliefs regarding exergaming integration in physical education.

## Method

### Participants

Institutional Review Board (IRB) approval and participant informed consent were obtained prior to data collection. The participants for this survey-based research study were 402 practicing (i.e., in-service) physical education teachers ( $M_{\text{age}} = 42$  years,  $SD = 10.6$ ; 65% female, 35% male; 84% White, 8% Hispanic, 7% African American) from 35 U.S. states. The teachers averaged 14 years ( $SD = 10$ ) experience teaching physical education; at the time of the study, 64% taught at the elementary level and 38% taught at the secondary level. The teachers were originally asked to participate in the study through an email invitation from their state Society of Health and Physical Educators (SHAPE) association. State-level SHAPE organizations ( $N = 41$ ) were contacted with the request to send the study invitation to their members via email lists.

### Instrumentation

The instrumentation for this study was an online survey, the Physical Educators' Exergaming Technology Integration, Attitudes, and Self-Efficacy Inventory (PEETIASI). The 43-item survey consisted of 14 self-efficacy and seven attitude questions regarding integrating exergaming technologies into physical education (5-point Likert scale; *strongly disagree* to *strongly agree*). Self-efficacy questions were modified from the Computer Technology Integration Survey for Physical Educators (Krause, 2017). The term “exergaming” was added before “technology” in each statement, for example, “I under-

stand *exergaming* technology capabilities well enough to maximize their potential for physical education” and “I can provide individual feedback to students during *exergaming* technology use.” Attitude questions were selected and modified in the same way from the Secondary Physical Educators’ Attitudes and Technology Practices Inventory (Gibbone et al., 2010), for example, “I would consider exergaming technology when redesigning my curriculum.” Sources of self-efficacy (i.e., mastery experience, vicarious experience, and social persuasion) questions asked participants about their levels of success for integrating exergaming for each source (4-point Likert scale; *very unsuccessful* to *very successful*) and were modified from the Krause (2017) instrument. Questions regarding prior exergaming integration training, access, implementation frequency, barriers, and demographic information were also included. For the purposes of this study, exergaming technology was defined as a video game system that required gross motor physical exercise or movement to play the game (e.g., game controller tracking; i.e., Nintendo Wii); wireless motion tracking (i.e., Xbox Kinect); or other exergaming devices such as bikes, rowers, dance pads, or steppers).

## Data Analysis

Data were analyzed with IBM SPSS Statistics. Demographics, beliefs, and behaviors survey data were analyzed with descriptive statistics. Measures of central tendency (i.e., means, standard deviations) were computed for self-efficacy and attitude scores. Relationships between self-efficacy, attitudes, and self-efficacy sources were evaluated with Pearson correlation coefficients.

## Results

The results are presented within two major categories: exergaming experiences and then exergaming self-efficacy and attitude beliefs.

### Exergaming Experiences

#### *Exergaming Access and Use*

Most teachers (73%) reported having access and using exergaming for instruction in physical education at least once and as much as daily throughout the school year. Nintendo Wii (41%), dance pads

(39%), and balance boards (29%) were among the most frequently integrated exergames.

### *Exergaming Training*

The most frequently reported sources for learning how to integrate exergaming in physical education were self-teaching (53%), conference/workshop (43%), and observation of other teachers (22%). Teachers also reported learning how to integrate exergaming through undergraduate (7%) and graduate (4%) courses. Thirty-three percent of teachers reported not having any training. On a scale of 1 to 4 (1 = *no experience*, 2 = *beginner*, 3 = *average*, 4 = *expert*), participants reported their levels of expertise between beginner and average level for playing exergames themselves ( $M = 2.5$ ), integrating exergaming into physical education ( $M = 2.2$ ), and connecting teaching and learning with exergaming in physical education ( $M = 2.2$ ).

### *Barriers to Integrating Exergaming Into Physical Education*

The most frequently reported barriers to successful implementation of exergames in physical education were budget issues (95%), lack of equipment (81%), lack of training on connecting exergaming to physical education content (38%), lack of training on exergaming setup/use (36%), and lack of administrative support (19%).

## **Exergaming Self-Efficacy and Attitude Beliefs**

The physical education teachers reported having positive (moderate to high) attitudes ( $M = 3.84$ ,  $SD = .62$ ) and positive (moderate to high) self-efficacy beliefs ( $M = 3.75$ ,  $SD = .8$ ) toward exergaming in physical education. Pearson correlation coefficients suggested strong, positive relationships between attitude and self-efficacy beliefs ( $r = .56$ ,  $n = 402$ ,  $p < .001$ ) toward integrating exergaming technology in physical education.

### *Sources of Exergaming Self-Efficacy*

Participants reported having successful prior mastery experiences ( $N = 253$ ,  $M = 2.93$ ,  $SD = .91$ ), vicarious experiences observing colleagues ( $N = 260$ ,  $M = 3.05$ ,  $SD = .85$ ), and social persuasion experiences ( $N = 282$ ,  $M = 3.14$ ,  $SD = .79$ ) with regard to integrating exergaming in physical education. All three sources of self-efficacy (mastery experience, vicarious experience, and social persuasion) displayed positive correlations with one another statistically

significant at the  $p < .01$  level. Each source was positively correlated (Cohen, 1988) with self-efficacy, with mastery being the strongest: (a) Mastery experience had a strong, positive correlation of  $r = .52$ ,  $n = 253$ ,  $p < .001$ ; (b) vicarious experience had a weak, positive correlation of  $r = .18$ ,  $n = 260$ ,  $p < .01$ ; and (c) social persuasion had a weak, positive correlation of  $r = .17$ ,  $n = 282$ ,  $p < .01$ .

## Discussion

### Exergaming Experiences

Exergaming prior experiences related to access and use, training, and barriers of use. This section discusses each.

#### *Exergaming Access and Use*

Nearly three quarters of the sample reported having access to and using exergames in physical education at least once in the past, with some claiming to use exergames daily in physical education. The Entertainment Software Association (2020) reported that 51.1 million U.S. youth (age 18 years and younger), or 70%, play video games, with 75% of Americans households having at least one video game player. Data that separate the prevalence of gaming between traditional sedentary video games and exergames could not be found. As well, past research has not investigated the prevalence of exergaming use among physical education teachers. According to our results, however, it appears this sample of U.S. K–12 physical education teachers did not lack access to exergames. These results may have been impacted by response bias (i.e., participants who chose to respond to the survey may have a substantial interest in exergaming, impacting their likelihood of having access to this equipment; Aday & Cornelius, 2006). Moreover, as some exergaming consoles limit the number of players that can play at once, future research might collect more detailed information on whether physical education teachers have access to an adequate amount of exergaming devices to increase student time on task.

The Nintendo Wii, dance pads, and balance boards were the most frequently reported exergames utilized by the sample. Interestingly, the Nintendo Wii and balance boards are commonly cited as facilitating balance and aiding at-home exercise adherence within rehabilitation and health care settings (Manlapaz et al., 2017; Rosly

et al., 2017). Certainly, as technology evolves, the types of exergames will also evolve. For example, a future trend within exergaming may be the use of augmented or virtual reality (Jenny et al., 2020).

### *Exergaming Training*

Strikingly, 33% of participants reported receiving no training on how to implement exergaming into physical education curriculum effectively. Moreover, only 7% of participants' undergraduate and 4% of their graduate coursework addressed exergaming in physical education. Conde-Cortabitarte et al. (2020) had similar findings. They found that in-service Spanish PE teachers perceived that they were not adequately trained to design effective physical education lessons with exergames, despite also feeling that exergames were a powerful tool in educational programming. The U.S. physical education teachers in the current study rated themselves primarily "beginners" regarding their abilities to integrate exergaming into physical education and to connect teaching and learning with exergaming in physical education. While the prevalence of technology courses required in physical education teacher education (PETE) programs is not, it appears inclusion of exergaming pedagogical techniques is warranted, whether as a standalone technology in a physical education course or as a technology imbedded elsewhere within a physical education methods course.

Various sources were cited regarding how the teachers learned how to integrate exergaming technology in physical education. Top responses were self-teaching, conference or workshop, or observing other teachers implementing exergaming. Therefore, school administrators should consider organizing for physical education teachers in-service professional development that targets exergaming implementation. Likewise, health and physical education professional organizations might consider providing workshops or presentations in this area because there appears to be an evident need.

### *Barriers to Integrating Exergaming Into Physical Education*

Participants reported several barriers to successful implementation of exergames in physical education. Albeit 5%, nearly all cited budget issues, with over three quarters also noting lack of equipment, which appears related. This corroborates research that cited monetary resources to purchase exergaming equipment as a major

barrier to use (Dixon et al., 2010; Zhang et al., 2016). For example, the new Xbox Series X and PlayStation 5 both cost approximately \$500 for the console alone, not including accessories such as additional games or controllers (about \$60 each), motion-sensing cameras (~\$100–\$200), or televisions or projectors to display the exergames. These costs may be exacerbated in low-income school districts and may make it more difficult for them to acquire exergaming equipment. Potential solutions to these barriers are temporarily renting exergaming equipment, sharing and rotating exergaming equipment among multiple schools within a single district, or requesting funding to purchase the equipment through a parent–teacher organization or grant.

Other top barriers of exergaming use were a lack of knowledge on how to set up and use the exergaming equipment, as well as how to connect exergaming to physical education curriculum. Burne et al. (2018) found that student learning can be enhanced through digital technology in physical education if the instructor and students are prepared to use it; the context and setting are suitable its use; and, most importantly, the technology clearly assists in meeting the lesson’s learning objectives—which should be connected to national physical education learning standards (SHAPE America, 2014). Both of these lack of knowledge barriers might be accomplished through integrating more hands-on exergaming training from physical education teacher preparation programs as well as learn-by-doing professional development. For example, if exergaming equipment is limited across an entire class of students, the teacher can consider making a stand-alone exergaming station across other fitness activity stations through which all students can rotate and each can have a chance to participate in exergaming across the lesson (Jenny et al., 2020).

## **Exergaming Self-Efficacy and Attitude Beliefs**

The participants reported generally positive attitudes and self-efficacy beliefs toward incorporating exergaming in physical education. This finding is in contrast to some research that reports teachers’ reluctance to integrate technology into their teaching because of beliefs that it will not enhance instruction or is not worth the effort, along with difficulty overcoming barriers to implementation (Hill & Valdez-Garcia, 2020; Wyant et al., 2015). Additionally,

although self-efficacy is not the construct in the Conde-Cortabitarte et al. (2020) study, the present study's overall positive results are also in contrast to the physical educators' feelings of being ill-prepared in Spain. There is consistency, however, with the Sheehan et al. (2015) finding of physical education teachers reporting exergaming as a positive curricular option that leads to high student engagement. Additionally, Jenny et al. (2013) found that the amount of time preservice physical education teachers spent playing video games increased their perception of the usefulness of exergaming in physical education. This is consistent with Krause's (2017) finding about beliefs on technology integration, in general. A strong positive relationship between attitude and self-efficacy beliefs toward integrating exergames in physical education was also found in the current study. This finding is consistent with research regarding technology, in general, and is not surprising because both attitude and self-efficacy beliefs can influence future behavior in similar ways.

### *Sources of Exergaming Self-Efficacy*

Participants in this study reported having successful prior mastery experiences, vicarious experiences observing colleagues, and social persuasion experiences with regard to integrating exergaming in physical education. Additionally, Pearson correlation coefficients indicated that exergaming self-efficacy was correlated with all three sources, consistent with Bandura's (1997) self-efficacy theory noting that self-efficacy beliefs develop and can be strengthened through these sources. Mastery experience with exergaming was the source most highly correlated with self-efficacy, also consistent with Bandura's (1997) theory that it is the most powerful source of self-efficacy. Additionally, these results are consistent with Krause's (2017) study of general technology self-efficacy with physical educators. Of note, the previously mentioned top sources reported by participants for learning how to implement exergaming into physical education draw parallels to *mastery experience* (i.e., self-teaching experience with exergames), *social persuasion* (i.e., learning about exergaming at a conference or workshop from a presenter), and *vicarious experience* (i.e., observing other physical education teachers deliver a lesson that implemented exergaming). Given the lack of formal training among these participants, it is not surprising that social persuasion's correlation, while positive, was not strong. Additionally,

physical education teachers, especially at the elementary level (64% of participants), often teach in isolation and, therefore, may have limited vicarious experience opportunities, which may help to explain its weak, positive correlation with self-efficacy.

## **Limitations and Future Research**

As with all research, this study is not without limitations. As noted, results from this study may have been affected by response bias, with the respondents opting to complete the survey possibly having a strong preexisting interest in exergaming. Likewise, participants' previous sedentary video gaming experiences or other types of digital technology may have impacted participants' attitudes and self-efficacy toward implementing exergaming in physical education. Moreover, results may not generalize to physical education teachers located in other countries, particularly in underdeveloped nations. Future studies might consider investigating whether exergaming is more developmentally appropriate to be implemented within certain physical education grade levels. They can also research specific pedagogical techniques utilized with exergaming. In addition, there is a need for more research on the potential cognitive and psychomotor instructional effectiveness of the use of virtual reality exergames in physical education.

## **Conclusion**

U.S. physical education teachers have positive attitudes and self-efficacy beliefs toward integrating exergaming into physical education. Many have access to and experience implementing exergames in physical education, despite several barriers to use, such as lack of budget, equipment, and exergaming-specific training. Prior exergaming mastery experience in the successful use of exergames in physical education, vicarious experience in the observation of others successfully teaching physical education with exergames, and social persuasion feedback suggesting one can successfully integrate exergaming in PE all positively correlate to self-efficacy of implementing exergaming into physical education. Mastery experiences have the most impact. Despite the potential of exergaming to increase children's and adolescents' physical activity levels inside and outside of the classroom, it is clear that more formalized hands-on training that

focuses on how to use and effectively implement exergaming into physical education programming is warranted.

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