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The efficacy of exergames for social relatedness in online physical education

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Abstract: Online physical education (OLPE) has been viewed as an oxymoron. Physical education curriculum at all levels seeks to help learners grow socially in the way they interact and deal with diverse and challenging fellow students and settings. Students who have no contact with other students while they are at home for various reasons may not be able to learn the proper response to the challenges of social participation or benefits derived from social contact. This study looked at the efficacy of remote exergame participation between students aged 11–18 ($N = 124$). The results show that exergaming over the Internet can provide students with a social experience that results in increased relatedness between participants versus playing by themselves against a non-player character (NPC). This relatedness can help students access the social standards for physical education when enrolled in OLPE.

Subjects: Design & Delivery; Physical Education; Secondary Education

Keywords: active video games; student interaction; e-learning

1. Introduction

Video gaming systems have been condemned for their proposed connection to problematic behaviors (Hill, Wyatt, Reed, & Peters, 2003). There is concern that players will become addicted, antisocial, and/or overweight due to a lack of movement (Ferguson, 2012; Goldfield et al., 2011). The association between video games and sedentary behavior is akin to the relationship previously and currently ascribed to excessive viewing of the television and inactivity (Gao, Hannan, Xiang, Stodden, & Valdez, 2013). The obesity which accompanies the stasis employed while sitting in front of a video game screen

Brian J. Kooiman

ABOUT THE AUTHORS

Brian J. Kooiman has been researching the effects of exergames when played over the Internet for the past two years. He has researched the physical, emotional, cognitive and social efficacy of exergames played over the Internet for secondary physical education students. He is currently working to expand this reach to other populations and settings.

Dwayne P. Sheehan has been researching physical literacy, functional movement skills, and pedagogy as they relate to exergames. He is involved with many projects in the Canadian province of Alberta and extends his reach to other countries and populations.

PUBLIC INTEREST STATEMENT

Middle school and High school students now have access to online classes. If online educational choices are going to provide parents and students with a valuable educational choice, they will need to provide course offerings that are comparable to those being offered at traditional schools. Parents, students, and teachers are finding that it is difficult to imagine how physical education can be taken online. Online learning conjures up images of students seated at a computer and not of students engaged in physical activity with their peers. New research has shown that secondary students experienced greater social relatedness when they played another student over the Internet than when they played a game created opponent. Exergaming may help to bridge the gap between online physical education and a curriculum that allows for complete physical education experience.

is the result of an energy imbalance between the calories which are consumed and those which are used (Hill et al., 2003). This negative connotation has hampered the acceptance of exergames as a credible way to encourage movement in youth and adults who are increasingly sedentary. Recent research has positioned exergames as an acceptable part of a physical education curriculum. Exergames can now be found listed in the Compendium of Physical Activities as a conditioning exercise capable of producing all levels of intensity (mild to vigorous) dependent on the participants' effort (Ainsworth et al., 2011).

Both the World Health Organization (WHO, 2013) and the National Association for Health, Physical Education, Recreation, and Dance (2012) stress the importance of physical activity for youth. The National Association for Sports and Physical Education (NASPE) and the International Council for Health, Physical Education, Recreation, Sport, and Dance (ICHPER-SD) identify aspects of physical development which are to be covered in a course in physical education (PE) (International Standards for Physical Education and Sport for School Children, 2012; National Association for Sport and Physical Education, 2004). The California state standards for PE follow these national and international recommendations (Physical education model content standards for California public schools kindergarten through grade twelve, 2010). Many states and countries also model their standards on the NASPE and ICHPER-SD standards. Standard five of the NASPE standards for physical education (National Standards & Grade-Level Outcomes for K-12 Physical Education, 2013) indicate that physically literate individuals need to engage in social interaction. Students who take online physical education (OLPE) may not have access to others to interact with. This is one of the dilemmas that has led some to refer to OLPE as an oxymoron (Buschner, 2006; Daum & Buschner, 2012; Kooiman, 2014; Mohnsen, 2012; Yang, Smith, & Graham, 2008). How can students who are not in a traditional physical education class access the social element embedded in the standards for physical education locally, nationally, and globally?

The recent literature suggests that exergames may be able to help students access physical education standards (Guy, Ratzki-Leewing, & Gwadry-Sridhar, 2011). Physical activity is purported to help students with social interaction by providing opportunities for self-expression which lead to increased self-confidence (WHO, 2013). Exergaming is seen as one of the ways to get those who are overweight to engage in exercise (Staiano & Calvert, 2011). Youth enjoy exergames, and exergames allow them to experience physical activity which can level the playing field between advanced players and beginners through pre-selected game levels (Silverstone & Teatum, 2011) while encouraging persistence to game (Mears & Hansen, 2009). This study endeavors to find out if remote exergaming against another student over the Internet is an effective way to incorporate the need for social interaction into OLPE.

2. Literature review

Exergames benefit participants socially, and participants report greater social bonding while participating in a virtual game than in a non-strenuous handheld video game with a partner (Mueller et al., 2007). The type of game played affects player perception of the value of the experience (Heeyoung & Johnson, 2012). Investigators have shown that subjects who enjoy a physical challenge are more motivated by competitive exergames (Snyder, Anderson-Hanley, & Arciero, 2012). Conversely, competitive games disadvantage subjects who are not competitive (Song, Kim, Tenzek, & Lee, 2010) emphasizing the need for the selection of games which balance competition with other gaming aspects.

Exergames help students grow socially (Witherspoon & Manning, 2012). There are varied reasons for this effect: the social benefits of exergames are evidenced by increased participant enjoyment (Kahlbaugh, Sperandio, Carlson, & Hauselt, 2011). A study of youth showed that the realistic movements of an exergame were also linked to increased social interaction (Bianchi-Berthouze, Kim, & Patel, 2007). The intrinsic motivation which accompanies exergaming helps to encourage collaborative play (Kong, Kwok, & Fang, 2012). Exergames can provide social interaction in a school setting (Hansen & Sanders, 2010).

Schools are the best fit for promoting healthy lifestyles among the youth of the world, (Swinburn & Egger, 2002). This should compel all physical education teachers who are tasked with OLPE to search out the very best curricular options for their students. Relevant and meaningful OLPE curriculum needs to address the students need for social growth. Online teachers are encouraged to build social interaction into their lessons, so that the students can practice cooperative learning in a variety of group settings (Moreno Murcia, Coll, & Ruiz Perez, 2009).

Staiano and Calvert (2011) view current research on exergames in a way which suggests that they can be a valued piece of a PE program. They propose that exergames may be useful for home exercise options and health clubs. Their work evaluates the many different benefits noted in the literature regarding exergames. While their study does make the connection between PE and exergame research, they do not infer a link between exergames and the curriculum for OLPE. Sheehan and Katz (2010) join them in stating that exergames may also benefit PE programs.

3. Theoretical framework

A framework for online learning will acknowledge the uniqueness of the learning environment while accounting for the needs of the individual learners (Pange & Pange, 2011). The self-determination theory (SDT) shows up often in exergame and physical education research (Boulos, Kamel, & Yang, 2013; Limperos, 2011; Lin & Zhang, 2011; Rutten, Boen, & Seghers, 2012; Ryan, Rigby, & Przybylski, 2006; Song, Kim, Tenzek, & Lee, 2013). The SDT provides a schema which champions the innate human propensity for self-sustaining healthy actions (Deci & Ryan, 2008; SDT, n.d.). The SDT is grounded on the belief that change flows from individual intrinsic motivation and engagement (Teixeira, Palmeira, & Vansteenkiste, 2012).

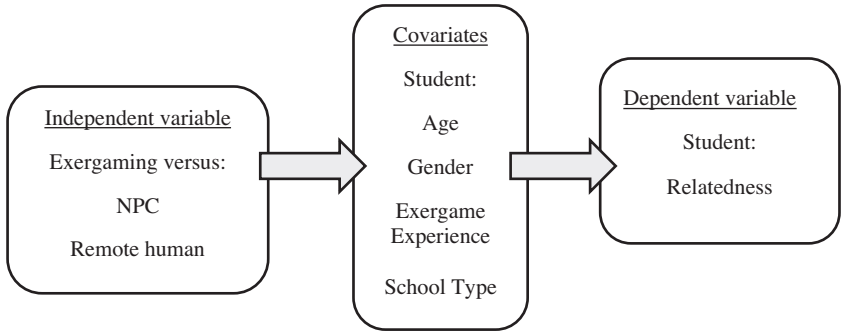
In an educational context, self-determined motivation is preceded by feedback, situation consideration, and teaching and instruction (Lonsdalea et al., 2010). Lonsdalea et al. (2010) suggest that self-determined motivation and a players effort during physical activity is related to their perception of choice. Exergames played as part of an OLPE course offer students free choice whether played over the Internet or against a console-generated non-player character (NPC). Teachers who use exergames in OLPE can build on the sense of autonomy that exergames encourage. The flexibility of exergame play helps to guide exergamers toward competence. OLPE often results in less opportunity for relatedness, so playing exergames remotely over the Internet may provide students with increased volition to be physically active as they participate with other students thereby increasing relatedness. Additionally, the self-determination theory may be a good fit for exergaming because exergames pull players into the game through entertainment that is auditory, visual, textual, and story based (Ryan et al., 2006). When students play an exergame over the Internet, they can connect with other students in an activity that provides them with the autonomy they desire, the opportunity to become competent through different game levels, and the relatedness achieved through the Internet-connected game play.

In this study, the variables in a theory proposed by Meyen et al. (2002) can be used to guide the process and are identified as follows: remote exergame play against a human opponent served as one condition of the independent variable (remote condition). Individual participation versus a computer opponent (NPC) served as the other condition of the independent variable (NPC condition). The covariates of age, gender, exergame experience, and school type were studied for their overall effect on the dependent variables. Student HR is identified as the dependent variable. Figure 1 uses the Meyen et al. (2002) conceptual framework as a starting point while adding in the pertinent parameters of the current study.

4. Research question and hypothesis

Will students who play an exergame against a remote student over the Internet report an increased level of relatedness versus when they compete in an exergame against a NPC?

Figure 1. Conceptual framework.



This question looks at the social impact of an exergame on the participant. Students in an e-course typically do so in their homes which are not replete with other students waiting for social interaction. A danger of this setting is that adolescents who play video games may exemplify problematic behaviors related to obsessive solitary playing times (Turner et al., 2012). Increased contact with peers can help a student feel more connected leading to an enhanced learning experience. Interaction in an e-course was shown to be important to the social development of postgraduate students (Westbrook, 2012) and undergraduate students (Garrett, 2011) but research pointing to a positive or negative social benefit for students aged 11–18 has not been examined. Individually played games lack the social element needed to address the social aspects of a PE curriculum. An examination of the satisfaction levels of students who compete individually versus an NPC and remotely against another student can help to determine the efficacy of exergames for producing a social link between students. This link will allow the participants to develop socially while engaged in the curriculum for PE over a distance.

H Null: A student playing an exergame against another student in a remote location will not report increased within-subjects t relatedness when compared to their competition with an NPC.

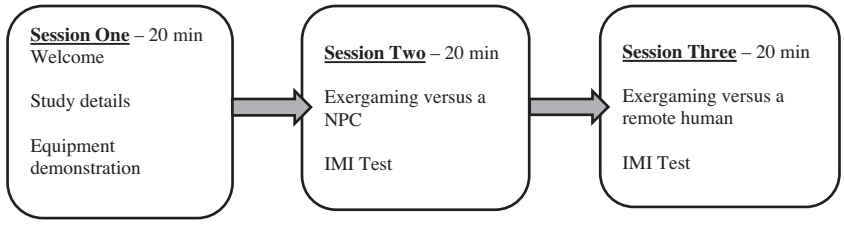
H Alt: A student playing an exergame against another student in a remote location will report increased within-subjects relatedness when compared to their competition with an NPC.

5. Methodology

This study looked at the efficacy of remote exergame participation between students aged 11–18 ($N = 124$). A within-subjects design was followed for this investigation. This design allowed the same group of subjects to experience both of the conditions meaning each participant played both games. Students were randomly assigned to a test group. In one condition, the subjects bowled versus an NPC and played table tennis against a remote human. In the second condition, they played table tennis against an NPC and bowled against a remote human. The first sport was played individually versus an NPC and the second game was versus a remote human subject. This allowed statistical analysis that helped to factor out unforeseen effects because of the reciprocalness of the design.

Each subject attended three sessions. In the first session, they were welcomed to the investigation and briefed on the purpose of the study. Following this, each participant was introduced to the equipment to be used and the games that they would be playing (see Figure 2). In the second session, each

Figure 2. Research protocols—subjects.



participant played an exergame versus an NPC. After each student finished playing the game against an NPC they were seated and completed the Intrinsic Motivation Inventory (IMI). The exergame took the first 10 minutes of the session and the tests accounted for the remaining time. The third session was like the second except each subject played their exergame against another subject located in a different room. The third session culminated in the second IMI test (see Figure 1).

5.1. Population

This study involved secondary students in grades 6–12 aged 11–18 enrolled in a public traditional, public charter, and private schools in Southern California. The choice of this age group is partly due to the proclivity of these students to engage in video game play (Roberts, Foehr, & Rideout, 2005) and partly due to the need for relevant research for this study population. The student population for this investigation included participants from a statistically balanced sample of students which met the study criteria. An a priori power analysis to determine sample size was completed using G*Power 3.1.5 software (Faul, Erdfelder, Buchner, & Lang, 2009). The Type I alpha (error level) was set a priori at 5%, corresponding to a Type II beta (error level) of 20% (or a power of 80%). This analysis showed that for the large effect size of .40 and an error probability of .05 with four covariates and a power of .80, the sample size would need to be $N = 111$. Thus, the target size of the random sample recruited for this study was greater than 111 students. A sample of this size will provide the study with the requisite power needed to provide valid results (Cohen, 1992).

Subjects were selected from those who returned to class with parental permission forms and student assent forms. In an effort to avoid sampling, bias selection of the classrooms was left to the site leader. The investigator kept track of the gender and ages of the subjects and worked to balance the covariates of gender and age by requesting proportionate numbers of subjects to work with.

5.2. Procedures

Of the three gaming systems which met the study parameters, the Microsoft Kinect system was used. Xbox 360 live Internet connections also provide the best remote multiplayer exergaming experience. This system allowed the participants to engage the game without holding any equipment. This was less distracting than systems which require the participant to hold a piece of equipment. It did require each participant to get used to the virtual nature and "feel" of the game. Of all the games available for this system, Microsoft Kinect Sports was used. This game was voted as the best home exergame of 2010 by The Exergame Network (Ten Awards, n.d.). With an Entertainment Software Rating Board (ESRB) rating of E for everyone, it was also suitable for use in an educational setting.

Bowling, table tennis, boxing, track and field, soccer, and beach volleyball are contained on the Kinect Sports game disk. Of these, bowling and table tennis were chosen. These games along with boxing received the highest marks for usability and for enjoyment among the six in the package (Qualls, n.d.).

To participate in a competitive exergame in different locations, each participant accessed an Xbox 360 system equipped with the Kinect Sports game for two of the three sessions. Four Xbox 360 gaming systems were connected using an Internet connection created by a smartphone to create a mobile hotspot.

Use of a mobile hotspot limited the location of the gaming systems. Mobile hotspots can transmit and receive reliably between two rooms within 50 feet of each other. This meant the rooms selected for the study needed to be in close proximity to one another. The drawback to this was student contact. Students in rooms of close proximity have more physical contact with each other than those who are connected over larger distances. This resulted in subject contact before and after exergaming in the third session which was designed to simulate the Internet-connected gaming systems being used in an OLPE course. In this way, the mimicry of the remote location was not as effective.

Measurements were made to identify if the stated hypothesis was supported by the investigation or falsified. Each subject participated in an exergame versus an NPC and versus a human opponent in a remote setting. One group completed a bowling session versus an NPC and a remote table tennis session versus a human. The other group completed a table tennis session versus an NPC and bowling session versus a remote human. In this way, all participants were exposed to both conditions but in an inverse order.

5.3. Results

The hypothesis attends to the social aspect of physical education. A one-way within-subjects ANCOVA was conducted to equate the effect of exergaming on social relatedness during play. Data was analyzed with a within-subjects factor of subscale (NPC IMI, remote IMI) and the covariates of age, school type, exergame experience, and gender. Mauchly's Test of Sphericity indicated that the assumption for sphericity had not been violated, χ^2 (2) = .001, p = .001. Therefore, no corrections were needed.

The predicted main effect on relatedness increased significantly after exergaming, F (1, 119) = 5.158, p = .025, ηp^2 = .042. The interaction between IMI scores and age was also significant, F (1, 119) = 17.608, p = .001, ηp^2 = .042. The interaction between IMI scores and school type was not significant, F (1, 119) = 1.139, p = .288, ηp^2 = .009. A similar non-significant interaction was found for IMI scores and exergame experience, F (1, 119) = 33.798, p = .344, ηp^2 = .008 and relatedness and gender, F (1, 119) = 2.778, p = .098, ηp^2 = .023. The interaction between age and relatedness was significant along with the main effect on relatedness.

The total of the first IMI scale, NPC exergaming (n = 8, M = 47.294, SD = 5.223) and the total of the second IMI scale, remote human exergaming (n = 8, M = 46.952, SD = 5.986) conditions were very close with slightly higher mean scores for the NPC condition. This small point summative difference (.342) between the conditions prompted additional testing to reveal the unique qualities of these item scores.

To gain a better understanding of the data-set, the difference between untransformed Likert scores for each of the NPC IMI scores were compared with their counterparts from the remote human IMI condition. Inspection of boxplots for each of the eight pairings did not reveal any outliers. In testing for normality, none of the Shapiro–Wilks tests provided a value of < .05 and so normality was not established. Visual inspection of normal Q–Q plots did show that all of the eight items conformed to normal. These corrected results of the tests for normality and outliers indicate that the data meet the assumptions for paired t-tests.

A paired samples t-test for each of the eight questions on the IMI scale revealed significant changes between the two conditions and provided increased clarity when viewing the data. All eight items changed significantly from the NPC condition to the remote condition. Details for each pairing are found in Table 1.

Mean scores between the IMI participant responses to the first condition and the second condition changed dramatically. The difference on item scores between conditions ranged from 3.339 to 4.298 (see Table 2) and indicated a large shift in relatedness between conditions. On a seven-point Likert scale, these differences accounted for nearly half to over half of the range of scores. Since mean difference for each question between conditions was statistically significantly different from zero as determined by the paired t-tests, we can reject the null hypothesis and accept the alternative hypothesis. Relatedness does increase in the remote condition over the NPC condition.

The results of this investigation show that all eight items on the IMI changed statistically significantly, in a positive way, over the NPC condition for the remote condition. This allows the null hypothesis to be rejected and the alternative hypothesis to be accepted (see Tables 3 and 4).

Table 1. Correlation between IMI items

Item No.	NPC condition	Remote coition	Correlation results	Sig. change: YES/NO
1	*M* = 5.741, SD = 1.242	*M* = 2.080, SD = 1.144	*t* (123) = 22.558, *p* = .001, *d* = 2.025	YES
2	*M* = 6.088, SD = 1.067	*M* = 1.790, SD = .998	*t* (123) = 29.403, *p* = .001, *d* = 2.640	YES
3	*M* = 1.919, SD = 1.071	*M* = 5.548, SD = 1.107	*t* (123) = 24.416, *p* = .001, *d* = 2.192	YES
4	*M* = 2.435, SD = .163	*M* = 5.774, SD = 1.174	*t* (123) = 20.674, *p* = .001, *d* = 1.856	YES
5	*M* = 5.792, SD = 1.142	*M* = 1.871, SD = 1.020	*t* (123) = 24.415, *p* = .001, *d* = 2.192	YES
6	*M* = 5.903, SD = 1.093	*M* = 2.073, SD = 1.127	*t* (123) = 23.606, *p* = .001, *d* = 2.119	YES
7	*M* = 2.137, SD = 1.121	*M* = 5.903, SD = 1.239	*t* (123) = 26.010, *p* = .001, *d* = 2.335	YES
8	*M* = 1.637, SD = .905	*M* = 5.501, SD = 1.204	*t* (123) = 26.010, *p* = .001, *d* = 2.312	YES

Table 2. IMI score differences between conditions

IMI item No.	Score: NPC condition	Score: remote condition	Difference	Changes in relatedness from NPC to remote condition
1	5.741	2.080	3.661	Changed from distant to close
2	6.088	1.790	4.298	Changed from less friend to more friend
3	1.919	5.548	3.629	Changed from less trust to more trust
4	2.435	5.774	3.339	Changed from less interaction to more interaction
5	5.792	1.871	3.921	Changed from less interaction to more interaction
6	5.903	2.073	3.830	Changed from less trust to more trust
7	2.137	5.903	3.766	Changed from less friend to more friend
8	1.637	5.501	3.864	Changed from distant to close

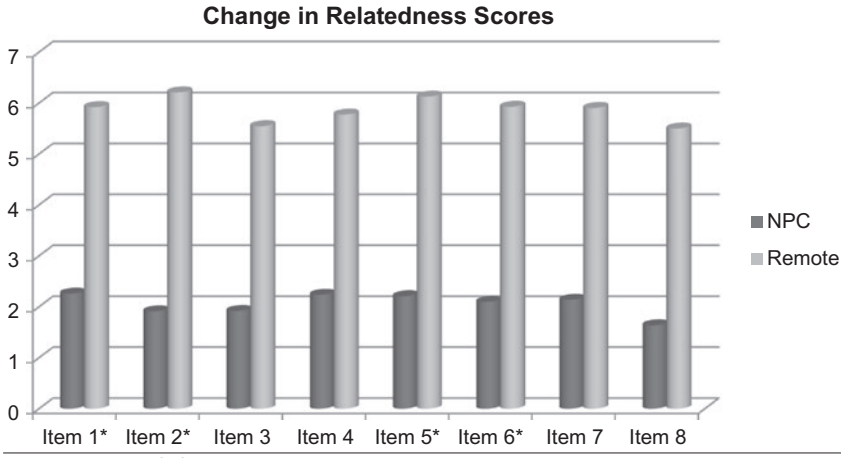
Table 3. Tests of within-subjects effects/IMI

Source		*df*	*F*	Sig.	ηp^2
IMI	Sphericity assumed	1	5.158	.025	.042
IMI × school type	Sphericity assumed	1	1.139	.288	.009
IMI × age	Sphericity assumed	1	17.608	.001	.042
IMI × exergame experience	Sphericity assumed	1	33.798	.344	.008
IMI × gender	Sphericity assumed	1	2.778	.098	.023
Error (IMI)	Sphericity assumed	119			

6. Discussion

Scores on the IMI increased after participating in the exergame competitive session versus another student in a remote location. Past studies have shown that subjects who participate in exergames in a social setting exhibit and report greater intrinsic motivation for participation than those who are playing in isolation (Finkelstein et al., 2011; Graves et al., 2010; Klein & Simmers, 2009; Sheehan &

Table 4. Change in relatedness scores



*Item reverse coded.

Katz, 2012a; Vazou, Gavrilou, Mamalaki, Papanastasiou, & Sioumala, 2012). The use of a seven-point Likert scale allowed for subject responses to be recorded as numerical data. These numbers were used to run a one-way within-subjects (repeated measures) ANCOVA of the data.

Seven-point Likert scores from the PACES were used to determine if there was a social benefit to exergaming versus a human opponent in a different location versus against an NPC. The scores demonstrated that subject relatedness was higher for the game played against another student in a remote location than for an NPC played in isolation. This complimented the results of other researchers who have found an increase in user connectedness while engaged in physical activity in a social setting (Chin A Paw, Jacobs, Vaessen, Titze, & van Mechelen, 2008; Kahlbaugh et al., 2011; Mueller et al., 2007; Staiano & Calvert, 2011). This increased kinship was also found in the subjects of this investigation in the remote condition pointing to the social benefits of exergames at a distance.

Only the covariate age was significantly correlated to the IMI scores of the subjects. Exergame experience, subject gender, and school type did not affect subject self-reported relatedness to either the NPC or to the remote human condition. Considerable changes in subject response indicate that the remote condition increased relatedness. In the first condition, the subjects scored their relatedness lower for the paired topics of connectedness, friendship, interaction, and trust than in the remote exergaming condition. Educators may use exergames as part of a PE curriculum with the knowledge that the social standards can be addressed more effectively than in an NPC condition.

Scores on the IMI highlight some interesting facets of the two conditions in this study. The IMI scale contained four pairs of questions. One pairing referenced subject connectedness with the other participant. The second addressed the aspect of friendship, the third spoke to player interaction, and the fourth analyzed the trust between participants. What is notable is that in the first condition, the subjects were asked to play against an NPC which is not an actual person but a machine-generated persona represented by a screen avatar. For this reason, subject attention was drawn to this peculiarity before taking the IMI scale after the NPC condition.

Informal questioning during progress monitoring and following testing turned up some interesting responses. Some of the students still misunderstood the items which were worded in both the positive and negative ways (see Table 5). These inversely worded questions resulted in mixed results with some students checking contradictory responses between the topic pairings. This issue did not

Table 5. IMI question pairs

Positive statement	Negative statement
I feel close to this person (item 8)	I felt really distant to this person (item 1)
It is likely that this person and I could become friends if we interacted a lot (item 7)	I really doubt that this person and I would be friends (item 2)
I felt like I could really trust this person (item 3)	I don't feel like I could really trust this person (item 6)
I'd like a chance to interact with this person more often (item 4)	I'd really prefer not to interact with this person in the future (item 5)

affect the majority of the subjects but is noted here. A majority of subjects were able to decipher the correct relationship between the pairings, while only a few had problems with the negatively worded statements.

The researcher did note the following in his informal observations and queries of the subjects: Some students actually felt connected with the NPC and scored their interaction in the first condition higher than the one against a remote human. Additionally, a few students actually felt they could trust the NPC more than the remote human. It seems some subjects may have sincerely felt connected to the NPC during their exergaming experience. This is an interesting aspect of social presence between screen avatars of a human and a machine. Of the four topics addressed by the questions that of friends caused the least confusion although, it was polarizing as well as some of the random subject pairings clearly matched students who were not friends with each other. This may have resulted in unfavorable responses from the participants in these pairings toward the remote condition.

It could be that the societal and cultural transition to all things related to technology has prepared or predisposed current 6–12 grade students toward an increased favorability or familiarity with NPC-type conditions. It may be that not much has changed and the difference can be explained by introverted and extroverted personality types. Whichever or whatever is causing these phenomena, it seems we are destined to ever increasing interaction and relatedness with the machines that surround us. With continued research, this trend can be maximized for its positive effect and not impugned for its negative implications (Di Tore, D'elia, Aiello, Carlomagno, & Sibilio, 2012).

The results from the IMI scale do indicate that a majority of the subjects credited the remote condition with greater connectedness, trust, interaction, and potential for friendship than the NPC condition. The collaborative theory explains this as the increased connectedness and contact the subjects felt with the remote human over the NPC. This strengthens the case for the use of exergames in an e-course in physical education. Multiplayer games have the added benefit of increasing the physical intensity of the participants (O'Donovan, Hirsch, Holohan, McBride, & McManus, 2012). Educators can confidently use exergames in a PE curriculum with the knowledge that social benefits exist for the remote condition. This study has also shown that remote exergaming results in more subject relatedness than NPC exergaming.

7. Significance of the research

Once an educational oddity, e-learning is now becoming so mainstream that school districts and states across the United States are not just offering e-courses but, in some cases, requiring that students take them before graduation (Brown, 2012). Students in e-courses will benefit from non-traditional choices for their physical education. Recent improvements to exergames have placed them at the forefront of viable options for students enrolled in an e-course in physical education. This research indicates that exergames can help students access the cognitive, physical, emotional, and social parts of the PE curriculum.

Exergames can help students engage in a comprehensive curriculum while enrolled in an e-course in physical education. Participating with other players remotely can help to increase the social value and benefit of participation. The use of exergames also allows the students to take part in an activity of high interest which addresses their emotional needs by helping with overall participant motivation. When teachers are comfortable and confident in their use of exergames, they become an effective tool for physical education. As with all physical activity, steps need to be taken to reduce the risk of injury to the students. When used to enhance an e-course in PE, exergames can help connect all the aspects of PE which are of importance both in the curriculum and for the students.

8. Limitations/delimitations

The sample used in this study may not generalize to other cultures and localities. The literature shows that participants in western countries, like North America, tend to work best when challenged with an independent exercise goal. Conversely, East Asian and Latin American countries respond well to interdependent exercise goals (Jin, 2010). This may mean that the use of exergames in divergent cultures will require different instructional techniques which meet the needs of the population taking the e-course. Fortunately, exergames are easily adaptable through game settings and lessons can be structured for the differing needs of the students taking the class (O'Donovan et al., 2012).

The population recruited for this investigation may have been predisposed toward a positive view of exergames. The recruitment methods used (flyer) may have resulted in a sample of subjects who already viewed exergames in a favorable light. The average self-reported amount of exergame experience was 3.040 years out of a possible of 6 years. This indicates that the mean was nearly the same as the median of 3 years of experience. This may show that the sample obtained did not self-select to be in the study solely because they were biased toward exergames. Nevertheless, it is noted that it is probable that bias existed on the part of at least some of the participants.

When testing the remote condition, the subjects had contact with each other and some may have known who they were playing remotely. The researcher was unable to obtain rooms on each campus which were separated by a sufficient distance to keep the two groups of subjects (conditions) from having access to each other. One school system only offered up a single space which was separated with partitions for the remote condition. Additionally, the distance between rooms was limited by a smartphone Wi-Fi connection as this proved to be the best way to connect the gaming systems. Attempts were made to use the Ethernet connections present in the school systems but the logistics required to open the district network to the commercial Xbox Live account play were daunting and given that the rooms provided were already of close proximity, it was decided that working to get access to the school system connections would not prevent remote subject contact.

This study is not designed to determine if exergames are effective as a stand-alone curriculum in physical education. Many different exergames exist making this a possibility but the addition of this variable would have distracted from the first question which is the question of the feasibility of remote exergames for use in an e-course in physical education. Additionally, research in e-courses at this level still lags that of higher education so adding to the body of secondary knowledge posed the greater need. It may have been desirable to compare exergames to their real-life counterparts. A study which assesses the benefits of a soccer exergame (type of game can vary) when compared to a real soccer activity would help to fill in a gap in the literature. Additionally, this experiment will not uncover the effect of exergames for students with disabilities. This intriguing use of exergaming will be tabled for a future study. Indeed, a recent science panel from the American Heart Association states that exergames have the potential to reach a large audience including those who have limitations which affect their participation in physical activities (Lieberman et al., 2011). In closing, the changes noted in this paper are measures of short-term changes to each aspect of PE and cannot be construed to reflect changes which would remain over a longer term.

9. Implications

Future studies should look at other exergames and gaming systems to see if there is continuity across hardware systems and games played. Investigators will also want to establish the viability of using exergames as a featured part of the curriculum and the effect availability of equipment, games, and Internet connections have on the success of exergames as an assigned part of student learning in physical education. More study is needed to determine if exergame participants continue to choose this type of physical exercise over time (Barnett et al., 2011). A longitudinal study which looks at the effect of exergames on student physical activity choices is needed to reveal the long-term effects of using exergames in the curriculum of an e-course in physical education. A study similar to this one for elementary PE curriculum may also be valuable in the future.

Exergames will change as newer more portable technologies are introduced. At present, these future devices take the form of smart phones, handheld GPS hardware, and other devices that are able to connect the natural world with that of the virtual world through some sort of online game (Cummiskey, 2011; Lieberman et al., 2011; Sibley & McKethan, 2012). Recent news of a new Xbox system named the Xbox One shows that continued innovation will affect this genre as each new advance in technology strives to make the game play more engaging, challenging, and lifelike. This after all is the purpose of those who market the systems because in doing so, they will have created a product which consumers will purchase.

A future study which compares exergames to their real-life counterparts also seems warranted. In this study, subjects would play table tennis on the exergame and then play the actual game with real equipment. Student scores on the IMI relatedness subscale and other measurement devices could be recorded to see how effective exergames are when compared to their real-life counterparts. Even if such a study was to show that there are many similarities between exergames and the real sport exergames should not be seen as a primary piece of a secondary PE curriculum. The positive effects of exergaming cannot and should not take the place of face-to-face play indefinitely. Participation in an exergame is not the same as participation in the actual activity. Exergames are useful as starter activities and/or transition activities. Exergames are useful for helping to connect students who are taking OLPE when they cannot or will not engage in other real-life activities, introducing less-fit students to physical activity, and building enthusiasm for movement at an intrinsic level. In the real world, there are multiple factors which add to and expand the activity beyond that of the virtual setting which provide the learner with a deeper experience than can be had with an exergame (Boes & Krell, 2010; Sheehan & Katz, 2010).

10. Conclusions

This investigation demonstrated that when learning at a distance is desirable or required, exergames can be useful as pieces of a PE curriculum. Proper game selection can present students with activities that have the potential to help with intrinsic motivation leading to increased levels of PI while engaged in physical activity. Exergames allow students to access PE standards and curriculum in new and exciting ways which seemed improbable only a few short years ago. It is time for educators to take notice of how stimulating, beneficial, and educational exergames can be when included as part of a curriculum for students taking PE at a distance. While exergames are not a replacement for traditional games (Hansen & Sanders, 2007; Sheehan & Katz, 2013, Staiano & Calvert, 2012; Stroud, Amonette, & Dupler, 2010; Sun, 2012; Van Niel, 2011), the results of this investigation have shown that exergames can and should be included in the curriculum of e-courses in PE which are taken at a distance. Students who engage in exergames work harder without even realizing it (Devereaux et al., 2012). This effect is magnified for subjects prone to handheld video game play (Leatherdale, Woodruff, & Manske, 2010). This effect may also be attributed to the higher intrinsic motivation which is associated with exergamers (Sheehan & Katz, 2012b). As a part of the curriculum, exergames offer the student a current, relevant, and interesting way to engage the content of the course. This new genre provides one more choice for students taking an e-course in PE as they explore movement activities and develop a lifelong desire to move. This study has established that exergames can be offered in a virtual PE class as "best practice" which makes them valuable as one element of a comprehensive curriculum (Hansen & Sanders, 2012).

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