The Effect of Nintendo Wii and Gender to Physical Education Students' Balance Performance

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Abstract: The aim of this study was to explore whether there is a gender difference in the beneficial effects of Nintendo Wii-Fit Plus, which is a series of sports video games used to support Physical Education students' balance performance. Participants were twenty-six (n=26) undergraduate students, between the ages from 20-22 years old. Thirteen (50%) of the participants were male and thirteen were female (50%). The balance ability assessment was performed with the Biodex stability system. Participants voluntarily completed 24-minute Wii-Fit Plus sports video games 2 times per week for a total of 8 weeks. A one-way analysis of covariance (ANCOVA) was conducted to compare the adjusted mean score of the post-tests for the two gender groups. The results indicated that there was no significant difference between the two gender groups on balance post-test scores. These finding suggest that females will benefit as equally as males by using the Nintendo Wii-Fit Plus balance games. However, further research is needed to see if these results exist with other student populations enrolled in other sports video games.

Introduction

Three essential elements frequently present in physical exercise include repetition, feedback, and motivation (Holden, 2005). Motor development and improvement achieved through repeatedly practicing an exercise or activity. Feedback in the form of success should be associated with the exercise or activity. An essential element to implementing repetition of an activity is motivation. Virtual reality (VR) and video games offer all three of these characteristics to an individual. VR systems provide individuals with repetitive, motivating, and safe exercises, which offer continuous feedback (Flynn, Palma, & Bender, 2007). This "real-time feedback" provided by VR interactive environments is presented in a form that is understandable to the individual (Holden, 2005). Video game systems, such as the Nintendo Wii, present an interactive game that could offer each of these aspects by providing an individual with the opportunity to perform beneficial repetitive movements in a motivating and engaging format that offers feedback in the form of success.

The Nintendo Wii is a recently released gaming system that features a motion sensing remote controller. The controller responds to a player's body movements and players can participate in games by interacting with onscreen environments and objects using their own body movements (Vernadakis, Gioftsidou, Antoniou, Ioannidis & Giannousi, 2012).

According to Papastergiou (2009) the active video games are appealing to young people and effective in helping them improve their fitness levels and develop motivation for physical exercise. Patsi, Antoniou, Batsiou, Bebetsos & Lymnioudis (2011) reported that the active video games are a popular alternative to the involvement of people with physical activities, combining entertainment with the performance.

Furthermore, Gee (2003, 2005) and Shaffer, Squire, Halverson & Gee (2005) argue that video games have the potential of placing students in simulated environments where they face authentic, open-ended challenges similar to those faced by actual professionals. Gee (2005) argues that when individuals play these type of video games they experience first-hand how members of a profession think, behave and solve problems, thus they are engaged in a deep, meaningful learning experience. Shaffer, Squire, Halverson & Gee (2005) conclude that one reason video games are powerful learning environments is because they make it possible to develop situated understanding.

Unfortunately, students who do not have access to or who are not interested in video games are believed to be disadvantaged compared to their peers who are interested and have exposure to video games. One group that is of particular concern is girls (Winn and Heeter 2009). Steiner, Kick, and Albert (2009) argue that a "gender sensitive approach (to educational gaming) is strongly needed, as the new learning technologies need to be appropriate and accepted for all students and ensure equal (learning) opportunities" (p. 5). Jenkins and Cassells (2008) warn: "It would be a big mistake to introduce games into the classroom if the results had the effect of further disadvantaging girls."(p. 14). Kelleher (2008) believes that "using computer games as a primary end-goal to motivate students towards computer science is potentially dangerous" (p. 28) on the grounds that games do not appeal to boys and girls equally. Certainly, it would be problematic if one gender were to be disadvantaged by the enthusiastic adoption of a new technology.

Thus, it is important to investigate whether the introduction of active video games in physical exercise in particular will have a differential impact on male and female students' performance. Therefore, the aim of this study was to explore whether there is a gender difference in the beneficial effects of Nintendo Wii-Fit Plus, which is a series of sports video games used to support Physical Education students' balance performance. The study looked at the following general research statements:

1. There is a difference between male and female on the balance performance using the Nintendo Wii training program?
2. There is a difference between pre-test and post-test measurements on the students' balance performance?
3. There is an interaction between gender (male, female) and measurements (pre-test, post-test) on the balance performance?

Methods

Participants

Twenty-six students (13 males and 13 females) participated in the study, with an average age of 20.5 years (SD = 0.9). They were from a third year undergraduate course in the Department of Physical Education & Sport Sciences at the Democritus University of Thrace, which is a university in the north east of Greece. The sampling frame used for this study was self-selected sampling. Participants were orientated to the purpose of the study and the obligations for participation in the experiment. Each student was asked to give consent to participation in the study. Students were informed that participation was voluntary and would have impact on their grades (two bonus points).

Instrumentation

Balance ability was assessed in all participants at baseline and after the completion of the eight week balance program. The balance ability assessment was performed with the Biodex Stability System. The Biodex Stability System is a dynamic postural stability assessment and training system which assesses the ability of the body to balance on an unstable platform (Arnold & Schmitz 1998). The participants completed a single leg static balance assessment for both limbs (dominant and no dominant) and they tried to maintain the unstable balance platform on the horizontal position. Specifically, the participants maintained single-limb stance for 20 seconds, with the Biodex platform set to freely move by up to 20^0 from level in any direction. Any balance platform deviations where reported numerically by the system in degrees (^{0}). The system provided three different indices according to the direction of the deviations from the horizontal plane; the overall stability index (OSI), the anterior-posterior index and the medial-lateral index, (Biodex Stability System, 1998; Rozzi, Lephart, Sterner & Kuligowski, 1999). However, the OSI score is believed to be the best indicator of the overall ability of a subject to balance on the platform (Testerman & Vander Griend 1999). Thus, three test trials were carried out and the one with the lowest score (best performance) in overall stability index was further processed.

Procedure

Participants performed a specific balance program for 8 weeks, two times per week, and 24 min per session. Before the intervention started, the students attended a 90-minute introductory session on how to use the Nintendo Wii-Fit Plus games and its tools. Then they used the interactive games Wii-Fit Plus of the Nintendo Wii console, as a training method to improve their balance. The games varied each week starting with the easiest and ending with the most difficult. Participants had the opportunity to choose the order in which they will play the balance games, but without allowing them to change their time engagement. At the beginning and at the end of each session the participants performed a series of yoga exercises (a. tree pose, standing knee pose b. and c. king of the dance pose) for a total duration of 10 minutes. In the meantime, they had to deal with Nintendo Wii-Fit Plus interactive balance games for 14 minutes. After each exercise – game there was a

15 second break. Specifically, the training program of the Nintendo Wii group is presented below on table 1.

Table 1. Means and standard deviations for pre-test and post-test scores of both groups on balance tests.

Week	*Yoga Exercises (6 min)*	*Balance Games (14 min)*	*Yoga Exercises (4 min)*
Weeks 1 – 2	King of the Dance (2 min – one minute each leg) Tree (2 min – one minute each leg) Standing Knee (2 min – one minute each leg)	Ski Slalom (5 min) Table Tilt (5 min) Soccer Heading (4 min)	Tree (2 min – one minute each leg) Standing Knee (2 min – one minute each leg)
Weeks 3 – 4	King of the Dance (2 min – one minute each leg) Tree (2 min – one minute each leg) Standing Knee (2 min – one minute each leg)	Balance Bubble (4 min) Penguin Slide (4 min) Ski Slalom (3 min) Snowboard Slalom (3 min)	Tree (2 min – one minute each leg) Standing Knee (2 min – one minute each leg)
Weeks 5 – 6	King of the Dance (2 min – one minute each leg) Tree (2 min – one minute each leg) Standing Knee (2 min – one minute each leg)	Penguin Slide (3 min) Ski Slalom (3 min) Snowboard Slalom – advance level (4 min) Balance Bubble – advance level (4 min)	Tree (2 min – one minute each leg) Standing Knee (2 min – one minute each leg)
Week 7	King of the Dance (2 min – one minute each leg) Tree (2 min – one minute each leg) Standing Knee (2 min – one minute each leg)	Soccer Heading – advance level (4 min) Ski Slalom – advance level (3 min) Table Tilt – advance level (3 min) Tightrope Walk – advance level (4 min)	Tree (2 min – one minute each leg) Standing Knee (2 min – one minute each leg)
Week 8	King of the Dance (2 min – one minute each leg) Tree (2 min – one minute each leg) Standing Knee (2 min – one minute each leg)	Snowboard Slalom – advance level (3 min) Balance Bubble – advance level (3 min) Table Tilt – advance level (4 min) Tightrope Walk – advance level (4 min)	Tree (2 min – one minute each leg) Standing Knee (2 min – one minute each leg)

Before and after the completion of the eight week balance program, participants completed a single leg static balance assessment for both limbs (dominant and no dominant). Participants were tested in overall stability index provided from the Biodex Stability System and performed three 20 sec practice trials and three 20 sec test trials out of which only the best score was recorded.

Design

The experimental design used for the purpose of the study was a pre-test/post-test design, with gender (male, female) and repeated measurements (pre-test and post-test) as independent variables, and balance performance as dependent variable.

Results

Homogeneity of variance and Sphericity was verified by the Box's M test, the Levene's test and the Mauchly's test (Green & Salkind, 2007). Initial differences between the gender groups for the mean balance scores were tested using independent-samples t test. Two-way analyses of variance (ANOVAs), with repeated measures on the last factor, were conducted to determine effect of gender groups (male, female) and measures (pre-test, post-test) on balance performance (OSI) using the Nintendo Wii console. Each variable was tested using an alpha level of significance .05. Where initial differences between gender groups or correlation between means were verified, one way analyses of covariance (ANCOVAs) were applied (Green & Salkind, 2007). Means and standard deviation for the male and the female group in pre-test and post-test are presented on table 2, while results of each analysis are presented separately below.

Table 2. Means and standard deviations for pre-test and post-test scores of both groups on balance tests.

Measurements	Male (*N*=13)		Female (*N*=13)	
	M	*S.D.*	*M*	*S.D.*
OSI – right limp 1st measure	5.29	1.71	3.85	1.05
OSI – right limp 2nd measure	3.41(3.08*)	1.62(.3*)	2.79(3.12*)	.39(.3*)
OSI – left limp 1st measure	4.72	.79	3.44	.78
OSI – left limp 2nd measure	3.02(2.76*)	.61(.19*)	2.5(2.75*)	.69(.19*)

* Adjusted mean & standard deviation

Balance overall stability index comparison

The balance stability index comparison on the right limp showed significant initial differences between the two gender groups $t(24) = 2.57$, $p < .05$. For removing the obscuring effects of pre-existing individual differences among participants, one way analysis of covariance (ANCOVA) was applied. Preliminary checks verified that there was no violation of the assumptions of normality, linearity, homogeneity of variances, homogeneity of regression slopes, and reliable measurement of the covariate. After adjusting for pre-intervention scores, there was no significant difference between the two gender groups on balance OSI post-test scores, $F(1, 23) = .007$, $p = .94$, partial eta squared = .000 (see Figure 2). There was a small relationship between the pre-test and post-test balance OSI scores, as indicated by a partial eta squared value of .30.

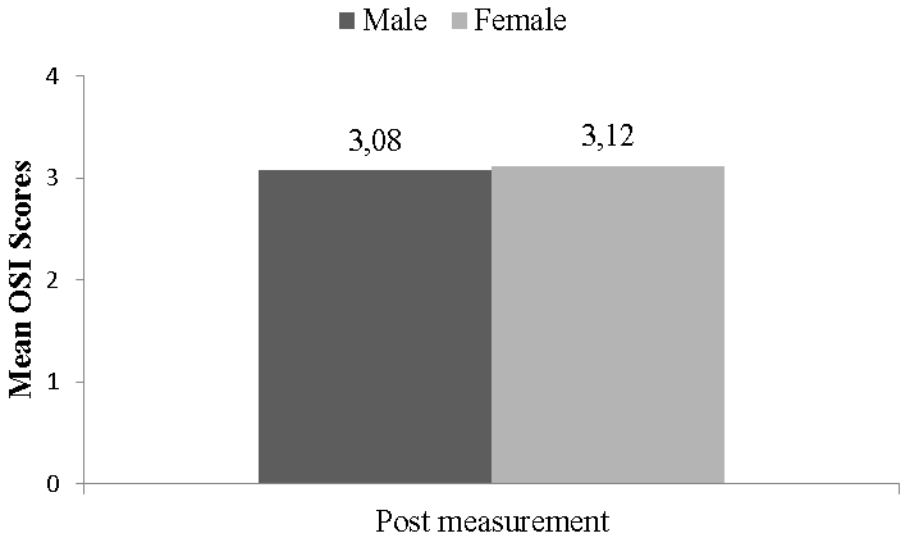

Figure 1. Right limp's performance of the gender groups on post measurement of the OSI test

Similar, the balance stability index comparison on the left limp showed significant initial differences between the two gender groups $t(24) = 4.17$, $p < .05$. For removing the obscuring effects of pre-existing individual differences among participants, one way analysis of covariance (ANCOVA) was applied. Preliminary checks verified that there was no violation of the assumptions of normality, linearity, homogeneity of variances, homogeneity of regression slopes, and reliable measurement of the covariate. After adjusting for pre-intervention scores, there was no significant difference between the two gender groups on balance OSI post-test scores, $F(1, 23) = .001$, $p = .97$, partial eta squared = .000 (see Figure 2). There was a small relationship between the pre-test and post-test balance OSI scores, as indicated by a partial eta squared value of .23.

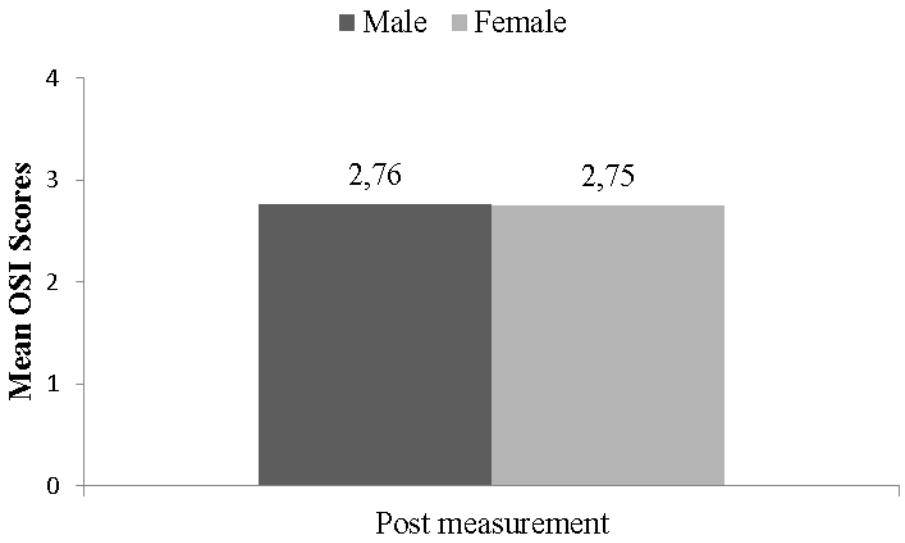

Figure 2. Left limp's performance of the gender groups on post measurement of the OSI test

Discussion

The phenomenon of active video games has concerned kinesiology and sports science for some time now. If one is looking in a scientific data base for studies, which researches into the influence of active video sport games in different samples to improve motor development and functional mobility, one will strike in rich very fast. Various reports can be found about children and adolescents but senior citizens are also a matter of interest for research projects with active video games. However, little research has specifically focused on how Nintendo Wii games can be used in kinesiology and sports science for learning and training and if this kind of video games will have a differential impact on male and female students' performance. Therefore, the aim of this study was to explore whether there is a gender difference in the beneficial effects of Nintendo Wii-Fit Plus, which is a series of sports video games used to support Physical Education students' balance performance. Results indicate that both gender groups demonstrated a decrease in OSI mean scores over the eight week of the intervention for the right and the left limp as well. While this decrease suggests an improvement in balance for both gender groups, the difference between male student scores and female student scores in the above stability index (right and left limp) was not significant. Overall, this decrease in scores to perform the OSI tests indicated that both gender groups demonstrated an increase in functional mobility, which is related to balance.

These findings are in line with previous research on active video games (Barab, Dodge, Tuzun, Job-Sluder, Jackson, Arici, Job-Sluder, Carteaux, Gilbertson, & Heiselt. 2007; Futterer & Laupheimer, 2008) which have also reported that female students learn as much as male students from playing in active video game consoles. The finding that both male and female students benefited equally is very encouraging for active video games

based learning and suggests that females will benefit as equally as males regardless of the type and design of the active video games.

There is a variety of explanations why female students improved their balance ability as much as male students after training with the Nintendo Wii gaming console. One explanation could be that the balance training program was task driven and required problem solving, supporting learners to become discoverers and examiners of the balance-based activities. According to Shaffer, Squire, Halverson, & Gee (2005), in the virtual worlds of active video games learners experience the concrete realities of what those words and symbols represent. They can understand complex concepts without losing the connection between the abstract ideas and the real problems they can be used to solve. Concluding that one reason active video games are powerful learning environments is because they make it possible to develop situated understanding.

Another possible explanation could be that the use of the Nintendo Wii gaming console was infinitely patient and could offer scaffolding, providing students with cues, prompts, hints and partial solutions to keep them progressing through learning until they are capable of directing and controlling their own learning path.

Moreover, another factor contributing to a similar balance improvement between male and female students could be the specificity and frequency of the feedback provided to the students by the system which was designed to be gender neutral. Augmented feedback in the form of either knowledge of performance or knowledge of results is known to enhance motor skill learning (Swanson & Lee, 1992). Feedback provides information about the success of the action, it informs the learner about movement errors and it is known to motivate the learner by providing information about what has been done correctly (Schmidt & Lee, 1999).

This study is not without limitations. First, the sample was a convenience sample that was relatively small, which limits the generalizability of the findings. Secondly, the results reported in this study are based on a single interactive gaming software (Nintendo Wii-Fit Plus). This is a case-specificity problem. It is possible that different gaming software covering different games & exercises would yield different results. Despite these limitations, researchers hope that this study adds to the knowledge base for kinesiology and sports science practice in terms of using gender neutral active video games to improve balance ability.

Conclusion

In conclusion this study investigated whether ether were any gender differences in the beneficial effects of Nintendo Wii-Fit Plus, which is a series of sports video games used to support Physical Education students' balance performance. Results indicated that male students will benefit as equally as female students by using the Nintendo Wii-Fit Plus balance games. Thereby, the incorporation of an interactive gaming console like the Nintendo Wii, in the balance training process, probably constitutes an important and powerful tool available to the kinesiology and sport sciences professionals in order to

improve the balance ability of their students or clients. Further research is needed to see if these findings exist with other student populations playing other active video games.

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