

# Exergames for Physical Education Courses: Physical, Social, and Cognitive Benefits

## Abstract

Digital games combining exercise with game play, known as exergames, can improve youths' health status and provide social and academic benefits. Exergame play increases caloric expenditure, heart rate, and coordination. Psychosocial and cognitive impacts of exergame play may include increased self-esteem, social interaction, motivation, attention, and visual-spatial skills. This article summarizes the literature on exergames, with a special emphasis on physical education courses and the potential of exergames to improve students' physical health, as well as transfer effects that may benefit related physical, social, and academic outcomes.

As obesity rates skyrocket in the United States (McGinnis et al., 2006), exergames that provide both exercise and gaming have emerged as an innovative tool for combating the crisis. Exergames are not only prevalent in homes but are also becoming part of students' physical education classes, such as West Virginia's statewide exergame curriculum (Schiesel, 2007). This article summarizes the literature on exergames, with an emphasis on (a) their development; (b) their potential to improve students' physical health, social activity, and academic performance, including transfer effects; and (c) their use in physical education courses. It concludes with recommendations to enhance exergame effectiveness.

## Development of Exergames and Integration into Youths' Environments

Video game play is nearly universal among 12- to 17-year-olds: 99% of boys and 94% of girls play them (Lenhart, 2008). They are enjoyable and sustainable activities, with exergames emerging as a profitable market. The Nintendo Wii exergame contributed to a 73% increase in Nintendo's net sales, with 24.5 million consoles and 148.4 million software units sold to date (Nintendo, 2008), making it the second highest selling video game in 2007 (Entertainment Software Association [ESA], 2008). Thirty-six percent of 8- to 18-year-old youth had Wii game

consoles in their homes in 2009 (Rideout, Foehr, & Roberts, 2010). Dance and rhythm exergames such as Dance Dance Revolution (DDR) and sedentary games such as Guitar Hero and Lumines are played by 61% of teenagers (Lenhart, 2008). Boys (58%) and girls (64%) and frequent gamers and nongamers play rhythm exergames (Lenhart, 2008).

The skills that youth acquire during exergame play can transfer to other activities, thereby benefiting physical, social, and cognitive development. According to Greenfield (1993), a video game player becomes an onscreen producer of content, a process heightened in exergame play when the player uses body movements to control the onscreen character's movements. Exergames interpret a player's bodily movements as inputs associated with specific meanings for game play, translating movement in three-dimensional space onto the two-dimensional screen. Because the exergame player is distanced from the character on the screen, he or she must use visual-spatial skills, hand-eye or foot-eye coordination, and quick reaction time to operate and successfully play the game. Moreover, exergame play allows multiple players to compete or cooperate on a team, thereby providing both a virtual and a real social interaction. These social and cognitive impacts of exergames provide additional potential benefits to the physical activity required for game play.

In order for exergames to influence physical development, designers developed systems to track and respond to players' gross motor movements. These games first emerged in the 1980s as stationary bicycles connected to game consoles that required pedaling and steering on a handlebar-mounted gamepad. They were unsuccessful because of high cost and interfaces that were complicated, easily broken, and unengaging. In the second-generation exergames of the late 1990s, DDR emerged as the first cost-effective exergame that produced significant caloric expenditure (Lanningham-Foster et al., 2006). Foot-operated pads, which DDR popularized, made foot movement an integral part of a commercially successful game. As foot movement required caloric expenditure, some schools began to use DDR in their physical education courses as an engaging way for youth to exercise (Schiesel, 2007).

Motion sensor technology, an alternative to foot-operated pads, uses a camera interface or controller device to transfer a player's image or movement to a screen (Lieberman, 2006). A major breakthrough in motion sensor technology was the Nintendo Wii, which uses an accelerometer within the Wii remote and a sensor bar to detect movement. For example, virtual Wii baseball requires the player to swing a Wii remote controller at a symbolic ball thrown by an animated onscreen character; the sensor bar picks up these actions, and the game displays them onscreen to represent the player.

Exergames are increasingly used as health tools. Gyms and health clubs, for instance, integrate gaming consoles into their equipment, such as Concept II's rowing machine that increases motivation through competition. Virtual personal trainers motivate players by monitoring progress on specific activities and encouraging them to proceed to the next level (Lieberman, 2006). In Wii Fit, the virtual trainer admonishes a player who stops mid-exercise and congratulates the successful player.

Exergames initially developed from technological advancements designed to make video games more fun (Parker-Pope, 2005). Exergames can now track full-body movement in three dimensions, accurately measure reaction time and acceleration, and capture the speed and power of a player's movement. Schools and fitness centers are gradually integrating these exergames into their curriculum and equipment. Exergames have clearly come of age in the commercial market. However, critics charge that exergames produce no health benefits, encourage screen time that displaces exercise, and produce insufficient motivation to sustain exercise for a long period of time (Lyons, 2009). There is also limited evidence of weight loss from exergame play (Maloney et al., 2008; Mhurchu et al., 2008; but see Staiano et al., 2011), and reading is more effective than gaming in developing certain cognitive skills such as reflection and imagination (Greenfield, 2009). How well do exergames meet the physical, social, and cognitive needs of young players?