Interactive Video Games in Physical Education

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Rather than contribute to a sedentary lifestyle, these games demand activity from the players.

Physical Education has become a popular venue for innovative technologies in recent years. In addition to the use of personal digital assistants (PDAs), pedometers, heart rate monitors, laptops, and performance analysis software, physical educators are gradually introducing students to interactive video games. These games, in contrast to those discussed by Hayes and Silberman (2007), require the player(s) to be physically active, thereby negating the long-standing belief that all video games contribute to a sedentary lifestyle.

Technology is by no means a prerequisite for educational games. Similarly, technology should not replace effective teaching, but should be viewed as a supplement to appropriate pedagogical practices. In an overweight nation where obesity is the second leading cause of death due, in part, to physical inactivity (Mokdad, Marks, Stroup, & Gerberding, 2004), any strategy for increasing or promoting physical activity is worth exploring.

Physical inactivity is a major contributor to the obesity epidemic spreading across the country (Kujala, Kaprio, Sarna, & Markku, 1998). The percentage of overweight children and teens (ages 6-19) in the United States tripled from about 5 percent in 1980 to roughly 16 percent in 2002 (U.S. Department of Health and Human Services, 2005). These alarming figures should spur us to get youths more active.

In recent years, interactive video games have crept into physical education settings, making physical activity fun and challenging for both high- and low-skilled students. Interactive video games offer more than just animated exercise. Many of these games have built-in assessments, such as scoring systems based on skill performance, as well as heart rate monitors and caloric expenditure estimates. Some are even specifically designed to enhance motor abilities such as balance, hand-eye coordination, agility, and core strength. These engaging, interactive video games have the potential to increase physical activity levels among children and teenagers. They can also serve as a tool to educate students about the physiological functions of their body, such as how their heart responds to various intensities of activity.

The topic of interactive arcade games in physical education is a new phenomenon, so empirical evidence is not yet available to support the wealth of positive

Table 1. Resources Related to Interactive Video Games in Physical Education

Technology/Topic	Item Description	Vendor/Source Web Site
Dance Dance Revolution	Dance pads	ddrfreak.com/store/ or cobaltflux.com
Dance Dance Revolution	Video lessons on DDR in PE	lightbridge.sonoma.edu/lightbridge/lessons/publish/115/main/introduction.html
Cybex Trazer	All hardware and software	cybextrazer.com
Eyetoy	Camera for use with PlayStation	eyetoy.com
Cateye Game Bike	Interactive gaming bike	cateyefitness.com
Sportwall	Interactive training stations	sportwall.com
PEP Grant	Physical Education for Progress grants	pepgrant.info
EETT	Enhancing Education Through Technology grants	ed.gov/programs/edtech

outcomes proclaimed by teachers and students in the popular media. Despite the lack of research, the state of West Virginia had enough confidence in Dance Dance Revolution (DDR, described below) to authorize the purchase of one machine for each of its 765 public school physical education programs, at a cost of $740 apiece (Toppo, 2006).

While interactive arcade games may enhance skills such as coordination, reaction time, endurance, speed, and agility, there is no research stating that, even if learned, these skills would transfer to other sporting contexts. However, interactive arcade games would be no less valuable if they failed to improve skills in other sports or physical activities. Teaching students to be physically active for life is the aim of physical educators, but at present only 30 percent of adult men and women regularly engage in physical activity (National Center for Health Statistics, 2005). Thus, exploring innovative curricular ideas such as interactive arcade games seems necessary and even urgent.

The two most popular video game consoles—Microsoft Xbox and Sony Playstation—are highly equipped for physically active gameplay with high-tech cameras, accessories (e.g., light-gun, dance pad, steering wheel), and Internet connections to compete against others online. Although the idea will likely provoke mixed opinions, video games may provide a more popular outlet for lifetime physical activity than more traditional sports and physical activities. This trend has already begun, as DDR tournaments are currently being held all over the world.

The popularity of video games is undeniable. For example, Sony, the video game market leader, increased its revenue from video games to $36 billion by 2002 (DFC Intelligence, 2005). According to the Entertainment Software Association (2006), the average video game player is 33 years old and has been playing games for 12 years. As interactive video games grow in popularity, gamers may adopt this new trend and burn calories in the process.

This article reviews five of the most popular and useful interactive video games and technological devices that can be used in physical education settings. Contact information of competing vendors, and web sites that include photographs and video clips of the equipment, can be found in table 1.

Dance Dance Revolution: Learning to Move to the Beat

Arguably the most popular interactive video game in physical education is Dance Dance Revolution ($300-$4,000). It was released in the United States in 2001, after an explosion of popularity in Japan in the late 1990s. Dance Dance Revolution requires a player to step on one of four arrows on a 3-foot by 3-foot pad based on visual cues from the screen, which results in the "dance." A Sony Playstation or Microsoft Xbox is connected to a television or LCD projector that shows eye-catching animation in the background and plays techno songs to which the player must dance. Numerous physical education programs across the country are including DDR in their curriculum to provide a fun means for students to engage in physical activity. The game has several challenge levels, requiring advancement in the following DDR skills that complement a quality physical education program (Wikipedia, 2006):

- Stamina—Hitting arrows in rapid succession for an extended period of time
- Rhythm—Staying on beat throughout the song
- Alternation—Alternating feet on each step, leading into more complex steps
- Spins—Following a circular pattern around the dance pad
- Crossovers—Hitting arrows on the opposite side of their original location on the dance pad
- Gallops—A set of 1/4 and 1/16 or 1/4 and 1/12 (or either note triplets) in rapid succession
- Triplets—One beat divided into three equal 1/12 notes

Photo courtesy of the authors

Dance Dance Revolution can accommodate multiple students.

• Jackhammers—Alternating on two steps that must be hit repeatedly in rapid succession

Due to its overwhelming popularity and comments from people who claim the game has helped them lose weight (Barker, 2005; Cable News Network, 2006; "Dance Dance Revolution," 2005) and even manage diabetes better (Twede, 2005), the media has taken an interest in DDR. It has been featured on Fox News, CNN, BBC News, Tech TV, *The Early Show* on CBS, and ABC News. Countless articles in newspapers and magazines have been written, including in *USA Today, New York Times Magazine, The Wall Street Journal,* and *Reader's Digest*. In one newspaper article in California, the physical education teacher noted "the kids love [DDR]. I wish we had more [dance pads]." A student in the class commented, "[DDR] is fun. It's what teenagers want" (Doyle, 2004). Halfway across the country in Illinois, some middle and high school programs offer DDR to students. According to the physical education teacher, they "have been able to reach the students that we weren't reaching with the other equipment. Our guys enjoy it as much as the girls do. It gets them exercising when they don't even realize they're doing it" (Kreimer, 2004). Another physical education program using DDR was televised on *The Early Show* on CBS. In an interview, the physical education teacher said, "[Students] just don't want to leave it alone. It's addicting" (Smith, 2002).

One teacher from Los Angeles said he lets students use DDR anytime they want during school hours, but charges 25 cents per song after school hours, which offsets maintenance costs for the machine. One of the vendors that sells DDR pads, Cobalt Flux, also sells a comprehensive lesson-plan guide book for third through 12th grade. Another good resource is a comprehensive series of video lessons demonstrating the use of DDR in physical education (lightbridge.sonoma.edu/lightbridge/lessons/publish/115/main/introduction.html). These videos show how to use DDR to teach rhythm and tempo and to arrange dance tournaments and dance choreography.

With these resources and a creative mind, a teacher could use DDR for a wide variety of lessons. The excitement of DDR makes it an easy sell to students of all grade levels. Realistically, however, DDR should not be introduced in early elementary (K-2) grades. Class management becomes overwhelming when teaching a full class of younger students how to play. The game is rated "E10+" (designed for everyone 10 years of age and older). The game has several difficulty levels for many different songs, so it provides successful opportunities for the low-skilled while still challenging the elite players.

Cybex Trazer: Performance Assessment

Although not as widely popular as DDR, the Cybex Trazer ($6,495) is a computer-based system that combines the training effectiveness of a flight simulator with the challenge of video games to create fun and functional fitness challenges, games, tests, drills, and rehabilitation programs. For example, the interactive animated device measures acceleration, reaction time, power, agility, static and dynamic balance, and vertical jump. In addition, if wearing a heart rate monitor, the player will receive live data such as heart rate and estimated caloric expenditure, as well as a final report on peak and average heart rate.

When using the Cybex Trazer, the player wears an infrared transmitter belt that allows them to become the animated character on the television screen. The player selects one of several video games, stands in front of the television, and then physically moves forward, backward, right, or left to play the game. Game play involves anything from lateral movements, to catching virtual balls falling from the sky, to avoiding virtual trap doors by jumping. Cybex Trazer has created software designed specifically for motor skill testing, exercise, and sport performance training. The software can

Photo courtesy of Cybex Trazer

Cybex Trazer puts students into a virtual-reality sport.

be modified to meet the needs, goals, and capabilities of any individual user regardless of age.

Although used in professional athletics, Cybex Trazer primarily markets their product to K-12 schools as well as to colleges and universities. The game is touted as a unique combination of fun and function. That is, it provides immediate biofeedback as it quantifies movement deficits, vertical leaping ability, reaction time, and power, while at the same time providing a fun way to interact in a virtual reality environment.

Like many of the physically challenging video games presented here, the Cybex Trazer can accommodate only one or two students at a time. Thus, it is not designed to replace effective teaching, only to supplement it. The Cybex Trazer could be used as an individual assessment tool, whereby students play the game one at a time either before school, after school, or during physical education class. They can determine their movement deficits (e.g., perhaps they slide laterally to the right slower than to the left) and measurements in other areas of motor development. Once these are determined, the teacher can help the student develop a physical activity plan to improve his or her weaker areas. Since students can play the game and be assessed almost any time, progress can be recorded over time and even reported to parents. Although expensive, the Cybex Trazer provides accurate quantitative measurements of motor abilities like few other devices can and obtaining these measurements simply requires students to play a video game.

Eyetoy: Hey, I'm on TV

In creating the Eyetoy ($30), Sony provided a means for one to four players to star in a video game instead of simply playing in a more vicarious manner. Released in 2003, the Eyetoy is a small USB camera that is placed on top of a television and connects to a Playstation. As the player stands in front of the television, the motion-sensitive camera transmits his or her image to the screen, placing the player in the middle of the action. The motion-tracking technology captures the player's movements, which are used to control steering, jumping, ducking, acceleration, punching, kicking, or whatever motor skill the game requires. As such, the player's arms, legs, head, and trunk become the operating controls for the game.

For example, a kung-fu game made by Sony requires the players to defend themselves by punching and kicking at enemies that come from all different angles. The camera allows players to see themselves in the television screen, striking the enemies in a virtual environment. At present, Sony manufactures about 14 games (including DDR) compatible with the Eyetoy, which is rated "E10+." Similar to DDR, the Eyetoy is usually most effective when used with third graders and up. Eyetoy games, much like all video games, have a wide range of levels from basic movements for lower-skilled students to complicated maneuvers that challenge more advanced players.

In November 2005, Sony released the Eyetoy Kinetic, which provides players with a personalized exercise program, as well as specific game activities in martial arts, meditation, and cardiovascular exercise. Sony teamed up with Nike Motionworks to provide this fun, immersive, and interactive device.

Both Eyetoy models can be used by up to four players, thus some pedagogical creativity will be required for implementation. Just as they do with any piece of equipment that is not designed for a class of 30, teachers could use the station approach or the rotation approach (taking turns using the Eyetoy during physical education time) described previously. Teachers could also allow students to use the equipment as a reward for anything from responsible social behavior to improved physical performance.

Cateye Gamebike: Bodies in Motion Replace Joysticks

Exercise machines with a video screen are nothing new. Many health clubs currently provide interactive rowing machines where you compete against a virtual opponent and stationary bicycles with screens showing your lap speed. The most recent and, possibly, most advanced form of virtual reality

Photo courtesy of Cateye Fitness

The split screen shows the progress of four students (two not shown), as they race their Cateye Gamebikes.

exercise machines is the Cateye Gamebike ($350-$2,300), which operates with a Playstation. The player uses a steering wheel to control turns, while pedaling to control speed. The player uses strategic maneuvers to beat a virtual opponent on the screen in whatever racing game is being played. These actions could enhance hand- and foot-eye coordination. A second bicycle can be hooked up for two-player action on a split-screen. The Cateye Gamebike is compatible with over 50 car, off-road, speedboat, and motorcycle racing games.

Cateye Gamebikes can be used in elementary, middle, and high school settings, and can be purchased in two sizes: small (for players up to 5' tall) and large (for players 5' to 6' 8" tall). Seat height and handlebar angle are adjustable on both models. Although the Gamebike is designed to physically accommodate players ages six and up, six-year-olds are often just learning how to ride a moving bicycle. Thus, the decision of when to implement the Gamebike should be based on whether or not it is (1) developmentally appropriate and (2) pedagogically feasible based on class size, physical stature of students, and previous bike-riding experience. With so many different types of compatible games and varying degrees of difficulty, both children and teenagers can be challenged and be successful. Using the Gamebike indoors, when it is too cold and snowy to ride outside, would be a fun way to keep students motivated, entertained, and engaged in physical activity.

Sportwall: Bringing the Walls of the Gym to Life

Sportwall ($6,000-$19,000) is one of the few interactive devices that can be used to teach children fundamental motor skills and still be challenging enough for high-performance sports training. Sportwall offers a product specifically designed for K-12 physical education called Smartball. Smartball is a 4-foot by 8-foot platform that can be mounted to a wall. It has a variety of games designed to enhance hand-eye coordination, visual-motor integration, agility, balance, bilateral coordination, concentration and listening skills, spatial awareness, flexibility, aiming, throwing, core strength, speed, and sport-specific skill training. In one competitive game, for example, students use a foam noodle to slap lights on the wall (the target) the instant they illuminate, repeating as many times as possible in 30 seconds. Whoever slaps the most lights (shown on the digital scoreboard) wins. In a more cooperative game, students have 60 seconds to chest-pass a basketball aiming for the lights when they illuminate. When time is up, the student quickly hands off the basketball to the next student who does the same. The wall tracks the group's score allowing them to strategize on how to improve next time. With Smartball, numerous motor skills can be refined while students have fun and experience a cardiovascular workout.

Each Smartball station accommodates up to six students. The most cost-effective package is to purchase four stations, which would accommodate 24 students, leaving very few to stand in line waiting for a turn. This package includes four Smartball stations as well as all upgrades, service support, and teacher training. The Smartball web site (see table 1) has a video feed with students engaged in various types of physical activity using Smartball, which physical educators could use in their class. Digital sounds, the scoreboard, and a time clock add to the excitement. Points can be earned for accuracy, speed, and team cooperation.

Photos courtesy of the authors

Students slap lights on the Smartball platform (above) and then run back to the starting line for their team (below).

Since Sportwall can be used for fitness enhancement, promoting teamwork, sport-specific training, and recreation, it is versatile enough to use at all grade levels. On their web site, Sportwall provides lesson plans that are aligned with the national standards for physical education in grades K-12 (National Association for Sport and Physical Education [NASPE], 2004).

Paying for the Equipment and Maintenance Costs

The equipment discussed in this article ranges from $30 to several thousand dollars. Obtaining money for the more expensive items can be difficult. Administrators at well-funded schools sometimes give money to physical education

departments to purchase equipment with the agreement that the physical education program must pay for the maintenance costs. Most physical educators, however, must find their own means of obtaining equipment.

The Carol M. White Physical Education Program (PEP) is a national grant competition that provides funds to local educational agencies to initiate, expand, and improve physical education programs. More information and an application can be found online (www.pepgrant.info).

Another funding source is Enhancing Education Through Technology (EETT), which provides funding from the No Child Left Behind Act of 2001 for school technology to improve student academic achievement. Through competitive grants, approximately $26 million were available for 2005-2006, with a projected $8 million for 2006-2007. In addition, districts may apply for formula grants, with a total of $31 million to be allocated. A good strategy with EETT is to focus heavily on the cognitive domain or to build a cross-disciplinary partnership that will target students' state and national academic test scores.

Using the Internet is also a great way to find grant opportunities. A NASPE web page (www.aahperd.org/naspe/grant_opp.html) summarizes several grant opportunities for professionals in the fields of physical education, recreation, and dance. Another useful web site is SchoolGrants (www.schoolgrants.org). After locating a grantor that matches the physical education program's goals, the next two steps in obtaining the external funding are (1) learning the eligibility requirements and application procedures, and (2) writing and submitting the grant proposal (Johnson and Schilling, 2001).

Typing "education grants" or a similar key phrase into an internet search engine such as Google will provide a wealth of information. For example, Best Buy supports "Te@ch Program", which rewards schools using interactive technology to make learning fun for kids. From 2003 to 2005, more than 2,000 schools were awarded nearly $6 million through this program.

Wal-Mart is another national store that provides grant money to local, state, and national teachers of the year. Grants range from $1,000 to $36,000. Wal-Mart and its affiliated store, Sam's Club, awarded $4.9 million in 2006, which was the program's 11th year.

In addition to grants, physical educators can contact companies, vendors, or national retailers that sell the type of equipment they are looking for and ask for a donation. Several telephone calls might be necessary to be successful. Mentioning how a donation could benefit the company (brand name on product will be seen by students, media will be at a grand-opening with new equipment, etc.) may improve the chances that they will make a donation. Companies looking to get their business off the ground might be willing to donate their product in exchange for some exposure.

Another strategy that has proven successful for some physical educators who live near a university is to collaborate with the faculty in the physical education or kinesiology department on a research project. For example, a physical education professor may want to conduct a study on children's heart-rate response while playing DDR, but may not have any subjects. A physical educator willing to collaborate in the research project and allow students to serve as subjects in the study may get to use the equipment free of charge.

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If these strategies seem cumbersome or unrealistic, other approaches include organizing a private fundraising event, requesting assistance from the PTA, or soliciting donations from university alumni, prominent community citizens, and/or sporting-goods manufacturers.

Implementing the Technology

Introducing such technology requires extensive research and planning. Once a technology has been considered useful and has been acquired and integrated into the curriculum, a teacher must consider the best way to implement it within the class routine. Given the expense of some of these technologies and the typically limited physical education budget, a common approach is to purchase one or a few of the technology items. However, there are still ways to make effective use of the technology while keeping the entire class actively engaged.

Teachers can use a host of strategies when implementing technology into their curriculum. A common strategy is to have as many students as possible actively engaged with the technology, with additional students following along in simulation exercises. An example of this is to have a few students using the fully functional electronic dance pads with DDR, engaged with the software, while the rest of the class is practicing to the same music and images displayed on a large screen, using identically marked rubber pads (Trout & Zamora, 2005). This routine is an effective component of a quality physical education lesson. First, students on the electronic dance pads have the opportunity to fully engage with the game interface, challenging themselves and receiving instant feedback on their performance. At the same time, the rest of the class is also involved, meeting the goal of moderate-to-vigorous physical activity throughout as much of the class time as possible. In addition, this helps to minimize management problems. Every few minutes, students can rotate so that all have the opportunity to challenge themselves with the electronic dance pads and

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game interface. As a result of this "rotate in, rotate out" system, all students are able to practice the skills of DDR, working toward mastering the game and improving their overall coordination and rhythm.

If a teacher has only two Cateye Gamebikes, the best way to implement them would be to use them either in stations, rotating students on and off the equipment, or as a reward for good behavior or achievement. Similar implementation strategies would apply to the Eyetoy, Trazer, Sportwall, and other technologies that may emerge.

Bicycles are unique, however, in that students could bring in their own bicycle, place it on a device called a roller, which slightly lifts and stabilizes the rear tire, turning it into a stationary bicycle. Perhaps the school could provide bicycles to those students who do not have one. With two students on the Gamebike and the other students following along on stationary bicycles, a full class could participate. Students could take turns rotating on and off the Gamebike after each race is over.

If any of the games become a distraction to the students who are not using them, teachers could reduce the volume of the game, put up a divider in the gymnasium, or allow the game to be used only before or after school or at recess. If all else fails, teachers could abandon the station approach and resort to using the game only when the entire class can participate.

Conclusion

As technology advances and computers become faster and more affordable, interactive video games will likely become more realistic and more accessible. In this day and age, people can get physically active by becoming the character in a game that requires them to dance, fight, meditate, race a speedboat, or save the world.

Many of the games described in this article provide engaging learning and movement opportunities. In addition, some of these games do not have the inappropriate level of competition present in many traditional physical education activities. Instead, students are often competing against themselves to continually improve and are therefore less concerned about "letting their team down." This feature could be appealing to coaches, adapted physical educators, personal trainers, and private instructors who work one-on-one with people and are looking for individualized training methods that may be unique and creative.

Some people may believe that interactive video games are little more than the latest "trick" to keep students entertained. Others, however, argue that the world of interactive video games has exploded in the United States and that anything that helps children become less sedentary is worth exploring. Physical educators are in the business of promoting lifetime physical activity and, so far, interactive video games appear to be an effective tool in that quest.

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