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The Practical and Theoretical Implications of Flow Theory and Intrinsic Motivation in Designing and Implementing Exergaming in the School Environment

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Abstract

Helping children develop a positive attitude toward being active for life is a primary objective for physical educators. The cultivation of an internal desire to participate in physical activity occurs over a prolonged period of time through a variety of positive experiences in school, at home, and in the community. Like any well thought out physical education unit, a meaningful exergaming (also known as active gaming) program must balance the needs of the students with the prescribed learning expectations. This paper is intended to bridge the theoretical aspects of intrinsic motivation and flow theory with the pragmatics of teaching active gaming programs in a school setting. The authors have established the Canadian Exergaming Research Centre (http://www.ucalgary.ca/exergaming/) in order to explore the impact of exergames in a school environment.

Author Keywords

Exergaming; motivation; flow; exercise; play

Introduction

Exergames, active games or interactive fitness activities are video games with interfaces that require active involvement and the exertion of physical force by participants (Hansen & Sanders, 2008). This unique concept attempts to link exercise and fun by providing stimulating opportunities for video game players to become more physically active. Traditional video games have long been viewed as undermining the advocacy for increased physical activity in children. However, there has been a realization that it is possible to use student enthusiasm for video games and the introduction of exergames as part of a solution to the crisis of inactivity. The trend toward these active video games has provided an alternative to traditional sedentary video gaming, making it an appealing supplement for promoting a healthy, active lifestyle (Graf, Pratt, Hester & Short, 2009).

Research and Literature Related to the Exergaming Phenomenon

Baranowski (2008) and colleagues reviewed 27 articles that examined 25 video games that promoted health-related behavior change. Most of the reviewed articles demonstrated benefits

from playing the video games. A study of college students in San Bernardino, California used virtual biking, boxing, and striking games to conclude that the caloric expenditure of exergaming was sufficient to be used as part of an overall aerobic exercise program (Siegel, Haddock, Dubois, & Wilkin, 2009). A study involving 20 children ages 10-14 indicated that playing active video games on a regular basis may have had some positive effects on children's overall physical activity levels (Ni Mhurchu et al, 2008). Additional research analyzed 25 children ages 8-12 while they were participating in activity-promoting video games and determined that the exergamers expended more than twice the energy compared to the sedentary control group (Lanningham-Foster et al, 2006). Evidence suggested that playing video games using whole-body movement required a greater exertion of energy than sedentary computer games (Graves, Stratton, Ridgers, & Cable, 2008; Lanningham-Foster et al. 2006; Mellecker and McManus 2008). Multiple authors have shown that moderate to vigorous physical activity levels have been achieved through certain types of active gaming, particularly with the use of *Dance Dance Revolution (DDR)* (Yang & Graham, 2006; Maddison et al, 2007).

Research into the use of exergaming in schools has shown similar positive effects (Staiano & Calvert, 2011). Unnithan, Houser and Fernhall (2006) used DDR with school children ages 11-17, and found that the students achieved an aerobic workout sufficient to enhance cardio-respiratory fitness levels. Research in the West Virginia Public School system found that daily participation in DDR resulted in significant weight loss in children (Barker, 2005). Additional studies in that state have found that children ages 7-12 developed greater self confidence and felt more coordinated after playing DDR (Brubaker, 2006). The success found in this research prompted a state-wide initiative to include the use of DDR in every public school in West Virginia. Additional advancements in the use of exergaming technology in the school system should balance the needs of the learner with the relevant curricular expectations. Researchers are beginning to study the factors that inspire and motivate children to participate willingly and sustainably in exergaming activities that promote fitness (Staiano & Calvert, 2011).

The Intrinsic Motivation of Exergaming

Physical literacy describes the "motivation, confidence, physical competence, knowledge, and understanding that individuals develop in order to maintain physical activity at an appropriate level throughout their life" (Whitehead, 2010, p. 11). A major component of physical literacy is the motivation to be active. Establishing and sustaining physical literacy is largely dependent upon experiences that occur with respect to an individual's involvement in physical activity, particularly at a young age which can have a substantial impact on attitude, ability and participation. Whitehead (2010) stated that motivation essentially arises from the confidence and self-esteem acquired through positive experience; that is, experience that has been perceived as successful and has been recognized as such. She also suggested that the ideal scenario is one in which the child's natural motivation to explore and experiment with ways of interacting with the environment is never lost. In its simplest form, the desire to achieve physical literacy is expressed as: Motivation = Perceived Confidence + Relative Success.

Since not all children are attracted to sports and leisure in the same way, innovative methods should be considered to provide positive experiences for every child. According to Ntoumanis

(2001) children who enjoyed physical education were more likely to acquire fundamental movement skills (the building blocks for more complex physical tasks) and accomplish a degree of physical proficiency than those who did not. When individuals demonstrate competence in physical activity they tend to be successful in other physical endeavors which is a key element in motivating children to pursue physical literacy and wellness (Ntoumanis, 2001; Sallis, Prochaska, & Taylor, 2000). A child's attitude toward physical activity is undoubtedly influenced by success or failure in physical education (Graham, Holt, & Hale, 2007).

Exergaming and interactive fitness activities could provide the stimulus for engagement to those students who have started to lose interest in more traditional forms of physical activity and re-engage them towards lifelong physical activity (Widman, McDonald & Abresch, 2006).

Motivating children to participate in exercise depends on a variety of factors. Exergaming has the following characteristics related to motivation (Hansen & Sanders, 2008):

(1) Fun – Children do not even realize they are exercising. Children may be sweating but they are smiling and seem to enjoy the games;

(2) Challenging – These activities offer a variety of self-motivating levels that children are able to progress through at their own pace;

(3) Motivating – When children walk into a room full of active gaming activities, many of them become immersed in the atmosphere which is full of action, flashing lights, and lively noise. Researchers are not sure why flashing lights and pulsating noise draw in participants, but it does have an arousing and stimulating effect (Wolfson and Case 2000);

(4) Developmentally Appropriate – Active gaming activities are designed to meet the needs for all ability levels. Success is essential for children to want to continue to be physically active;

(5) Individualized – Active gaming can provide a non-competitive environment without necessarily focusing on team sports. Children can create the competition level desired, at their own discretion;

(6) Contemporary – Children are living in a technology driven society that has ultimately changed every facet of the way we live from the way we think, work, and even the way we exercise.

The graduated levels of today's exergaming allow children to progress at a pace that is individualized to their physiological and psychological readiness. The excitement of advancing to a higher and more difficult level can be a powerful motivational tool. In the virtual world of active gaming users can work in a safe, yet exciting virtual environment. Beck and Wade (2006) stated that the attraction to the gaming world was due to the simplicity of the games, the customized reward system, and the highly stimulating entertainment experience that allowed players to escape from boredom. Since 86% of children reported that fun was the most important

part of physical activity while growing up (Lindstrom & Seybold, 2003), activities that do not include a healthy degree of excitement are quickly left behind. If the high "fun factor" was what attracted children to try new games, exergames such as DDR, Wii Fit*, XR* Board and Lightspace could be used to encourage physical activity.

Vansteenkiste, Lens, and Deci (2006) described intrinsic motivation as the pure enjoyment and unconditional interest in participating in an activity without any external pressure. In order for somebody to be described as physically literate, their motivation to capitalize on their personal physical activity potential must be internalized and realized. Ryan, Frederick, Lepes, Rubio, and Sheldon (1997) reported that a willingness to partake in physical activity simply for internal rewards was related to a higher likelihood of exercise adherence. Children who enjoy being involved in activity for the simple satisfaction of playing are considered to be intrinsically motivated. Children who are motivated by external rewards (pleasing others, winning the game, avoiding punishment, being first, etc.) may not develop a positive attitude toward physical activity and may tend to put forth the least amount of effort necessary to receive the greatest reward (Lepper, 1988).

Hinson (2001) identified five essential components that intrinsically motivate children to participate in physical activity: control, challenge, curiosity, creativity, and constant feedback. Without an inherent desire to participate in physical activity, some children will continue to slip through the cracks toward a lifetime of obesity related health issues. A physical education program that can inspire children to take responsibility for their health by being physically active has the potential to change behaviour patterns. Today's youth may be motivated to partake in fitness activities that are interactive, technologically driven, and ultimately more rewarding than traditional physical education models (Cappella, 2000; Prensky, 2001; Prensky, 2003). For example, Paw, Jacobs, Vaessen, Titze, and van Mechelen (2008) found that pre-adolescent elementary students (aged 9-12) enjoyed active gaming in groups (or multi-player) over individual play.

It would appear that Hinson's (2001) components of intrinsic motivation can be identified in active video games in five ways.

Control is evident in the individualized manner in which children participate in the game. They are free to pause, restart, and end a game at will. There is control in the selection of the game, its level, and when they want to play. This independence has a strong influence on younger children as it provides them an opportunity to make their own choices.

Challenge is an essential element of any successful video game. Progressive levels of increased difficulty provide the user with periodic accomplishment and setback. The ability for children to accept defeat and persevere when gaming is a strong life lesson like one learned while playing sports. The capacity to cope with these challenges and eventually succeed is evident when children are actively playing for prolonged periods of time.

Curiosity and ambiguity about what the next activity is helps keep children engaged and motivated. Many exergames are designed for children to achieve objectives in a number of

different ways. Children will often search for a faster or more efficient way to progress through the levels. Hidden clues cultivate curiosity for the player.

Creativity is related to curiosity in that how children choose to play the game can often be an expression of their personality. The virtual environment of age-appropriate exergaming provides children with the ability to take risk-free chances and think 'outside the box'. Experimentation and problem solving are the foundation of any elementary school experience and can be achieved while being active during exergaming.

Constant feedback is evident throughout most exergaming experiences. Players are often bombarded with details about their progress, the details of which only the most serious players can absorb. Yet, children thrive on this personalized information and can adjust their strategy to improve their results. Knowing how they are doing at all times will inevitably help keep children engaged and focused.

A sixth intrinsically motivating component of exergaming could be added to the list. *Competition* is an underlying premise of most games whether on a playground, the ice rink or in front of a monitor. The founder of flow theory reported that competition was one of the basic components of intrinsically motivated activities (Csikszentmihalyi, 1978). The distinctive ability of exergames to individualize competitive experiences for each player may be creating a new paradigm of competition. When children have the ability to choose their level of opposition, the competitive environment can be both gratifying and demanding. This kind of differentiated learning event could result in a positive and rewarding competitive physical activity experience. Exergaming has the potential to provide a unique opportunity for those children who may not be competitive, to enjoy a spirited yet fair test of their physical potential. Ultimately, these students could develop fundamental movement skills and become confident enough in their abilities to pursue physical activity outside a virtual environment (Sheehan & Katz, 2010).

While competition in games and exergames increased intrinsic motivation for highly competitive individuals, studies have shown it is a motivational detriment on subjects who were not competitively inclined Song, Kim, Tenzek, & Lee, 2009; Deci, Betley, Kahle, Abrams, & Porac, 1981; Tripathi 1992; Vallerand & Losier, 1999). Therefore, designers of games for which the outcome is enhanced physical activity must use caution when creating an environment that is overly competitive. The target audience of those most needing physical activity may be left behind if the games focus solely on beating others or the game.

Understanding How Flow Theory Relates to the Design of Exergames

Physically literate individuals maintain a positive attitude towards physical activity throughout their life course and are involved in a range of different and appropriate forms of physical activity as they mature and approach old age (Whitehead, 2010). The development of an internal state of arousal about physical activity that directs and sustains human behavior is a challenging task for any physical educator. Flow is the achievement of an optimal state of intrinsic motivation and the willingness to participate in physical activity for its own sake, with little regard for any external reward (Csikszentmihalyi, 1990). The state of flow (flow zone) occurs

when participants are completely engrossed in their activity and discover an internal feeling of accomplishment and enjoyment. When children are engaged in a flow experience, there is equilibrium between their ability and the challenge (Figure 1).

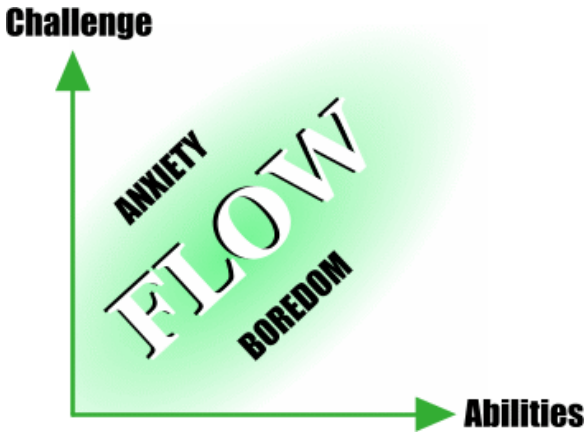


Figure 1: Challenge versus abilities
(adapted from Csikszentmihalyi, 1990)

The balance that exists during flow is the first of Csikszentmihalyi's (1975) eight elements described below:

(1) *Balance between the difficulty of an activity and an individual's proficiency.* Is there an achievable perceived challenge?

(2) *Apparent goals.* Is there a clear objective that distinguishes pertinent from immaterial information?

(3) *Immediate feedback***.** Is there personalized feedback being received in a timely manner?

(4) *The harmony of action and awareness***.** Is there awareness of what's happening without thinking about the need for this awareness?

(5) *Focused concentration.* Is the person able to concentrate on a limited stimulus field?

(6) *Decreased self- consciousness.* Is there awareness of internal processes and less emphasis on one's self image (while maintaining a sense of their physical reality)?

(7) *Perception of Control*. Is the person capable of adequately achieving the prescribed task and less concerned about perfection?

(8) *Decreased awareness of time***.** Is there a feeling that the importance of time is diminished (losing track of time)?

Exergaming systems such as Wii Fit, iDance, XR Board and Lightspace incorporate the eight components of flow. For example, there is no external reward for participating in these games. Each system has a creative way to provide relevant feedback and uses varying levels of difficulty. If the objectives of the game are clear and understandable then the players are completely in control of their results. When the optimal balance between challenge and ability is achieved in these activities, many players will enter into the flow zone (a.k.a. "the zone") and begin to lose track of time and care less about those around them and more about being immersed in the activity. This is why advancements in exergaming hold such promise in the field of physical literacy.

Not all players start at or advance at the same pace when exergaming. Like any physical activity, different students have certain strengths and weaknesses. Children should be provided opportunities to choose the level of difficulty with which they feel comfortable and encouraged to push themselves to more difficult challenges when ready. Children who frequently experience failure or frustration with tasks that are too difficult are not likely to want to pursue the activity and may learn to avoid them (Rogers & Sawyers, 1988). In order to differentiate the experience for every individual, active gaming systems should be designed to be as customizable as possible. The test is to create an experience that does not overwhelm the user with choices yet still provide enough flexibility to make the game fun and motivating. For example, Sweetser and Wyeth (2005) showed that the length of time that children remained engaged in gaming depended on the duration of their flow experience and whether they reached the flow zone. Some games are designed to adjust themselves during play in order to balance the challenge with the user's ability, which can extend flow almost indefinitely (Holt, 2000).

To provide an enjoyable interactive experience for the widest variety and number of users, exergaming design should follow a four-step methodology: (1) Mix and match the components of flow; (2) Keep the user's experience within the user's flow zone; (3) Offer adaptive choices, allowing different users to enjoy the flow in their own way; and (4) Embed choices inside the core activities to ensure the flow is never interrupted (Chen, 2007).

Connecting Flow to Physical Activity and Play

The instinctual desire for children to have fun by playing is an important aspect of flow theory and relates well to the objectives of physical education. Given that children do not usually need to be encouraged to play, it is generally considered intrinsically motivating. The emergence of exergaming has broadened the definition of traditional play to include technologies that simply did not exist a decade ago. Some may doubt the effectiveness of technology in fostering cognitive play experiences in children, but researchers are beginning to understand how new forms of play using computer software can provide children with beneficial play opportunities (Johnson, Christie & Wardle 2005). Hansen (2010) described a child's persistence to play games (P2G) as an intentional choice to participate in physical activity that was facilitated by technology. Much like other play experiences, P2G flow existed when players were happy to participate and voluntarily remained engaged in the zone for any period of time. Research has shown that students who were intrinsically motivated to perform tasks experienced this flow regardless of the activity (Glynn, Aultman & Owens, 2005).

Regrettably, the notion of play is often minimized and regarded as "simply fun" rather than as a learning tool (Elkind, 2007). However, Rogers and Sawyers (1988) stated that play is perhaps the only human behavior that integrates and balances all aspects of human functioning as it is a necessary component for all of us to develop our full potential. This is supported by Whitehead's (2010) theory of an individual being a holistic embodied being. Play reinforces cognitive development with respect to representational competence, operational thought, and problem solving, yet it also serves as a context and vehicle for the expression and consolidation of development, providing opportunities for new learning (Johnson, Christie & Wardle 2005). It has been reported that free and unstructured play was not only healthy, but also essential to help children reach important social, emotional, and cognitive developmental milestones in addition to helping them manage stress and become more resilient (Ginsburg, 2007). Play keeps children's minds actively involved in interacting with the environment. Results have shown that optimal brain development occurred when children interacted with the environment and the environment was responsive to that interaction (Johnson, Christie & Wardle, 2005). Ratey (2008) described the powerful impact that play has on brain development. Play experiences mediate brain development first by helping with the creation of the large number of synapses that are formed in the first three years and then by helping with the formation of the more complex neuronal structures that are created over the childhood years (Elkind, 2007; Ratey, 2008). Play is a vital component of child development and some academics support the notion that play is how children discover and acquire life skills (Koster, 2005).

Implementing Exergaming in a School Setting

The theoretical implications of incorporating the concepts of flow theory and intrinsic motivation into the development of an exergaming program in a school are not always the same as the practical implications. Best practice in teaching is often the result of research-based learning theory that is adapted to meet the needs of an individual school culture. Designing and implementing an exergaming experience that is motivating and sustainable is feasible in most schools with careful planning and a creative will. Like any effective physical activity, balance must be achieved between the need for structure and the freedom of choice for students. The following model highlights key aspects from each category to consider when creating an all-encompassing exergaming experience that encourages flow (Figure 2).

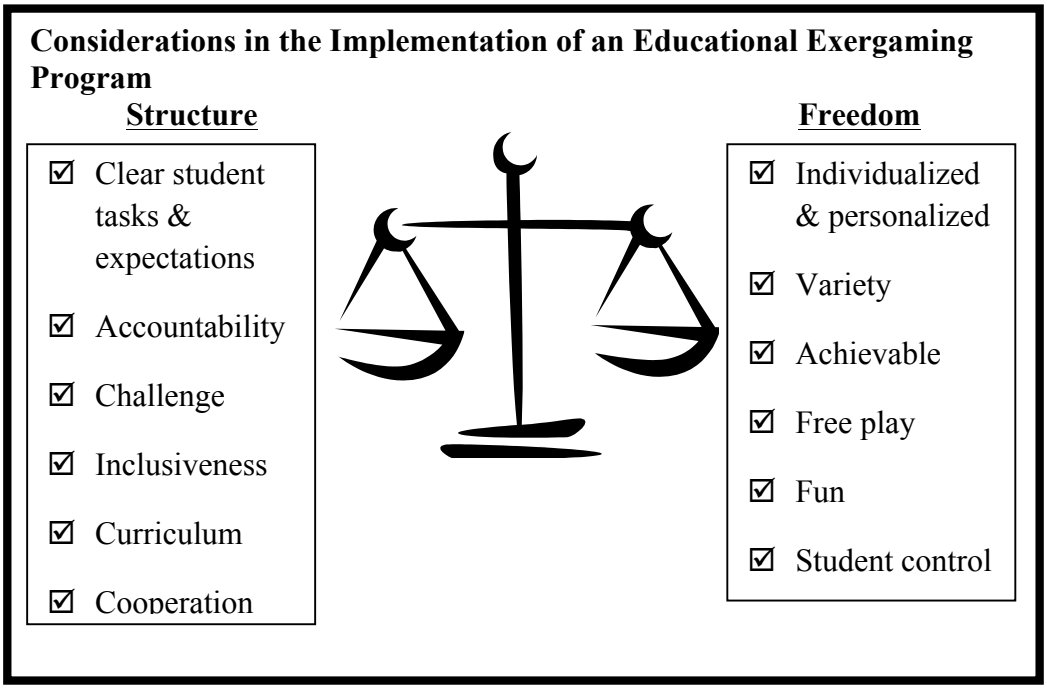


Figure 2: Exergaming and flow

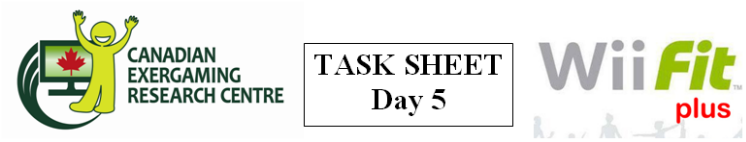
Creating an active gaming environment that promotes opportunities for student engagement and quality learning cultivates the potential for achieving flow. The intentional design of educationally appropriate video games that require the use of the whole body to play already affords students the personalized experience needed to find balance between the level of difficulty and their skill level. Once that agreement exists, other aspects associated with intrinsic motivation and flow can be attended to (achievable goals, perception of control, prompt feedback, focused concentration, etc.). Providing a variety of experiences with minimal wait times is another important consideration. Students quickly lose interest if they are repeating the same activity or have to wait long periods of time while others participate. Other components for success of the practical implementation of an exergaming program in a school environment are as follows:

Fun – Above all else, the experience must be enjoyable. Curriculum outcomes can be achieved by using active gaming technology that is entertaining and exciting. Exergames use a variety of multi-media strategies to engage and motivate students and excitement is a necessary component for a well designed exergaming program.

Structure – Well run physical education experiences depend heavily on organization and order. Control of students in a gym, on a field, or in an exergaming area is a learned skill that is practiced daily by educators. Establishing routines that require very little discussion minimize transitions and maximize activity time for children.

Curriculum - An educational exergaming experience requires that there be an alignment with objectives and standards associated with a curricular area. Learning outcomes related to health, physical education, math, technology, and science can all be linked to activities that occur during an active gaming class. Informing other teachers about the type of data and relevant content learned in class will help make cross-curricular experiences possible.

Tasks and Expectations – Children appreciate the opportunity to explore and experiment within the gaming world, but teachers expect that student learning is part of the exergaming experience. A compromise that works well is to use daily task cards that are provided to students at the start of class and include a detailed list of expectations. The task cards must be carefully designed to allow the students to achieve the teacher's intended outcomes and still allow time for the children to return to their activity or explore the system further. A supplemental workbook that includes basic expectations and recording sheets ensures that players are accountable for completing the expected tasks. Task sheets can easily be taped on to each exergaming station which allows for quick and easy changes to meet the needs of different classes. Figure 3 is an example of a task sheet and a recording form used in a grade 3 and 4 exergaming program developed at the Canadian Exergaming Research Centre (http://www.ucalgary.ca/exergaming). Other challenges and games can be incorporated into an exergaming program (such as bingo or scavenger hunt) where a student reaches an established goal by completing a particular number of tasks. Clear expectations of student conduct in a classroom filled with technology helps ensure that children are safe and that the equipment will not prematurely expire. A list of rules should be highly visible and reinforced constantly. These rules were developed after two years of working with students in the Canadian Exergaming Research Centre.



1. Complete **one** new *training plus* activity of your choice
2. Complete **all remaining** basic *yoga* activities
3. Complete **one** new basic *strength* activity of your choice
4. Complete **one** new *aerobic* activity of your choice
5. Complete **one** new *balance game* activity of your choice
6. Complete a **body test** (from calendar page)

When done, explore and record any activities of your choice

Figure 3. Elementary school task sheet for an exergaming program

XR Board 2000 **&** **LightSpace (Wall)**

Recording Sheet

Snowboard Course	*Time*		LightSpace Game	*Level/Round*	*Result*	*Result*

Figure 3b: Recording portion of task sheet

Free Play – The idea of free time seems appealing to students but often results in a limited overall experience. Even minimal expectations help students with their initial focus and set the tone for the remainder of the class. This is particularly true of an elementary school environment.

Inclusiveness – Most active gaming systems permit flexibility and choice that allow a teacher to cater a learning experience to the individual needs of each child. Dance systems provide multiple levels of play using the same music so children of varying abilities can all be dancing together. Wii Fit provides games that are simple enough for toddlers to play. The one limitation that most games have is that the user must be able to read. However, creative use of graphics and audio cues can sometimes make even reading unnecessary or compensate for times when the user moves his/her eyes from the screen. Some companies have thoughtfully created alternative peripherals to allow for children with disabilities to participate. For example, lap or tabletop platforms have been designed to permit students without the use of their legs to participate in rhythmic activity; or children participating in certain striking games can participate in a wheelchair by quickly rolling and/or striking with an extended implement rather than their hands (Yang & Foley, 2011). Additionally, some use audio tones and visual cues that could allow someone with a visual or hearing impairment to join in the fun.

Cooperation and Competition – Students can be very cooperative within an exergaming centre. Encouraging comments and interest in how others are doing can be encouraged. Friendly competition with an intramural event is a great way to build class spirit and encourage improvement. There are now organized exergaming tournaments that are becoming more and more popular with community recreation leaders. When a data-recording sheet is used, students

tend to be more concerned with improving their own score over time than how they compare with others.

Freedom – Providing students with the ability to make choices in an active setting like physical education encourages risk-taking and improvement. When children are able to determine the appropriate level of challenge, their interest and engagement remain high.

Conclusion

Given the popularity of video games with young people, it is likely that momentum will continue to build to support the concept of blending technology and physical activity. The more opportunities provided for children to play in the zone, the greater the likelihood that they will develop a positive attitude about physical activity and develop the confidence and desire to be active for life. Successful implementation of exergaming strategies in any school must consider the cultural context in which the children are situated. Sensitivity regarding the interactions between students and the competency of skills, customs, and practices valued by the culture will encourage a richer learning environment (Scrimsher & Tudge, 2003). Exergaming is a fun, social, and inclusive way for children to be active and holds promise as a tool for the development of physical literacy (Sheehan & Katz, 2010). Properly integrated in a school environment, exergaming can be used to encourage physical activity as a life long pursuit.

References

Baranowski, T., Buday, R., Thompson, D.I., and Baranowski, J. (2008). Playing for real: Video games and stories for health-related behavior change. *American Journal of Preventive Medicine,* 34 (1), 74-82.e10.

Barker, A. (2005). Kids in study try to dance away weight. *Associated Press*.

Beck, J., and Wade, M. (2006). *The kids are alright: How the gamer generation is changing the workplace*. Boston: Harvard Business School Press.

Brubaker, B. (2006). Teachers join the dance dance revolution: Educators begin training to use the exercise video game. *The Dominion Post*, B2.

Cappella, E. (2000). What children think about computers. *The Future of Children,* 10 (2), 189-191.

Chen, J. (2007). Flow in games (and everything else). *Communications of the ACM,* 50 (4), 31-34.

Chin A Paw, Marijke J. M. , Wietske M. Jacobs, Ellen P. G. Vaessen, Sylvia Titze, and Willem van Mechelen. (2008). The motivation of children to play an active video game. *Journal of Science and Medicine in Sport,* 11 (2), 163-166.

Csikszentmihalyi, M. 1975. Play and intrinsic rewards. *Journal of Humanistic Phsychology,* 15 (3), 41-63.

Csikszentmihalyi, M. (1990). *Flow: The psychology of optimal experience*. New York: Harper and Row.

Deci, E. L., Betley, G., Kahle, J., Abrams, L. and Porac, J. (1981). When trying to win, *Personality and Social Psychology Bulletin* 7 (1), 79-83.

Elkind, D. (2007). *The power of play*. Cambridge, MA: Da Capo Press.

Ginsburg, K. R. (2007). The Importance of Play in Promoting Healthy Child Development and Maintaining Strong Parent-Child Bonds. *Pediatrics,* 119 (1), 182-191.

Glynn, S. M., Lori Price Aultman, and Ashley M. Owens, A.M. (2005). Motivation to learn in general education programs. *The Journal of General Education,* 54(2), 150-70.

Graf, D. L., Pratt, L.V., Hester, C.N. and Kevin R. Short, K.R. (2009) Playing Active Video Games Increases Energy Expenditure in Children. *Pediatrics,* 124 (2), 534-540.

Graham, G., S.A. Holt, S.A. and M.P. Hale, M.O. (2007). *Children moving*. New York, McGraw-Hill.

Graves, L., Stratton, G., Ridgers, N.D., and Cable, N.T. (2008). Energy expenditure in adolescents playing new generation computer games. *British Journal of Sports Medicine,* 42(7), 592-594.

Hansen, L. (2010). Examining active gaming theories and practices among 3rd - 5th Graders. In *Games for Health*, edited by B. Sawyer. Boston, MA.

Hansen, L., and Sanders, S.. (2008). Interactive gaming: Changing the face of fitness. *Florida Alliance for Health, Physical Education, Recreation, Dance and Sport Journal,* 46(1), 38-41.

Hinson, C. (2001). *Games kids should play at recess*. 2nd ed. Wilmington, DE, Physical Education Resources, Co.

Holt, R. (2000). Examining video game immersion as a flow state. Undergraduate Honors, Department of Psychology, Brock University, St. Catherines, ON.

Johnson, J.E., Christie, J.F. and Wardle, F. (2005). *Play, development and early education*. New York, Allyn & Bacon.

Koster, R. (2005). *A theory of fun for game design*. Scottsdale, AZ: Paraglyph.

Lanningham-Foster, L., Jensen, T.B., Foster, R.C. Redmond, A.B., Walker, B.A. Heinz, D., and Levine, J.A. (2006). Energy expenditure of sedentary screen time compared with active screen time for children. *Pediatrics,* 118(6), 1831-1835.

Lepper, M. R. (1988). Motivational considerations in the study of instruction. *Cognition and Instruction,* 5(4), 289-309.

Lindstrom, M., and Seybold, P. eds. (2003). *Brand child: Remarkable insights into the minds of today's global kids and their relationships with brands*. Revised ed. Great Britain: Kogan Page Publishers.

Maddison, R., Ni Mhurchu, C.N., Jull, A., Jiang, Y., Prapavessis, J.H. and Rodgers, A. (2007). Energy expended playing video console games: An opportunity to increase children's physical activity? *Pediatric Exercise Science,* 19(3), 334-343.

Marshall, S. J., Gorely, T. and Biddle, S.J.H. (2006). A descriptive epidemiology of screen-based media use in youth: A review and critique. *Journal of Adolescence,* 29(3), 333-349.

Mellecker, R. R., and McManus, A.M. (2008). Energy expenditure and cardiovascular responses to seated and active gaming in children. *Archives of Pediatric Adolescent Medicine,* 162(9), 886-891.

Ni Mhurchu, C., Maddison, R. Jiang, Y., Jull, A. Prapavessis, H. and Rodgers, A. (2008). Couch potatoes to jumping beans: A pilot study of the effect of active video games on physical activity in children. *International Journal of Behavioral Nutrition and Physical Activity,* 5(1), 8.

Ntoumanis, N. (2001). A self-determination approach to the understanding of motivation in physical education. *British Journal of Educational Psychology,* 71(2), 225.

Prensky, M. (2001). Digital natives digital immigrants. *On the Horizon,* 9(5).

Prensky, M. (2003). Digital game-based learning. *Computer Entertainment,* 1(1), 21-21.

Ratey, J. (2008). *Spark: The Revolutionary New Science of Exercise and the Brain*. New York, Little, Brown and Company.

Rogers, S., and Sawyers, J.K. (1988). *Play: In the lives of children*. Washington, DC, National Association for the Education of Young Children.

Ryan, R.M., Frederick, C.M., Lepes, D., Rubio, N. and Sheldon, K.M. (1997). Intrinsic motivation and exercise adherence. *International Journal of Sport Psychology* 28, 335-354.

Sallis, J. F., Prochaska, J.J. and Taylor, W.C. (2000). A review of correlates of physical activity of children and adolescents. *Medicine and Science in Sports and Exercise,* 32(5), 963-75.

Scrimsher, S., and Tudge, J. (2003). The teaching/learning relationship in the first years of school: Some revolutionary implications of Vygotskya's theory. *Early Education & Development,* 14(3), 293 - 312.

Sheehan, D., and Katz, L.. (2010). Using interactive fitness and exergames to develop physical literacy. *Physical and Health Education,* 76(1), 12-19.

Siegel, S. R., Haddock, B.L., Dubois, A.M. and Wilkin, L.D. (2009). Active video/arcade games (Exergaming) and energy expenditure in college students. *International Journal of Exercise Science,* 2(3), 165-174.

Song, H., Kim, J., Tenzek, K.E. and Lee, K.M. (2009). The effects of competition on intrinsic motivation in exergames and the conditional indirect effects of presence. Paper read at *12th Annual International Workshop on Presence*, at Los Angeles, CA.

Staiano, A. E. and Calvert, S. L. (2011). Exergames for physical education courses: Physical, social, and cognitive benefits. *Child Development Perspectives*, 5, 93–98.

Sweetser, P., and Wyeth, P. (2005). GameFlow: a model for evaluating player enjoyment in games. *Computer Entertainment,* 3 (3), 3-3.

Tripathi, K. N. (1992). Competition and intrinsic motivation. *Journal of Social Psychology,* 132(6), 709.

Unnithan, V. B., Houser, W. and Fernhall, B. (2006). Evaluation of the energy cost of playing a dance simulation video game in overweight and non-overweight children and adolescents. *International Journal of Sports Medicine,* 27(10), 804-809.

Vallerand, R. J., and Losier, G.F. (1999). An integrative analysis of intrinsic and extrinsic motivation in sport. *Journal of Applied Sport Psychology,* 11(1), 142 - 169.

Vansteenkiste, M., Lens, W. and Deci, E.L. (2006). Intrinsic versus extrinsic goal contents in self-determination theory: Another look at the quality of academic motivation. *Educational Psychologist,* 41(1), 19 - 31.

Whitehead, M., ed. (2010). *Physical literacy: Through the lifecourse*. New York: Routledge.

Widman, L.M., McDonald, C.M. and Abresch, R.T. (2006). Effectiveness of an upper extremity exercise device integrated with computer gaming for aerobic training in adolescents with spinal cord dysfunction. *Journal of Spinal Cord Medicine,* 29(4), 363 - 370.

Wolfson, S., and Case, G. (2000). The effects of sound and colour on responses to a computer game. *Interacting with Computers,* 13(2), 183-192.

Yang, S.P. and Foley, J. (2011). Exergames get kids moving, in Gray, T. & Silver-Pacuilla, H. (Eds.) *Breakthrough teaching and learning: How educational and assistive technologies are driving innovation*, (pp. 111-126). Springer Publishing, New York.

Yang, S.P. and Graham, G.M.. (2006). Exergames: Being physically active while playing video games. *EKIBOLOS (Biannual Bulletin of the Hellenic Academy of Physical Education)* 4, 5-6.