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Review

Operationalizing physical literacy: The potential of active video games

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Abstract

The core idea of physical literacy is a mind-body integrated, holistic approach to physical activity. A physically literate individual is expected to be cognitively knowledgeable, physically competent, and mentally motivated for a physically active life throughout the lifespan. The advancement of technology in recent years, especially those in active video games (AVGs), seems to have allowed the mind-body integrated physical activity accessible to children at all ages. This article reviews findings from research and critique research on AVGs in light with the theoretical and pedagogical tenets of physical literacy and, on the basis of the review, elaborates the potential that AVGs could contribute to enhancing children's physical literacy.
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1. Introduction

The newly released U.S. National Standards for K-12 Physical Education stated that the goal of physical education (PE) is to develop physically literate individuals with the needed knowledge, skills, and confidence to enjoy a lifetime of healthful physical activity (PA).[1] A physically literate individual is expected to have the skills necessary to engage in a variety of PA, understand the implications and the benefits of PA participation, value PA and its contributions to a healthful lifestyle, participate regularly in PA, and be physically fit.[1] To help students achieve the National Standards for Physical Education, researchers and professionals in the field continue to explore new and creative ways for effective teaching in PE. Creatively using technology has emerged as an approach that can enhance teaching and learning in PE.[2]

By the time when children meet the age requirement for school entrance, they are accustomed to and familiar with technology as one of the primary tools for receiving information.[2] As a recent CNN report indicated, today's PE is not the same that we remember from school.[3] Teachers are now facing a generation of digital natives and expected to have a deep understanding of how to use educational technologies to facilitate student learning. In some states (e.g., Texas), teachers are expected to have competence of using technologies such as heart rate monitors or personal digital assistant.[4]

Technology has been integrated in PE curriculum development, instructional design, and assessment of students' achievements. During the past two decades, a variety of tools, such as pedometers, heart rate monitors, accelerometers, global positioning system, online learning in PE, and active video games (AVGs) have been adopted by physical educators in their teaching practice. For example, Lazerte and Lathrop[5] designed a website for PE lessons guided by their school district curriculum of health and PE (Grades 1–8) and ideas suggested by students and teachers. The website had a homepage and other 13 online pages such as the "get moving, practice your skills!" page, the "active living, it's great!" page, the "talk to the teacher" page, and the "why do we have to have (PE)?" page. Results suggested that 76% of the students reported that they would at least "always" use the website. Students also indicated that the website provided them with more information and helped them think about and participate in sports. This study showed the potential to develop health

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and PE website to enrich elementary school students' experience in PE. But more evidence is needed to identify long-term effects on students learning in PE.

Web-based PE and others using advanced information technology requires knowledge and skills to navigate through the learning process in different ways. The different knowledge and skill sets may be known as digital literacy. The core idea of physical literacy is a mind-body integrated, holistic approach to PA.[6] A physically literate individual is cognitively knowledgeable, physically competent, and mentally motivated for a physically active life throughout the lifespan. The development of technology has provided a platform that not only makes the integrated, embodied experiences possible, but also affords the mover with instant cognitive, motivational information during all phases of PA.

Among a variety of technologies used in PE, AVGs or exergames have received substantive attention from researchers and practitioners. AVGs are a new generation of video games that requires children to put in high volume of body movement in association with the usual cognitive functioning tasks while playing.[7] Sheehan and Katz[8] argued that AVGs could support the development of physically literacy by making connections to the three learning domains in PE: cognitive, psychomotor, and affective. Although other technology applications such as web-based PE, adoption of pedometers and heart rate monitors in instruction have changed in-class learning behaviors, AVGs emerge as a curriculum modifier that may have an impact on PE programming in the future.[9] In this article, I will review and critique research on AVGs in light with the theoretical and pedagogical tenets of physical literacy and, on the basis of the review, elaborate the potential that AVGs could contribute to enhancing children physical literacy.

2. AVGs and motivation in PE

The essential characteristic of physical literacy is the desire to become knowledgeable, competent, and confident to engage in a variety of PAs, to persist with these activities, and to appreciate physical competence and performance.[6] Whitehead[6] described that a physically literate individual is a motivated individual who enjoys challenge, is prepared to take time and effort, has a positive attitude towards participation in PA, and involves in PAs regularly. AVGs have shown a strong potential to motivate children to become active players of the AVGs.[7] Using technology such as AVGs, therefore, might be feasible to motivate school-aged students to engage in PA.

Research findings are consistent that AVGs can provide more interesting and enjoyable experiences than activities in the traditional PE[10–12] and sedentary video games.[7] For example, Sun[11,13] examined the difference of students' perceived situational interest in an exergaming unit and a cardiovascular fitness-education unit. She suggested that students perceived significantly higher level of situational interest in the exergaming unit than they did in the fitness-education unit. In other words, results indicated that exergaming activities provided a unique opportunity for novel and innovative experiences, demanded high attention throughout the game play, led to explorations of different game situations, challenged student both cognitively and physically, and elicited a high level of instant enjoyment.

In PE, situational interest has been assumed to have practical meaning with respect to curriculum and task design. Unlike individual interest, situational interest can be controlled and manipulated by teachers.[14] Situational interest is embedded in tasks and learning environments. In a study examining the effects of different cognitive and physical demands of learning tasks on situational interest, Chen and Darst[15] found that cognitive demand in a PA determines the level of situational interest. The middle school students in the sample ($n = 242$) considered the tasks with high cognitive demand as highly situationally interesting, regardless of the physical demands. Tasks with low cognitive and low physical demands were evaluated particularly low in situational interest. A PE learning task consists of, in large part, a physical movement component and, often neglected, a cognitive component.[16] How much cognitive information is integrated in a PA task may offer different situational interest in PE. Therefore, for a task to become a motivation source, it should be designed carefully to become situationally interesting to the learner.[14,17]

In addition to interest and enjoyment, AVGs were found to foster higher level of self-efficacy than traditional PAs. For instance, Gao et al.[10] compared fourth graders' experiences of dance-exergaming (Dance Dance Revolution, DDR) and aerobic dance in PE using a repeated measures design. Students ($n = 53$) who experienced both DDR and aerobic dance activities reported significantly higher self-efficacy toward DDR than they did toward aerobic dance activity. Gao et al.[10] asserted that AVGs such as DDR might provide unique experiences that contribute to the sources of self-efficacy. Particularly, in PE class children learned how to play DDR gradually for mastery by mimicking the dance movements of the dance figures in the screen. They received simultaneous feedback from the AVG system and timely comments from their teachers and peers. They played DDR at their individual expertise levels for optimal challenge. All these experiences provide a positive learning environment for developing their self-efficacy.

One salient characteristic of AVGs or exergames is social interaction, which can influence or enhance motivation.[11,18] In Staiano et al. study,[18] 31 adolescents (15−19 years old) were randomly assigned to a competitive condition where players competed individually against a peer, or a cooperative condition where players played with a peer. Motivation was measured through questionnaire and interview at the end of the intervention. The result showed that cooperative condition produced higher intrinsic motivation than competitive situation. Also, the intrinsic motivation was positively correlated with energy expenditure during game play. The researchers speculated that the motivation stemmed from perceived control/choice opportunities due to the design of the exergame.

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