

## Chapter 36

# Kinesthetic Gaming, Cognition, and Learning: Implications for P-12 Education

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### ABSTRACT

*Kinesthetic gaming, which is also called full-body gaming, is the rising star of digital gaming trends of recent years. With the integration of commercially available motion tracking systems into game consoles, players are able to control the games with kinesthetic movements without any handheld controllers. This new form of advanced human-computer interaction (HCI) allows players to interact with games in more realistic and natural ways. Because of its novelty, research in kinesthetic gameplay is limited, and experimental research on the effects of kinesthetic gaming on learning is almost non-existent. The purpose of the chapter is to investigate the philosophical foundations of kinesthetic game-playing by emphasizing the role of physical action on learning under the framework of cognitive theories and to discuss possible implications in P-12 education. The author aims to introduce kinesthetic game-playing as a powerful tool for learning and to develop new insights on gaming in P-12 education.*

### INTRODUCTION

Due to new developments in gaming technology, motion tracking systems that use players' physical actions as inputs are becoming widely available. As of today, almost all gaming consoles are coming with motion tracking systems such as Microsoft Kinect®, Nintendo Wii® or Sony Move®. These motion tracking systems provide unique opportunities to evaluate game-play not only from an educational perspective but also from a cognitive perspective since players' gaming experiences become more realistic and natural with the integration of physical action into gaming. Such controller-free gaming experiences provide opportunities to attribute new meanings to physical movements that are not game-related especially when they are evaluated under the principles of cognitive theories. This new meaning attributed to the

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non-registered inputs might be helpful to investigate the mutual relationship between physical action, environment and cognitive development.

Kinesthetic gaming has an extreme potential for educational implementation and practice through virtual experiential learning. Educational content can be delivered in an effective way, and learners can interact and engage with the content as they learn in real life settings through gaming. The kinesthetic gaming in P-12 can be integrated into any content area or field of teaching. For instance, learners could collect virtual apples from trees in virtual learning environments in which learners are physically active to learn counting in mathematics in early grades; an adult learner can learn how to play piano by physically practicing a virtual piano; a graduate student could complete a dangerous experiment in a virtual chemistry laboratory; a 5<sup>th</sup> grader could take a field-trip to a virtual museum by physically wandering around in real-life settings; or a medical student could complete a virtual surgery by physically acting in real life settings. These are basic ideas, and more mature and complex tasks can be proposed for educational purposes.

There is an increasing number of research studies that investigate the role of kinesthetic engagement and physical action on learning processes in gaming, cognitive science, and learning literature (e.g. Bautista, Roth, & Thom, 2011; Bianchi-Berthouze, 2013; Chang, Chien, Chiang, Lin, & Lai, 2013; Chao, Huang, Fang, & Chen, 2013; Chen, Hsu, Hsieh, & Chou, 2014; Ferrai, 2007; Nakamura et al., 2013; Rambusch, 2006; Rambusch & Ziemke, 2005; and Xu & Ke, 2014). Generally speaking, research on kinesthetic game-playing and its effects on educational outcomes are promising; however, there is a lack of experimental research. Although basic requirement of learning settings are satisfied in virtual learning settings that offers engaging educational experiences, educational theory and game design cannot meet on a common ground through a well-designed model (Kiili, 2005). Therefore, virtual learning environments in which players are totally immersed and physically active should be developed by considering design principles of gaming in order to investigate the effects of kinesthetic gaming on learning progress. Kinesthetic movements not only impact players' experiences of game-playing and cognitive development in virtual learning settings, but also affect the learning experiences and cognitive development in real life.

Prominent names of 20<sup>th</sup> century in the fields of pedagogy and cognition evaluate experiences and physical actions of cognitive agents in real life settings from different perspectives. For example, Piaget (1952) evaluates the role of physical actions from a cognitive perspective whereas Bruner (1966) and Kolb (1984) look from educational perspectives. Bruner's studies initiate the development of student-centered discovery learning approach that focuses on active participation and creative problem solving whereas Piaget's studies along with Lewin's model of action research and laboratory training, and Dewey's model of learning underlie experiential learning model developed by Kolb. According to Kolb, learning is "the process whereby knowledge is created through the transformation of experience. Knowledge results from the combination of grasping and transforming experience" (as cited in Kolb and Kolb, 2009, p. 297). Lainema (2003) explains that designers of virtual learning environments have been inspired by the experiential learning theory (as cited in Kiili, 2005), and "[t]he ideology of experiential learning provides a fruitful basis for integration of gameplay and pedagogy" (Kiili, p. 17).

Piaget defines four stages of cognitive development as sensorimotor, pre-operational, concrete operational and formal operational (Huitt & Hummel, 2003). Likewise, Bruner (1966) introduces three modes of representation which explains how information or knowledge is processed and stored in memory: enactive, iconic and symbolic (McLeod, 2012). Physical actions and experiments are essentials for cognitive development in early stages of development at Piaget's sensorimotor stage (from birth to 18-24

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