

## Chapter 2

# The Role of Metacognition in Learning via Serious Games

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### ABSTRACT

*This chapter focuses on three recommendations from the National Research Council (2011) for conducting research that may increase the impact of serious games on student achievement. At the core of these recommendations is an emphasis on the role of metacognition in learning. The first recommendation examines the player's self-awareness as a learner and how a sense of agency can be nurtured by serious games to promote self-regulated learning. The second examines the mediating processes within the individual that influence learning with games. This section describes embodied cognition, which examines the interactions among body, mind, and game environment that can lead to learning. The third examines the problem of transfer of learning. This section offers suggestions on how transfer from gaming contexts to academic contexts can be facilitated. The chapter concludes with an examination of whether research in response to these recommendations can positively impact learning via the serious game.*

### INTRODUCTION

The popularity of video games in the United States is indisputable. A recent report by the Entertainment Software Association (ESA, 2015), indicated that four out of five households own a device to play video games, 42% of Americans play video games three or more hours per week, 26% or 40.3 million gamers are under 18 years of age, and the popularity is fairly evenly divided between females (44%) and males (56%). In addition, there is an ever-broadening corpus of research showing that video gaming can have strong positive effects on visual processing of spatial characteristics of information, attentional processing, executive functioning, inductive reasoning, mental rotation, memory, and task motivation (Green, 2014)—all necessary characteristics for video gaming. One obvious interpretation of these findings is that high engagement with video games enhances a person's ability to engage in video games. But, other than the self-perpetuating effects of video games, are there other benefits to be gained through playing video games? In the context of the current volume, the question becomes, Do the skills and knowledge

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gained through video games transfer to formal educational settings? The belief that the high engagement engendered by the entertainment value of video games can act as a motivator for children to learn as they entertain themselves has been a strong force behind the development of a genre of video games for academic learning (Ritterfeld, Cody, & Vorderer, 2009). This new genre of video games, called serious games or digital-learning games, attempts to “target the acquisition of knowledge as its own end and foster habits of mind and understanding that are generally useful or useful within an academic context” (Klopfer, Osterweil, & Salen, 2009, p. 21).

Unfortunately, the use of serious games for formal educational purposes has met with mixed results (Blumberg, Almonte, Barkhardori, & Leno, 2014; Chen & Hwang, 2014), and in many cases only limited success has been attained with child and adolescent students (Kato, 2012). Reports from the National Research Council (NRC; 2011), Tobias and Fletcher (2011), Young, Slota, Cutter, Jalette, Mulling, Lai, Simeoni, Tran, and Yukhymenko (2012), and McClarty, Orr, Frey, Dolan, Vassileva, and McVay (June, 2012) have shown that the current state of research on the use of video games for formal educational purposes is inconclusive. Although all four reports are positive about the use of serious games in the classroom and that there are theoretical reasons to believe that serious games could be beneficial for student learning, the reports are in agreement that there are many instances in which game design is not based in empirical theory (van de Sande, Segers, & Verhoeven, 2015) or sound psychological principles, that educational outcomes and entertainment value are not directly tied to one another (Ritterfeld et al., 2009), and that research on the educational value of edutainment is greatly lacking (Ritterfeld et al., 2009; Young et al., 2012). Young et al. (2012) concluded that “Many educationally interesting games exist, yet evidence for their impact on student achievement is slim” (p. 80); and, Graesser, Chipman, Leeming, & Biedenbach (2009, p. 83) agreed that “Unfortunately, at this point in the learning sciences, very few serious games have been developed that would impress experts in education.”

What is the disconnect between learning via serious games and academic performance? People are quite capable of gaining knowledge and problem-solving skill within a serious game and yet fail to utilize that knowledge and skill outside of the game, or even to other games that are structurally similar (Barnett, 2014; Lieberman, Biely, Thai, & Peinado, 2014; McClarty et al., 2012; Morris, Croker, Zimmerman, Gill, & Romig, 2013). The disconnect could be as simple—or difficult—as a lack of transfer. Simple in that the problem of learning from serious games could be attributable to a single process; difficult in that the process of transfer is likely the most critical problem in education, and despite nearly a century of research, remains a critical problem. To add to the difficulty, because transfer research has consistently shown that the likelihood of transfer depends on the similarities between the learning context and transfer context, transfer in gaming may be even less likely because typically the gaming context is highly dissimilar from the classroom context (Morris et al., 2013).

The purpose of this chapter is to discuss what is seemingly an intractable problem: How can the characteristics of durable learning that are evident in players of many popular video games, such as high interest and motivation, critical thinking, affective engagement, social feedback, metacognitive monitoring and control, and strategic planning, be fostered in serious games to make them valuable instructional tools? The belief that the high engagement engendered by the entertainment value of video games can be used to motivate academic learning needs to be substantiated. The NRC (2011) report *Learning Science through Computer Games and Simulations* acknowledges that the impact of serious games on academic learning is questionable and provides several recommendations for research that can potentially increase that impact.

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