Chapter LXVI
Instructional Game Design Using Cognitive Load Theory

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ABSTRACT

This chapter proposes an instructional game design framework based on the 4C/ID-model and cognitive load theory, its associated theoretical foundation. The proposed systematic design framework serves as the processing link to connect games' powerful characteristics in enhancing learning experience with desired learning outcomes. In this chapter we focus on the cognitive aspect of learning outcome: the development of transferable schema. This chapter introduces design guidelines to attain specific game characteristic by prioritizing the design components in 4C/ID-model. Each game characteristic consists of three levels of design emphasis: preliminary, secondary, and tertiary. The ultimate goal of this chapter is to initiate a series of dialogue between cognitive learning outcome, systematic instructional design, and instructional game design thereby seeking to improve the overall game design and instructional efficiency.

INTRODUCTION

In recent years, the use of games for teaching and learning has grown significantly in the training industry and K-16 educational settings. There is, however, a lack of understanding between what games readily provide (i.e., games' characteristics) and what the learners need from games (i.e., learning outcome). Such deficiency makes it difficult for instructional designers to systematically apply a

design framework as well as to justify their decisions in using games to enhance learning. Being equipped by their multi-dimensional characteristics, the instructional potential of games therefore cannot be fully utilized until there is substantive evidence linking specific instructional benefits to various game characteristics. Moreover, the lack of systematic instructional game design process supports unnecessarily prolonged, costly, and inefficient game design.

Games today are usually designed and developed based on generic film production procedures as well as filmmakers' mental models. Entertaining *is* the key design *objective*. All actions taken in game design are focused on one reason: to entertain the players. But what happens if we are to design instructional games? Does the entertainment element still override everything? While this key objective works for game developers, if games are to become a viable tool with instructional value, games need to more than entertain, they need to facilitate learning. This chapter believes that the design focus should be shifted to enhancing learning experience while still utilizes entertainment to support learner engagement. The ultimate goal of designing instructional games is to preserve the complex nature of games in order to optimize their impact on learning. The lack of a systematic design framework, however, often leaves some games' learning-enhancing features unexplored. As a result, instructional games' capabilities are not fully manifested for the purposes of enhancing learning and learning transfer to performance settings.

The purpose of this chapter is to describe a systematic instructional game design framework to address the issues just presented. We identify the cognitive load theory-based 4C/ID-model as the prototypical model to base the instructional game design framework, emphasizing the 4C/ID-model's focus on schema construction for complex learning and performance transfer. The following sections first discuss games' characteristics based on previous studies. Second, the chapter introduces the 4C/ID-model in the context of cognitive load theory; and third we propose an instructional game design framework based on 4C/ID-model to attain specific game characteristics in support of complex cognitive learning. Finally, the chapter proposes a design framework for future research with the intention to initiate meaningful dialogue on how we can empirically investigate the learning impact of instructional games.

BACKGROUND

What Are Games

A game is a context in which individual and teamed players, bounded by rules and principles, compete in attaining identified game objectives. There is a series of decision-making processes are required by the game players. Elliot Avedon and Brian Sutton-Smith (1971) explained that game playing is a voluntary exercise of controlling a system (i.e., the game) intended for a state of disequilibrium. In other words, game players continuously try out new methodologies and strategies during the game-playing process based on the system's feedback until they achieve the game objectives or the equilibrium state. The following section explains several game components that include:

- Games create experiences
- Rules and interactions in games
- Games are complex
- Games are models

Games Create Experiences

Games are known for their capabilities to promote collaborative and active learning (Downes, 2004; Klabbers, 2006; Vygotsky, 1978). Game players learn from their success and mistakes in order to improve their gaming skills and playing strategies. Players learn about the games and how to win the games from playing games and reflecting on