Chapter 10
Designing Digital Cognitive Games that Facilitate Mindful Reasoning and Decision-Making

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EXECUTIVE SUMMARY

This chapter discusses the design of external representations of the internal formal structure of cognitive games. The formal structure of a game provides the choices, which players use in decision-making. As such, four games that provide different kinds of choices are examined: 1) spatial navigation, 2) the parameters of operations, 3) object transformation, and 4) resource management. For each game, an externalization of its internal formal structure is discussed. Studies conducted with two of the games are also presented. In total, these four cases examine how an externalization can facilitate more mindful reasoning and better decision-making.

DOI: 10.4018/978-1-4666-1933-3.ch010

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INTRODUCTION AND BACKGROUND

Reasoning and decision-making are fundamental constituent activities of learning. From an educational perspective, it may be desirable to engage others in tasks, which involve activities such as reasoning and decision-making. An example of this kind of task can be a digital game. However, depending on the game and how it was designed there are differences in the degree to which players are engaged in mental activities such as reasoning and decision-making. Designers of digital games can consider the manner in which a game engages, promotes, and support such mental activities. To better understand the design aspects relevant to this engagement and support, a number of background topics will be covered first.

Problem Spaces

It may be useful to conceptualize a problem as a space in which there are many states (Russell & Novig, 2002). Each state has one or more transitions, which lead to other states. Problem solvers enter the space at a starting state and transition between states until they reach a goal state. Since a state may contain many transitions, problem solvers engage in decision-making to determine which transition to follow. The destination state of a transition, and other states which can be reached as a result of that transition, factor in to the decision-making process. As games contain one or more problems, games can be useful examples for understanding this conceptualization of problems and problem solving.

Consider the game Chess. As a problem space, Chess is composed of many game states. A game state refers to the position of all the pieces on the game board. The current arrangement of pieces is the current game state. Players alternate performing game actions. An action consists of changing the position of a piece, and possibly removing a piece from the board, such that the current state of the game changes each time players perform an action. In other words, actions transition the game from one state to another. The various states and transitions between states could be represented in a diagram like Figure 1.

In terms of decision-making, players need to decide on the next action to perform. As the goal is to win the game, players should choose actions that lead them along a path towards a goal state. For example, in Figure 1 the black player's action "move bishop" will put the white king in check. At first glance, this would be desirable for the black player. However, in Figure 1 there are two possible actions given for the white player after the black's bishop has moved. In both cases, the black player will lose the bishop piece. By looking at least two turns ahead, the black player may choose to not move her bishop.

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