Chapter 5
Feedforward as an Essential Active Principle of Engagement in Computer Games

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ABSTRACT
Learner engagement is important for learning, yet the question of how to design engaging learning experiences still lingers. One of the facets of computer games is that they tend to be engaging. In addition, they are designed experiences. By examining computer games as examples of the design of engaging experiences through the lens of design theory, it may be possible to extract more fundamental principles for the design of engagement. Such principles could inform the design of serious games and other learning experiences. This chapter uses Vincenti’s fundamental design concept of operational principle to identify the core components and active principle that underlie the design of engagement in games. The chapter also introduces the concept of feedforward to describe the continual elicitation of anticipatory cognition and behavior by players/learners. This feedforward effect in the context of player/learner agency is essential to the active principle of engagement in computer games.

INTRODUCTION
Learner motivation and engagement are seen as necessary conditions for learning to occur (see Blumenfeld, Kempler, & Krajcik, 2006; Buchanan, 2006; Edstrom, 2002; Katzeff, 2000). Yet learner engagement remains a persistent problem for education (Blumenfeld, et al., 2006; Buchanan, 2006; Csikszentmihalyi, 2002; Gardner, 2002). One of the significant potential contributions of computer games to education is that they are generally successful at eliciting engagement, and thus may foster student engagement in the learning process (Aldrich, 2004; Barab, Thomas, Dodge, Carteaux, & Tuzun, 2005; Gec, 2003; Papert, 1998; Prensky, 2001; Rieber, 1996; Squire, 2005). While engagement has been addressed from psychological and phenomenological points of view, the question of engagement has not been examined sufficiently from the perspective of design (Katzeff, 2000; Kickmeier-
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In addition, Kirriemuir and McFarlane (2004) suggest,

Rather than aiming for an experience that superficially resembles leisure-based “fun” activities, or one which attempts to conceal the educational purpose, it might be argued that we should understand the deep structures of the games play experience that contribute to [optimal engagement] and build these into environments designed to support learning. (p. 6)

The purpose of this chapter is to explore the “deep structures” of games from the perspective of design to generate a better understand of the design of engaging experiences. Computer games are examined as a type of experience designed for engagement in order to inform other design situations in which engagement is desirable (i.e., serious games in particular and instructional design in general).

BACKGROUND ON DESIGN THEORY

The study of the phenomenon of design has emerged as its own discipline and is most often referred to either as design studies or design science (Bayazit, 2004; Eastman, McCracken, & Newstetter, 2001; Van Aken, 2004). Practitioners in this field assert that the study of design is fundamentally different from the natural sciences (physics, chemistry, geology and biology) in the object of study, in the type of knowledge produced, and in its research methodologies (Bayazit, 2004; Eastman, et al., 2001; Simon, 1996). The distinction of the study and practice of design from traditional scientific method has also been noted in the field of instructional design (Bannan-Ritland, 2003, 2008; Gibbons, 2000; Inouye, Merrill, & Swan, 2005; Reigeluth & Frick, 1999). Some of the notable differences are that:

- Design problems are not well defined; solutions are not theoretically or procedurally predictable, but are contingent on situational conditions as well as the preferences, competence, and creativity of the designer (Gibbons, 2000; Inouye, et al., 2005; Silber, 2007; Simon, 1996). Consequently, there is no single design solution, but a variety of alternative design possibilities that offer different affordances and constraints.
- Design knowledge is testable and verifiable, but contextually and, in many respects, qualitatively rather than universally and objectively as it is in the natural sciences (Bannan-Ritland, 2003; Collins, Joseph, & Bielaczyc, 2004; Van Aken, 2004). While science may be used in the design process, and elements of a given design may be testable scientifically, design also includes inherent subjectivity, localization and novelty in its nature and thus does not lend itself to scientific inquiry (Inouye, et al., 2005; Simon, 1996; Sloane, 2006).
- Design theory is generalizable, but as heuristic principles rather than universal laws (Silber, 2007; Van Aken, 2004; Vincenti, 1990). Again, science is often used in design, but design is not reducible to an application of science; the process of design and the object of design can take a variety of forms that tend to be guided and adapted heuristically (Gibbons, 2000; Silber, 2007; Simon, 1996; Vincenti, 1990).

Computer games are designed artifacts. It follows then, that the design of computer games might employ scientific principles in part, but would
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