Chapter 14

Implementing a Game-Based Instructional Design Strategy in the Eighth Grade Science Classroom:
Teaching Science the *Chutes and Ladders* Way!

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ABSTRACT

This chapter examines the effects of a game-like environment on instructional activity design and learning outcomes in a middle school general science class. The authors investigated if science content can be designed and successfully delivered instructionally using a game-like learning environment. The authors also wanted to investigate if by utilizing a game-design method could class and student engagement be increased. The results indicated that the instructional design of the unit using a game-like environment was successful and students exhibited learning. The authors also address the challenges inherent in utilizing this instructional strategy.

INTRODUCTION

Knowledge is being created at a rapid rate for a myriad of mediums (Schilling, 2013). Adapting to change is a crucial skill for the 21st century because the transition from a linear to an exponential growth of human knowledge requires flexible learners who can cope with this explosion of new information. However, the typical teaching paradigm operating in today's classrooms is *tell and practice* where the

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teacher first tells or demonstrates a concept and then asks the students to respond to a series of questions (Schwartz, Chase, Oppezzo & Chin, 2011). Heibert and Stigler (2004) describe a typical routine of a classroom teacher:

Lessons are planned (sometimes quickly, by identifying a sequence of activities), then implemented, then assessed (sometimes by watching students' reactions during the lesson, listening to students and questioning them informally, and collecting student work), and then reflected on (sometimes quickly, by making mental notes of what worked well and what didn't, who acted up, and so on). (p. 13)

This form of instructional delivery, however, according to some researchers, limits a deeper and more flexible understanding of the content. Catrambone (1998) notes, "Students tend to memorize the details of how the equations are filled out rather than learning the deeper, conceptual knowledge that is implicit in the details" (p. 335). Further, according to Heibert and Stigler (2004) most practice problems focus on skill development rather than conceptual understanding.

What we need is a shift in the delivery of instruction. Dewey (1963) suggests that we shift delivery from a top-down approach to one that is more personal and individualized to where "change is the rule and not the exception" (p. 19). Dewey also argued that the type of instruction that is disseminated from textbooks or authorities as though it is "a finished product…" is too rigid (p. 19).

Numerous attempts over the past 40 years have seen explicit instruction increasingly supplanted by approaches more closely aligned with constructivist concepts of exploration, discovery, and invention such as discovery learning, problem based inquiry and the like (Alfieri, Brooks, Aldrich & Tannebaum, 2011). As early as 1992, Brown was noticing that the implementation of the discovery types of instructional delivery was somewhat ineffectual. Alfieri, et al. (2011) in a recent meta-analysis found two major drawbacks in the discovery type of implementation strategies. First, students are often unequipped to access the to-be-learned material because they lack the prerequisite content skills or knowledge. Second, the ability to make sense of the instructional experience requires "considerable metacognitive skills, and it is unlikely that all learners, in particular children, would have such skills" (p. 3.) Nonetheless, Brown (1992) noted that the "motivational benefits of generating knowledge cannot be overestimated and the sense of ownership that this creates is a powerful reward" (p. 168).

The problem for teachers and instructional designers is how to design personalized and individualized experiences that are truly effective. Belew (1990) suggests that learning is a recursive process that is dependent on prior experiences. Dewey (1963) concurs and notes, that even though "all genuine education comes about through experience does not mean that all experiences are genuinely or equally educative" (p. 25). He further points that out "every experience affects for better or worse the quality of future experiences" (p. 27). Consequently, experiences need to be properly engineered and sequenced so that each experience contributes to the whole.

BACKGROUND

Engineering Experience

The correct experience has to come at the most appropriate time for the experience to be meaningful to a student. In large part, instruction leads students through an appropriate sequence of content and activi-