Chapter 6
Dynamic Decision-Making Model:
Integrating 3D Printing in Education

Marlo Bruce Steed
University of Lethbridge, Canada

ABSTRACT

The purpose of this chapter is to inform educational practitioners as to possible frameworks and models for effectively integrating 3D printing into instruction. This will focus on the conceptual ideas that overarch and guide the decisions for integrating 3D printing in education. Educators need a critical perspective and rationale so that the novelty of the tool doesn't overwhelm sound pedagogy. An understanding of how the features of 3D printing match up with the attributes of instructional approaches is the key to designing and orchestrating effective learning experiences. This chapter describes a model of decision making that takes into account the affordances, constraints, and approaches of 3D printing and details the implications for learning activities. The decision-making model will enable educators to effectively integrate 3D printing into educational contexts.

INTRODUCTION

The advent of 3D printers in educational institutions has fueled discussion about the efficacy of integrating this technology. It is important for educators to make informed decisions about when, where, and how to integrate 3D printing for learning purposes as well as their reasons why they wish to do this. This technology holds promise but, as with all technological innovation, the educational value is determined by how it is used.

The purpose of this chapter is to inform educational practitioners as to possible frameworks and models for effectively integrating 3D printing into instruction. This will focus on the conceptual ideas that overarch and guide the decisions for integrating 3D printing in education. Educators need a critical perspective and rationale so that the novelty of the tool does not overwhelm sound pedagogy. An understanding of how the features of 3D printing match up with the attributes of instructional approaches is

DOI: 10.4018/978-1-6684-6295-9.ch006

the key to designing and orchestrating effective learning experiences. This chapter describes a model of decision making that considers the affordances, constraints, and approaches of 3D printing and details the implications for learning activities. The decision-making model will enable educators to effectively integrate 3D printing into educational contexts.

BACKGROUND

Constructivism and Play Framework

A useful theoretical framework for thinking about 3D printing is constructivism. This perspective suggests that learners are builders of their own knowledge, so providing students with tools that parallel this construction process is potentially useful. The theoretical framework of constructivism, espoused by Piaget, Papert, and others (Ginsburg & Opper, 1988; Kozma, 1991; Papert, 1993), suggests that learning can be defined as the construction and/or transformation of internal representations. The design of 3D models mirrors this mental construction process. Papert (1993) spoke of "objects-to-think-with" (p. 182), and Ackermann (2001) referred to the value of personalized production of knowledge artifacts; 3D prints are knowledge artifacts. This perspective suggests that the design and building of tangible artifacts mirrors the mental representations. Although instructors cannot peer into the minds of learners and see their mental models, 3D printing provides a way of externalizing a student's mental representations by making a permanent physical artifact that can be viewed and assessed. As such, 3D printing fosters intellectual honesty through the correspondence between the physical object and the mental model. In speaking of constructivism, Trust and Maloy (2017) stated, "Central to that culture is enabling students to create and construct knowledge as they transform ideas from their imaginations into physical objects and models that represent those ideas" (p. 265). Hence the act of creating 3D prints may foster learning through questioning, design, construction, and discovery.

Instructional Problem-Solving Framework

One of the keys to designing effective instruction is to match the attributes of the instructional problem or outcomes with the features of the learning activities. This approach to instructional problem solving is one that is intuitive but is often overlooked when instructors develop instructional solutions. The result can be a less than an optimal match between the problem or outcome and the instructional solution. Steed (2008) suggested that this problem-solving strategy can be encouraged with the use of an activation matrix. This is an approach that matches the instructional outcomes to the features of the instructional activity or tool. This kind of formalized approach may slow down instructors so that they consider the best possible match between the technology tool and instructional interventions. To do this, instructors need to know the attributes of the instructional problem and the features of the technology tool. The use of thoughtful decisions to address instructional problem-solving is foundational to effectively integrate 3D printing into education.