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Short Communication

A Theoretical and Contextual Background of 3D Printers and Design

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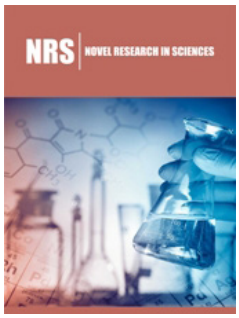

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Introduction

Defining informal learning is a crucial step prior to identifying specific technological trends that can impact delivery and execution of any new technologies. Maier [1] stated that informal learning occurs during non-structured activities such as everyday tasks and activities at home and work, or during leisure. Marsick and Watkins mentioned the following three types of informal learning: self-directed learning, mentoring, and coaching. These examples of learning typically occur outside the confines of the traditional classroom. One technological innovation that may be included in the repertoire of informal learning activities, particularly in self-directed endeavors, is the three-dimensional (3D) printer. According to 3DPrinting.com (2017), "3D printing or additive manufacturing is a process of making three [-] dimensional objects from a digital file."

According to Ainsworth [2], the theory of constructivism posits that people are not passive receivers of knowledge, but instead are actual participators in creating knowledge through building upon past acquired information and developing complex mental constructs. The author also added that this theory promotes the use of experimentation and experiential learning in developing knowledge rather than memorization of information from prepackaged material from lectures and texts. Constructivism may explain how people gain knowledge from using 3D printers. They may experiment in using the device, incorporate previously acquired experiences, and learn from their interactions with people who may share their interests in 3D printer use. Another theory that may be used to explain how people learn from technological tools is constructionism. In constructionism, Bers proposed that, "people learn better when provided with opportunities to design, create, and build projects that are personally and epistemologically meaningful" (2008, p. 16). Constructionism also promotes the use of technological devices that assist users in creating "powerful ideas", or they may be "a set of intellectual tools worth learning, as decided by a community of experts in each of the fields of study" [3]. The implications of the commercial availability of 3D printers and design applications mean that people can employ these powerful ideas in creating tangible objects from a mental representation in a relatively short period of time. The use of 3D design application and printers promote the project-based learning and inventions of self-directed users. The "makerspace" movements also support the project-based use of 3D printers. According to Lang [4], the "maker" process is defined as "[c] reating and exploring new possibilities through building and experimenting with tools, [sic] technology" (p. 22). By this definition, the maker can be someone who invents and creates tangible objects by using the 3D printer and design applications. The available 3D design applications and printers in the market can be useful in self-directed learning. Self-directed learning involves the management of one's entire learning process from start to finish [5]. Also, self-directed learning can share the unstructured nature of informal learning. Although makers can engage in self-directed learning of 3d printer applications, they can also learn how to use the device in "affinity spaces." According to Gee [6], an affinity space is a place where people can interact and affiliate based on the performance of shared activities, regardless of characteristics such as age, race, or gender. Schon [7] mentioned somr examples of technological movements that may be related to the concept of affinity spaces: 1) Maker Movement (involves the creation of concrete or digital objects using new devices); and 2) Fablab (involved in providing ordinary people

access to tool prototypes for fabrication of personal creation of products). From its nascent form in the 1980's, this device has been developed into a more accessible form of technology that has been used in innovative ways. It has been used to create objects for leisure and even organs used for medical transplant. The incorporation of this technological tool in various settings can promote learning by doing, creating, and inventing [8-10].

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