Design and Development of 3D Printed Teaching Aids for Architecture Education

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ABSTRACT

This article describes how the implementation of 3D printing in classrooms has brought many opportunities to educators as it provides affordability and accessibility in creating and customizing teaching aids. The study reports on the process of fabricating teaching aids for architecture education using 3D printing technologies. The practice-based research intended to illustrate the making process from initial planning, 3D modeling to 3D printing with practical examples, and addresses the potential induced by the technologies. Based on the investigation into the current state of 3D printing technologies in education, limitations were identified before the making process. The researchers created 3D models in both digital and tangible forms and the process was documented in textual and pictorial formats. It is expected that the research findings will serve as a guideline for other educators to create 3D printed teaching aids, particularly architectural forms.

KEYWORDS

3D Modeling, 3D Printing Technology, Educational Technology, Teaching Aids, Traditional Korean Architecture Education

INTRODUCTION

Digital fabrication technologies have attracted widespread interest among the public in recent years due to the production of desktop 3D printers which are relatively affordable and easy to operate when compared with other types of industrial printers. 3D printing refers to the technology that turns a digital design into a physical object using CAD (Computer Aided Design) software. Educators have noticed the potential utilization of the technology, particularly the use of desktop 3D printers in education, to advance the idea of ‘thinking through making’ and ‘learning with artifacts’ (Papert, 1980) in the twenty-first century. From ideation, digital model design, to 3D printed object, students can turn ideas into reality in classrooms.

Accordingly, much attention has been paid to developing educational contents that can integrate the new technologies into classrooms as a scholarly research subject. The existing research areas include the application of the technology in a variety of subjects from math, science, to art and design both inside and outside the classroom (Cisita Parma srl, 2015; Maloy et al., 2017). It is notable that public institutions such as museums, libraries, and fablabs are as enthusiastic as schools in adopting digital fabrication technologies in educational contexts (Halverson and Sheridan, 2014).

DOI: 10.4018/IJMBL.2018070106

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Despite the growing body of research on the implementation of 3D printing in education, most studies have only focused how the technology can boost student engagement through digital and hands-on making activities which contribute to the development of creativity, problem-solving skills, and self-motivated learning. Relatively fewer researchers addressed the potential opportunities for teachers to create their teaching aids that are customized for specific instructional contents.

The studies investigating 3D printed teaching aids have addressed that 3D printable models of teaching aids specially designed for STEM (Science, Technology, Engineering, and Math) fields have become widely available in the form of open source files (Groenendyk, 2016; Highfield, 2015; Kostakis et al., 2015). However, there are very few resources available in understudied or specialized subject areas such as traditional Korean architecture.

A major challenge observed from the recent research findings is that the new technologies are still unknown to many teachers. It has become crucial to provide a practical solution on how to enable teachers to utilize the new tools and related contents effectively. In particular, educators who intend to employ 3D printing to create customized teaching aids will demand more experiential resources and guidance.

This research aimed to provide a comprehensive explanation of the process of developing teaching aids from collecting resources, designing 3D models to 3D printing in the form of practice-based study. It also attempted to create a curriculum for the educational program associated with a museum exhibition about traditional Korean architecture.

The process of creating 3D printed teaching aids in this study can be broadly divided into three phases. First, the researchers collected information about the current state of 3D printing application in educational sectors. Second, the researchers designed and produced teaching aids reflecting on the findings from the collated data. Lastly, the researchers ran two educational sessions employing the 3D printed teaching aids based on the curriculum.

3D PRINTING TECHNOLOGY IN EDUCATION WITH A FOCUS ON 3D PRINTED TEACHING AIDS

According to the Wohler’s Report 2013, the global printing market is anticipated to reach $8.6 billion by 2020 (Columbus, 2015). Currently, North America and Europe lead the 3D printing market and will remain the largest, while other regions including Asia-Pacific markets are expected to proliferate (Grunewald, 2016). In an attempt to stimulate the development of additive manufacturing technology and the growth of the industry, the Korean government announced a 10-year plan in 2014. It is expected that the Korean government will provide 227 libraries and 5585 schools with desktop 3D printers by 2017 (NIA, 2014; Saunders, 2017).

Despite the attention given to 3D printing in education, it is still in the exploratory stage. Many cases of successful adoption of the digital fabrication technology in classrooms have been reported over the past decade, but to the best of the researchers’ knowledge, there are no widely-accepted national or international standard guidelines or manuals in 3D printing in educational contexts yet. Although a considerable number of books have been published globally for the dissemination of technical information, books dedicated to 3D printing in classrooms are minimal. Unless schools offer a 3D printing training workshop, educators have to seek for opportunities to learn the technologies, explore new educational contents on their own, and share the outcomes through various channels (Sullivan and McCartney, 2017).

In 2007, a group of researchers at Cornell University developed an online platform (3Dprintables.org) for printable teaching aids (Knapp et al., 2008). At that time, there were very few online platforms where users could find 3D models for teaching aids. Thus, the researchers attempted to construct an archive of open source files and provided a user-friendly modeling software. The platform does not exist anymore, and up to date, online repositories built by educators are known to be very rare (Groenendyk, 2016).
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