

Chapter 9

Design and Evaluation of a Collaborative Learning System for 3D Model Sharing

Tsai-Yen Li

National Chengchi University, Taiwan

I-Sheng Lin

National Chengchi University, Taiwan

ABSTRACT

Due to the prevalence of 3D printers, many applications of 3D printing have been developed for education in the recent years. Although there are web sites hosting 3D models created by students and allowing them to be shared with others, these systems usually lack educational functions, especially for collaborative learning. On the other hand, most learning management systems do not provide functions needed for sharing and viewing 3D models. In this chapter, a system called 3D model co-learning space (3D MCLS), dedicated to collaborative learning, will be reported. The system allows a user to store, share, display, and discuss 3D models and allows a teacher to manage a group of students in a flexible way. Furthermore, the system can create the thumbnail of a 3D model automatically. It uses tags to organize models into groups according to their attributes or teams in a class. In addition, it provides blind assignments of peer reviews. The authors have implemented such a system and conducted a pilot study to obtain a preliminary evaluation on the usability of the system.

INTRODUCTION

In recent years, 3D printing technologies have become more mature and accessible to the public, especially under the trend of maker movement. In addition to making prototyping of a product easier, 3D printing is also widely used in school education to create student art work or teaching aids aiming at facilitating the learning of abstract concepts through concrete object models. Due to the popularity of 3D printing, an increase number of 3D models has been designed and created by students at various levels

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of education. However, the authors have not found any of the current Learning Management Systems (LMS) dedicated to the presentation of 3D models or the learning of 3D modeling. On the other hand, although a few models sharing websites such as Free3D (free3d.com) have been in service for some years, most of the functions on the websites are not designed to facilitate model sharing and collaborative learning in a specific group.

This chapter discusses a website that has been developed by the authors of this chapter to enable easy sharing and collaborative learning of 3D printed models created in small groups. In addition to the commonly found functions of storing, sharing, searching, and displaying 3D models, the web site, called 3D Model Co-learning Space (3D MCLS), also features 1) automatically generating thumbnail for a best view of a model, 2) using tags to organize learning groups and activities, 3) supporting model version control and external application program interface (API), and 4) supporting blind peer review and self-assessment comparison. The system also allows a user to put a 3D pointer at a focus location from a chosen specific view before making comments to a model. The website can be used by students to share and obtain feedback on their 3D printed models. The authors have also conducted a preliminary pilot study to evaluate the design and usability of the system and the results are presented in this chapter.

RELATED WORK

3D printed models refer to the physical 3D models that can be produced with the additive manufacturing technologies that become easily accessible in the last decade (Gibson, Rosen, & Stucker, 2014). Especially, under the recent maker movement, 3D printed models have been widely used in various applications for fast prototyping. Makers typically use 3D modeling software to create their own customized models or download existing 3D models to produce printed models to support their applications.

3D Model Sharing System

Most of the 3D model sharing services are not designed for educational uses. 3D model is a type of digital content that can be managed in traditional Learning Management System (LMS). However, since the way to share and view 3D models is more content specific, most LMS's do not provide specific functions to provide special supports to this type of content, neither do the associated Learning Content Management Systems (LCMS). Therefore, most websites that share 3D models are standalone and independent of existing LMS's. In fact, most of the 3D model sharing services were set up for sharing models created for 3D applications such as computer game development or animation creation. Some exceptions are set up by the manufacturers or retailers of 3D printers to provide model storage services for their customers. For example, My Mini Factory (myminifactory.com) is a website maintained by the retailer, iMakr that features guaranteed printable 3D models. Thingiverse (thingiverse.com) (see Figure 1) is another popular service, maintained by Makerbot, a 3D printer manufacturer. Most of these websites support model sharing, searching, viewing, and commenting to some degree. However, instead of small group discussions in an educational setting, the target users are the public who have created good 3D models to share or are trying to find a good model to use. Tinkercad (tinkercad.com) is an on-line 3D modeling website that provides easy-to-learn 3D modeling functions on a web browser as shown in Figure 2. Because the system is more for educational uses, Tinkercad also supports sharing of teaching plans as well as tutorial documents. However, it does not allow a group of users to perform peer assessment

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