Top-notch Talent BIM Education Based on Program of Innovation and Entrepreneurship

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Abstract. After finishing a standard BIM course of study, selected students are invited to accept advanced BIM training completed in cooperation with various companies and using a variety of models. The results, which include further development using Revit for BIM and identification of a needed project, are actually adopted by the company and used to guide the work in the actual construction phase.

Introduction

Building information modeling (BIM), is a cutting-edge architectural technique that has resulted from several decades of development. BIM techniques are based on 3D design and is taking the place of traditional 2D CAD design by allowing a collaborative platform, combining architectural, structural, and mechanical, electrical, and plumbing (MEP) models together to facilitate cooperation between designers [1]. BIM techniques are widely used on a global level in design, the construction industry, and for maintenance.

Accordingly, in 2014, the People’s Republic of China’s Ministry of Housing and Urban/Rural Development enacted policies designed to encourage the utilization of BIM in China. And, as a result, more and more companies in China have adopted BIM techniques. Prior to 2014, design programs at universities in China taught only 2D design techniques.

With the increasing number of companies involved in BIM field, there is now a subsequent shortage of skilled BIM-trained talent in the People’s Republic of China. Unfortunately, few universities provide BIM coursework to undergraduates. The shortage of both talent and training offer challenges and opportunities for faculty and university-level design programs. Certainly, university-level faculty in the People’s Republic of China need to develop programs and teaching strategies that will encourage students to develop skills with this cutting-edge technique and increase their career options [2]. To do that, faculty in China will benefit by learning from teaching strategies already developed and proved effective.

Since the late 1980s, BIM education has been an important component of computer-aided design in the US and globally. There are many pedagogical strategies available. Among those approaches, Jennifer Macdonald [3] explores methods of improving collaborative design education among students in architecture, engineering, and construction (AEC) disciplines. Lee [4] seeks to understand
and accommodate the imminent transformational shift in construction management education and evolve curriculum to facilitate better learning and understanding. Farid J. Sabongi [5] studies BIM Education in the construction industry. Finally, Jiri Hietanen and Robin Drogemuller [6] examine approaches to teaching BIM at the undergraduate level. One thing appears certain: involving students in internship programs helps students gain real-world experience.

In the People’s Republic of China, the value of internship programs has not gone unnoticed. Accordingly, the Innovation and Entrepreneurship Training Program was initiated in 2012 by the Ministry of Education of the People's Republic of China. The Program’s aim is to cultivate undergraduate students’ innovation and entrepreneurship abilities. This program provides opportunities for select students, including undergraduates, to get more fully develop their awareness of real-world applications for what they lean in classrooms.

At the Harbin Institute of Technology, BIM courses were developed that included internship-styled advanced training that would cultivate top-notch talent in BIM design by providing students the opportunity to complete needed work [7].Students involved in this program of innovation and entrepreneurship rapidly develop versatile BIM skills.

**BIM Course and Training**

BIM courses offered to select freshmen after finishing a civil drawing course. Students grasping basic knowledge about standards and who had the ability to draw and read working drawings related to architecture, structure, and MEP could take part in the BIM basic course. The basic BIM course included learning how to create 3D models for solid bodies and families by using Revit series software produced by Autodesk.

BIM techniques include not only using software but also identifying the information provided by models, so BIM training requires not only teaching student how to use the software but also providing instruction on how to integrate the models together and use the identification of data information to guide modifying those models and make the models meet the needs of the building life cycle.

Further courses and MEP are provided, depending on different majors. MOOCs courses online are also available for students to review and/or gain area-specific knowledge.

**Real BIM Case Study and Achievement**

BIM is a demanding technique; hence, students benefit though the applied study accompanying their joining a real project. The application of previous learning allows students to progress from a textbook-based perception to a project-based application of the material studied. That is selected students are provided the opportunity to enjoy the subsequent learning opportunities associated with real-world applications of what they learned from their textbooks.

After successful completion of the civil drawing and BIM coursework, five Students were picked to form a group. The members of that group were then tasked with successfully applying their knowledge of BIM through grant funding made available by the Student’s Platform for Innovation and Entrepreneurship.

Internship opportunities were offered by a company cooperating with the tutor. Students have resources in the form of faculty support provided by the university and project supervisors within the company itself. Students interned in a variety of departments such as architecture, structural design, and MEP. After a month-long introduction, students appeared to have rapidly progressed in their modeling and secondary development on BIM software skills.

At the end of the month-long orientation, students were provided a chance to apply their BIM skills toward the demands of a real project, which, in this case, was a 70-thousand square meter construction zone being designed in Zhengzhou, China.

The team leader was placed in charge of project scheduling and communication between the job-site tutor and team members. Students accepted different roles, according to their majors. In two months, they finished modeling the architecture models, structural models, MEP models, internal and
external roaming, and the collision test. Secondary development based on Revit by using C# was used to create a platform of construction, which included guiding information in various construction stages. The result list is shown in table 1.

<table>
<thead>
<tr>
<th>Name</th>
<th>Software</th>
</tr>
</thead>
<tbody>
<tr>
<td>Architecture modeling</td>
<td>Revit Architecture</td>
</tr>
<tr>
<td>Structure modeling</td>
<td>Revit Structure</td>
</tr>
<tr>
<td>MEP modeling</td>
<td>Revit MEP</td>
</tr>
<tr>
<td>Roaming</td>
<td>Lumion</td>
</tr>
<tr>
<td>Collision test</td>
<td>Naviswork</td>
</tr>
<tr>
<td>Platform of construction</td>
<td>C#,API,Visual Studio</td>
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</table>

The models of this project and the platform are shown in figure 1. The architecture model by using Revit architecture is shown in figure 1-a; the structure model by using Revit structure is shown in figure 1-b; the integration of architecture, structure and MEP model is shown in figure 1-c; the detail of MEP model by using Revit MEP is shown in figure 1-d; the detail of steel roof is shown in figure 1-e. To build the roof model is a complicate part in this project. Student in charge of this part asked help from the company tutors and also teach himself to overcoming the difficulties appeared during the process. Figures 1-f show the detail of collision test, a process requiring the intern designers to modify the design plan based on results from collision test. The revision process produced alterations that, ultimately, reduced construction costs.

![Figure 1. Models of the Real Project.](image-url)
After finishing the models, secondary development was initiated which allowed for communication between workers and designers. A platform was designed by packaging the architectural methods guiding videos into the models. As shown in figure 2-a, when workers choose one building component, the corresponding videos show synchronous. Meanwhile, as shown in figure 2-b, the curve of the construction schedule simulation could be drawn in a coordinate system with the horizontal axis representing days and the vertical axis representing a complete accounting of parts. Figure 2-c shows how the accounting of building parts could be calculated according to style choices.

By taking advanced study and trying to do the research work associated with secondary development, each team member realized that the BIM technique means not only using the software but also using additional tools to make the software more convenient.

Although BIM technique could be used during the whole life cycle of an architectural project, more utilization focus on the design period, the research work on construction period and operation and maintenance period need scientists pay more attention on.

![Platform of Construction](image1)

![Construction Schedule Simulation](image2)

![Account of Building Elements](image3)

Figure 2. Secondary Development.

**Summary**

The BIM technique has been used in China for ten years. At this point, too few Chinese architecture designers have the training to design using BIM techniques. Developing the kinds of advanced training opportunities in China brings challenges and opportunities. Teachers should look to using techniques that offer students valuable learning experiences. As one such technique, internships can provide students with a powerful learning tool.

Applying the knowledge of BIM in real project is an effective way of helping students develop not
only technical abilities but also the capability to create effective collaborations among their student, faculty, and on-the-job colleagues. Ultimately, internship possibilities fulfill the task of building 3D models using classroom-developed BIM skills. Such interactions thereby increase students’ engagement.

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References


