

Flipping the Construction Management Class: Beneficial?

Dr. Rajarajan Subramanian, Penn State Harrisburg

Rajarajan Subramanian is currently working as an Assistant Professor of Teaching at Pennsylvania State University at Harrisburg. Previously, he worked for four years as Transportation Engineer at Maryland State Highway Administration. He earned his Ph.D. and master's degree in engineering from the Department of Civil & Coastal Engineering, University of Florida. He has 25 years of experience with government, academia, and industry. He was a Senior Lecturer at Annamalai University, India, teaching civil engineering for about 10 years. He also worked in Linton Institute of Technology as a Senior Lecturer in Ipoh, Malaysia, for three years.

Dr. Fazil T. Najafi, University of Florida

Dr. Najafi has worked in government, industry, and education for many years. He received his BS, MS and Ph.D. in civil engineering from Virginia Polytechnic Institute and State University. His experience in the industry includes work as a highway, structural, mechanical, and consultant engineer and construction manager for US government and private companies. He taught in the Civil Engineering Department at Villanova University, Pennsylvania, a visiting professor at George Mason University, and the University of Florida, Department of Civil Engineering and Coastal Engineering. He has published and presented more than 300 refereed publications. He has received numerous awards including a Senior Fulbright scholarship award, teaching awards, best paper awards, community service awards, and admission as an Eminent Engineer into Tau Beta Pi. His research on passive radon-resistant new residential building construction adapted in HB1647 building code of Florida Legislature. Najafi is a member of numerous professional societies and has served on many committees and programs, and continuously attends and presents refereed papers at international, national, and local professional meetings and conferences. Lastly, Najafi attends courses, seminars, and workshops, and has developed courses, videos and software packages during his career. His areas of specialization include transportation planning, Engineering and management, legal aspects, construction contract administration, Renewable Ener

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Abstract

Flipping the class means changing the traditional style of teaching (via lectures) to facilitate self-learning through engaging the students. The students' attention span is as short as 15 minutes; hence, the traditional lecturing does not promote effective learning. Sometimes, flipped class looks chaos when 50 or more students interact with each other to try to solve engineering problems to arrive at the right solution. Nevertheless, at the end of the class period, the number of students that learn the subject precisely improves a lot. Recently, flipping the classes has been used widely in all kinds of classrooms across the globe, whether it is K-12 educational institution or post-secondary educational establishment.

Construction Management is a course that cannot be taught by mere lectures only. It has a lot of definitions, principles, theories and hypotheses that need to be taught in 50-minute class setting. Given the fact that the attention span is short for most of the audience, it is difficult to create keen interest among students in the class for the whole 50 minutes' period. Effective teaching is very difficult to incorporate in the classroom. Flipping the class to hands-on activities yields promising results. Hands-on activities can include exercises such as group discussion, Building Code review exercises, Shadowing Construction Managers at construction sites, working through construction management software and working on a mock construction project.

This paper explores the different ways of flipping classes and their advantages and disadvantages through different case studies and the personal experiences of flipping classes for the past 20 years of teaching.

Introduction

Construction Management (CM) has been one of the courses of Civil Engineering Curriculum that most of the educational institutions offer across the United States. CM consists of major modules such as planning, design, and construction. Overall, CM has the different aspects such as bidding, contracts, scheduling, quantity takeoff, estimating, construction, safety and close out that are enmeshed indistinguishably. These different modules are inextricably interlinked in the solution of real-life problems. For this reason, the teaching of construction management is ideally suited to a combination of traditional and problem-based methods of teaching. Where the traditionally taught classes permit the efficient delivery of basic knowledge, problem-based learning classes provide the opportunity for synthesis of the knowledge, development of skills, and the possibility of developing innovative solutions to engineering problems (Williams, 2002).

Initially, "Universal Design for Learning (UDL) was developed in such a way that the people from all walks of life can enjoy learning in equal manner. Later on UDL was misunderstood as though it can be applied to people with physical or mental disabilities only. It is essential to learning that the information or materials of a course has to be accessed easily, but is not sufficient. While designing accessible information is very much essential for UDL, facilitating an accessible tutelage is also important for students.

The framework for UDL is based in findings from cognitive neuroscience that tell us about the needs of individual learners. It embeds accessible pedagogy into three specific and central considerations in teaching: the means of representing information, the means for students' expression of knowledge, and the means of engagement in learning" (Rose et al. 2006).

The "flipped classroom" approach has been used for years in some disciplines, notably within the humanities. Barbara Walvoord and Virginia Johnson Anderson promoted the use of this approach in their book *Effective Grading* (1998). They propose a model in which students gain *first-exposure learning* prior to class and focus on the *processing* part of learning (synthesizing, analyzing, problem-solving, etc.) in class.

To ensure that students do the preparation necessary for productive class time, Walvoord and Anderson propose an assignment-based model in which students produce work (writing, problems, etc.) prior to class. The students receive productive feedback through the processing activities that occur during class, reducing the need for the instructor to provide extensive written feedback on the students' work. Walvoord and Anderson describe examples of how this approach has been implemented in history, physics, and biology classes, suggesting its broad applicability (Berrett D, 2012).

Flipping of Construction Management Course

Construction Management course can be flipped in different ways. In the following sections three different case studies are analyzed.

Case Study 1

A graduate level course was designed having the Building Information Modeling (BIM) as the core of the syllabus. BIM was used in this course to integrate project management skills and construction related expertise with the aim of finishing a building construction project on time. The pedagogy includes traditional lecture, group learning, hands-on assignments, team discussion and presentation, reading pertinent literature, case studies and independent learning. BIM is a process-oriented approach that emphasizes on learning BIM as a revolutionary construction management process and its impacts on the success of projects.

The course structure includes several learning modules and each module consists of four different sessions as follows:

1. Introductory oral presentation accompanied by exclusive studying materials;
2. Lab 1: Teaching Assistant leading a hands-on-exercise tutorial by a well-defined procedure.
3. Lab 2: Question and Answer session addressing the students' questions after group discussions.
4. Feedback and discussion-assignment delivery and presentation.

Through these modules, the students gain the core BIM knowledge, hands-on experience with the state-of-the-art BIM results, and cross culture joint effort experience from students of different countries with various backgrounds. With the help of group efforts, all lab assignments are done. Three to four students are allowed to form the teams from different levels of industry experience and varied backdrop.

Over the period of five semesters, the proposed process-oriented BIM pedagogy approach was successfully carried out and very well received by students. The course evaluation and students' learning outcomes at the end of the semester illustrated the advantages of this type of pedagogy. In summary, this course can be judged a successful pedagogical experience for teaching BIM in Construction Engineering and Management programs (Li Wang, 2014).

Case Study 2

Learning Construction Management includes Scheduling and Estimating techniques along with Management skills. Learning the logic of Construction Management and managing its accompanying risks at the undergraduate level is very difficult because of lack of field experience. Teaching construction scheduling to students requires detailed and comprehensive learning of the methods and procedures involved in construction along with the impacts of risk and uncertainty on the methods and processes of construction.

The challenge, then, in teaching complex construction concepts lies in involving students in a more active form of learning to enhance knowledge acquisition and retention. Simulation technologies and serious games have been demonstrated to foster active learning through increased engagement as opposed to the passive memorization typical of traditional teaching methods (Dede and Lewis 1995). An educational simulation is generally defined as a simplified model of reality or set of abstract concepts that provide basic information that facilitates student learning and understanding (Sawhney et al. 2000). Simulations are developed around learning situations that contain contextual information mastered through reflection and interaction with the virtual environment (Dede et al. 1999).

A University research aimed at developing a (Four Dimensional) 4D learning module, the Virtual Construction Simulator (VCS) to soak students in a 3D model to produce a building construction sequence by effective interaction. The VCS game simulation was tested in Spring 2010 in an introductory building and construction management engineering course of eighty-six students. A two-hour practicum session was used for the exercise, during which students were asked to develop and simulate the project sequence using the VCS application.

Given the budget and available resources, the students were asked to test and report how quick they can build a pavilion under given constraints in order to bring out the competitive criterion of the assignment. Following this planning stage, students enter the simulation mode and move through daily simulation cycles in which they determine daily site resources and observe progress through daily summary reports. The as-planned schedule serves as a guideline to the overall schedule duration; students can accelerate activities by "hiring" more resources during the simulation as needed. In other words, the VCS game really created a construction scenario inside the classroom to meet the real-life construction needs out in the field.

To understand the level of student learning, motivation and their perception of the simulation experience, data was collected through pre and post survey questionnaires. Analytical information such as academic standing and previous experience with computer games was collected to improve the accuracy of the analysis. By using open-ended questions, the level of know-how in construction concepts was measured and compared to determine if the simulation experience make an impact to see if there is any change in learning occurred.

The VCS game activity and both surveys were completed by 80 students. Same instructor handled both the class sections. The results from surveys confirmed that the use of VCS game really reinforce the entire learning process of Construction Management course. The following benefits are the outcome of the application of VCS game in the course curriculum.

1. VCS demonstrated its value in providing a visual, interactive, realistic and engaging learning experience.
2. VCS games are generally perceived as more interesting than lectures and other formats of traditional teaching methods.
3. Information retention is another important issue when implementing simulations and educational games. It can be generally perceived as information retention has highly improved.
4. Immediate feedback shifts the student's role from passive to active learner, complements instructor feedback, and creates opportunities to raise more questions and richer in-class discussions.
5. Motivation to learn grew larger.

Based on the results, the VCS will be improved and further developed to incorporate additional educational and structural factors. With an elaborate dataset, the effect of gender differences and learner preferences can be further explored to enhance the effectiveness of the VCS as a teaching tool. Using strategies such as role-playing and self-evaluation, game-based simulations in construction engineering education can provide students with opportunities to learn construction concepts through practical experience (Dragana Nikolic, 2010).

Case Study 3

Recently, teaching the students "Construction Management" with only lecture-based classes has become very difficult. There is a general notion that any "Management" course cannot be taught in the "classroom only environment". The purpose of education is to serve the students community with the updated knowledge in the respective field so that they can face the real-world situations with minimum problems.

In this study, some of the latest methodologies, techniques, usage of various internet sites and software are explained. Particularly, the usage of different internet websites for construction-oriented purposes is very helpful for the students to learn about how the construction companies do business in the real world. To complement their learning experience, the site visits, the video shows on construction, guest lectures and shadowing the Construction Managers at the construction sites are very helpful. They also get involved with writing a report on how to do a construction project by choosing any building type that they want to construct.

The following activities are arranged for the students to get involved in classroom events and learn effectively the course content.

Course Modules

1. Examinations: There are two examinations given in the whole semester time period.
2. Class works: There are about 20 classwork assignments given during the entire semester. Each one is unique that involves lots of challenging activities including online exercises and construction related articles reading assignments.
3. DVD shows: There are about 4 video shows done in a semester.
4. Site Visits: Minimum of 4 Site visits are undertaken.
5. Guest Lectures: Minimum of 4 Guest speakers spoke before the students giving 50 minutes' worth of lecture that explains the field experience.
6. Group Discussions: Minimum of 2 discussion sessions per semester that involves students led group activities with brainstorming sessions and debates.
7. Site Manager Shadowing Project: Students will visit a site and follow the site supervisor or manager for a day and note down all the activities the supervisor gets involved and make a report for 4 to 5 pages explaining the experiences with the supervisor and the construction site.
8. Internet sites such as "Construction Management" online modules can easily facilitate the construction managers conduct the project from concept design to closeout without much difficulty. Good organizational structure is built into this online software that can be used for conducting construction projects with ease.
9. The Department of Transportation websites include lot of information such as bid tabs, project details, and specifications. The students can be asked to figure out the companies winning bidding amounts and their comparison to the other bidders to discuss the reasons and make a report containing the strategies followed by the winning company.
10. Also, the online bidding sites can be used to figure out how to bid for a construction project. Students are asked to analyze these sites and give comparison report on the advantages and disadvantages of these sites.

Each module is important to the student for the effective and successful learning of the course in the classroom. Sometimes the students feel that the workload for this course is overwhelming comparing to the other courses in the same semester. However, upon closer examination it is clear that most of the work is done inside the classroom or within the class period. Outside the classroom, a student spends time for the site visits module and the Site Manager Shadowing Project module.

The students are very much engaged in the classroom activities with these introductions of different modules. Some students felt that they studied two courses in one course.

From the feedback of students who took the course, the advantages of these different modules are as listed below:

1. Students learn lot better with different module system than with the power point lectures system.
2. They feel connected to the industry personnel and helpful for their job search.
3. They feel they are empowered through the Group discussions.
4. Through the DVD shows, they got to see the latest technology used in the construction industry.
5. The project at the end of the semester, gives them the feeling as though they have finished a big project and the feeling of learning Construction Management as a complete course.
6. Most of the students are responding to the different types of class settings and instruction modules enthusiastically.

The disadvantages of these modules are given below:

1. Students feel that they are overwhelmed with too much information about construction and construction management in one semester.
2. Site visits have their own risk from the safety point of view. Instructor bears the responsibility of taking the students to the site safely and brings them back to the campus.
3. Group discussions sometimes encourage too many arguments and quarrels over subject matter.
4. Few students cannot handle the pressure of managing different modules of the coursework.

Also, there are some disadvantages to the instructor that are listed below:

1. It needs 50% more time to prepare for this course. The reason could be that it was tried first time. Over the time, it is possible to reduce the preparation time for this course.
2. Course organization was bit difficult to do, because of handling various modules of ways of instruction.
3. Sometimes the communication was difficult for site visit arrangements, site shadowing arrangements and guest lectures.

Overall, the introduction of seven modules into the course on Advanced Construction Management class yielded lots of benefits. From the feedback of students, it is clear that they have a feeling of getting a good quality education of Construction Management in the classroom setting.

Conclusions and Recommendations

Five semesters of data collection have proved that the process-oriented BIM teaching approach was successfully implemented and well received by students. The advantages of this type of pedagogy are that the students gain the core BIM knowledge, have hands-on experience with the state-of-the-art BIM results, and enjoy cross culture joint effort experience from students of different countries with various backgrounds. In summary, this course can be judged a successful educational experience for teaching BIM in Construction Management programs.

The results from surveys confirmed that the use of VCS game really reinforce the entire learning process of Construction Management course. Based on the results, the VCS will be improved and further developed to incorporate additional educational and structural factors. Using strategies such as role-playing and self-evaluation, game-based simulations in construction engineering education can provide students with opportunities to learn construction concepts through practical experience. With an elaborate dataset, the effect of gender differences and learner preferences can be further explored to enhance the effectiveness of the VCS as a teaching tool.

Overall, the introduction of seven modules into the course on Advanced Construction Management class yielded lots of benefits. From the feedback of students, it is clear that they have a feeling of getting a good quality education of Construction Management in the classroom setting. The students' feedback was gathered through the "Students Rating of Professors" at the end of the course.

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