Experiential Learning: Using Small-scale Projects to Teach Project Complexities and Relationship Roles in Construction

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Experiential Learning in the Classroom: Using Small-Scale Projects to Teach Project Complexities and Relationship Roles in Construction.

Abstract

Experiential learning opportunities give students the ability to understand the implications of principles and theories learned in the classroom through lived experiences. This article examines the use of a construction project simulation activity to teach project management principles in an undergraduate construction management course. After a description of the experiential learning theory and relevant literature examining experiential learning simulations in education, it provides an overview of the methods used to create the experience of small-scale design–bid–build project simulation in a project management course. Around 240 undergraduates students at the junior or senior level participated as designated contractual players in the project and went through the project from inception to completion over the course of 5 weeks. Finally, it offers a brief discussion of the implications of the findings for construction management and engineering education. Specifically, it discusses that simulated projects possess the potential to provide unique learning opportunities particularly, designed experiences triggering different emotions within the structures of the traditional classroom.

Keywords

Experiential learning, simulations, construction

Introduction

This paper discusses the use of a small-scale design-bid-build project simulation to provide experiential learning for construction management students in the College of Engineering and Technology at Brigham Young University. Experiential learning opportunities like this allow students to explore the implications of principles and theories of the industry by learning in the classroom through their own direct, lived experience in a low risk setting. Reflecting on their experiences helps them develop understanding and application of the concepts they are learning in class and it also provides a foundation of experience that can help them in future projects.

Even in this little project I can see that there can often be issues between the owner and what he envisioned and what is reality when it comes to building a building or home or some other project. I think this was a helpful exercise to help put into perspective that everyone needs to be better at communicating and helping people see their vision. Ethan, a construction management student, statement made in response to his experience with the class project simulation.

Although he may not have realized it, Ethan’s reflection on his experience in small project simulation succinctly summarizes principles similar to those Kolb and Kolb (2008) describe as essential parts of experiential learning when they explain:
Immediate or **concrete experiences** are the basis for observations and **reflections**. These reflections are assimilated and distilled into **abstract concepts** from which new implications for action can be drawn. These implications can be **actively tested** and serve as guides in creating new experiences. (p. 5)

Although experiential learning opportunities are already being used in construction management programs by taking students onto actual job sites, as well as experienced gained during internships and work experience, other opportunities exist in the classroom to simulate project scenarios that illustrate project stakeholder relationships. Specifically, simulations in classroom settings can help students discover feelings and emotions that come along with scenarios in the industry including some they may not have considered before. This study examines one use of a team project simulation in a project management course in an undergraduate construction management program. It highlights relevant literature supporting the use of experiential learning and simulations in education and provides an overview of methods used to conduct the simulation and to report observations from the experience. We also offer a brief discussion of the implication of these findings for construction management and engineering education. Specifically, it examines the following research questions:

- What principles of project management do students learn from participation in the small scale design-bid build- project simulation?
- How does experiential learning, specifically a simulation, provide students with opportunities to explore communication and professional issues?

**Conceptual Framework**

Philosophers and educational researchers rely on a variety of theories of teaching and learning to make sense of the way teaching and learning occurs. Building on Dewey’s theory of experiential education (Dewey 1938), and drawing on the work of Piaget (Piaget, 2000), David Kolb developed what he called the Experiential Learning Model (Kolb, 1984). Like his predecessors, Kolb’s theory also emphasizes experience and learning through doing as central to meaning making and learning.

Kolb’s work, specifically designed to describe the management process as learned by managers, teams, and organizations, described three key components as central to experiential learning (Kolb & Kolb, 2008). In order to achieve the desired outcome of an experience or activity, first students must interface directly with the content area being studied in order to grasp key concepts. Second, students receive feedback on their initial involvement or ideas and reflect on this initial learning experience. Then third, students take the experience to a higher level of abstract comprehension by applying analytical skills in order to better understand the content.

Kolb’s model of experiential learning supported the team project experience simulated in the course by providing a concrete experience for the learners to use as the basis for their reflective observations about different issues, trends, emotions and challenges in the field of construction management. These reflections were then evaluated and discussed with the students to help develop an understanding of different issues they might face in the field of construction management.
Review of the Literature: Experiential Learning Simulations in Educational Contexts

When applied to the classroom, experiential learning takes multiple forms. The most common, which serves as the focus of our study, centers on simulated experiences. In contrast to case studies where students simply talk about how a situation should be resolved, experiences require active participation in solving the dilemma, resolving the issue, or responding to a situation (Asal, 2005). Simulations and experiential learning provide active learning approaches that put individuals in automated situations to teach “real life” lessons (Sanders, 2013). In the context of this paper the term simulation is used to refer to an activity designed to provide students a realistic imitation of real project challenges they may face.

Simulated experiences are used in many educational domains, from learning to maneuver heavy machinery at a jobsite to experiencing the stress of a factory assembly line while studying the industrial revolution in school. In academic settings, simulations have been used in many forms over the years (Troka & Nedelman, 1975). In the sciences, experiential learning simulations take the form of experiments that allow students to test hypotheses as they engage in the scientific process of inquiry (Bell & Smetana, 2008). Political science professors use simulations to engage students in ethical dilemmas (Wheeler, 2006). Although they often take the form of a face to face or computer generated experiences, a simulation presents students with a situation that represents a circumstance faced in real life (Ellington, Gordan & Fowlie, 1998). Simulations in the form of learning games can be utilized in the classroom to create real-world experiences that allow students to learn, enjoy and engage in subjects that can demonstrate complex scenarios (Korman, 2011).

In the field of construction management education, simulations are used to teach processes or operations and vary by their scope and level of interaction (Mukherjee & Rojas, 2005). Several simulations have been developed to teach construction management skills in a wide variety of simulated contexts (Goedert, Cho, Subramaniam, Guo, Xiao 2011; Ndekugri, Lansley 1992; Rokooei, Goedert, & Fickle (2015); Rizk, 1993; McCabe, Ching, & Rodrigues, (2000); Jaafari, Manivong, & Chaaya (2001). For example, Korman (2011) used a construction industry simulation “COINS” to integrate project management practices into multiple courses in the curriculum at Cal Poly San Luis Obispo. Simulations also encourage autonomy as students respond to situations based on their own thoughts, motivations, and desires (Arnold, 1998; Kachaturoff, 1978). As students are required in a simulation to work through the problems they face, their thinking must move beyond basic recall and they must use higher-order thinking skills, such as the application and analysis of information, and evaluation of decisions and choices made by themselves or others (Wheeler, 2006). The construction industry is an experience-oriented field where students need experiences to learn general knowledge they will need in their career. Some experiences can be recreated in a classroom but there is not always an easy way to learn all the aspects of construction management in a classroom setting. (Lee, McCullough and Chang, 2008)

The learning exercise discussed in this paper examines lessons that apply directly to construction management. This simulated experience presents a unique opportunity for students to experience project relationships in a low stakes setting. It has been shown that this experiential form of
learning has a deeper and longer lasting impact than simply discussing the desired outcomes (Sanders, 2013).

Methods

Construction Management programs prepare students for management positions in the construction industry by providing them with the educational tools they need to be successful. Hands-on experiences coupled with theory-based instruction prepares students to become well-rounded professionals. It is a rare building project that does not require the contributions of a broad range of participants, including the building owner, architects, engineers, specialized consultants, prime contractors, subcontractors, regulatory officials, user groups, financiers, real estate brokers, title companies, attorneys, and more. Achieving a well-built building depends not only on a sound knowledge of construction technology, but also on the ability to communicate effectively and to apply technical knowledge in the context of a project’s often competing priorities and complex web of participants.

For this study a multiple-case study design was used to research the principles project management students learned by participating in the designed project simulation. It also served as a basis to understand how the project provided students opportunities to explore relationships, feelings, experiences and challenges they may face in the industry. The research examines issues from overlapping disciplines, namely the practices and procedures that govern what construction and engineering companies can and actually do, as well as the questions of the humanities that examine the ethics of what people do, as well as approaches within the field of education that examine how to teach abstract concepts to students. Therefore, case study methods are an appropriate fit.

Participants

The participants in this course were comprised of Construction Management, Facilities, Property Management, and Civil Engineering Majors. It is a 400 level class where most of the students are juniors and seniors in their courses of study. The simulation exercise has been performed over 4 years and over 240 students have participated in the simulation. Before the simulation begins and while the simulation is going, students are learning principles and methods that coincide with the simulation they undertake. This simulation takes place over a 5-week period during the semester. Students assembled themselves into groups of three and were asked to assign the roles of Owner, Architect, and Contractor to members of the team.

The Simulation

Intent of the Simulation: The design of the simulation is to mimic the construction process and team dynamics of a traditional design-bid-build construction project in which there is an owner who hires and architect to design a project, and then a contractor who builds the project. The simulation has the players go through the process of construction while implementing project management skills taught in class so that those skills are reinforced and the communication chain is followed to complete the assigned tasks and to complete the project. The instructor also purposefully introduces changes or challenges in the process that mimic real life situations that might happen on projects. These changes and challenges help promote problem solving and
conflict resolution scenarios for the students to overcome. The assignment instructions included below are then given to each team.

**CM Project Team Assignment Instructions**

To complete this exercise, you will be assigned a role representing the key players in the building process. The exercise will focus on communication and teamwork rather than building techniques and materials. Your goal is to complete a simple construction project, from initial conception to finished product. Don’t be fooled by the seemingly simplistic nature of the construction itself. In this exercise, you will be using technology with which almost every student of design and construction should be familiar with.

You should gain from this exercise an appreciation of the challenges in achieving a coherent and successful project in the context of a process that involves many participants. When you have finished this exercise, imagine increasing the scale of complexity many orders of magnitude, as is the case with almost any real-life project. As a project manager, remember that successful building construction requires technical knowledge, the skills to apply that knowledge, and the ability to get others to complete the desired project.

**OBJECTIVE**

Design and build a simple object within a limited budget and time frame. The constructed object is to be made of easy to obtain materials. Past class groups have used paper and glue or tape. This semester you can expound the items you will use if you so choose. The maximum budget is $5.00. (Any changes to this will require a signed change order by instructor!) In addition, you can use any materials that the OWNER can successfully negotiate from an outside party at no cost.

**INSTRUCTIONS**

NOTE: All submissions (except the final product) from any group must be turned into the instructor as well as to the other parties involved.

1. Groups of 3 students will be selected. Each of you will be assigned a role of either Owner, Architect (Designer/Consultant), or Contractor (Project Manager/BUILDER).

2. The first day of this project some of you will be assigned to be an Owner. Your task that is due 1 week from the class period this assignment is issued is to write a concise project statement describing broadly the goals for the project. What kind of object is desired and how should it look? Don’t try and describe how it is made or define its characteristics in detail. (Isn’t that typical of owners?) You have no more than $5.00 to spend and need it completed in 5 weeks. This project statement must be typed and is due as Part 1 Project Team Assignment. The Owner needs to turn this in via email to the instructor and also needs to provide a copy to the Architect.

3. The second part of this group project begins one week from the date this assignment was handed out. The person chosen to be the architect in your group is assigned to review the project statement with the Owner. If necessary, changes in the Owner’s requirements should be negotiated until all parties are satisfied that the project is achievable within acceptable limits of time, budget, and quality. Your task will be to type a set of construction documents, consisting of drawings and written specifications for the project. The drawings should describe the shape, size, and arrangement of the object and construction, and provide any necessary assemble or finishing instructions. It is up to the Architect to organize their efforts so as to efficiently combine their
efforts and produce the required documents within the established design budget. This will be turned in as Part 2 Project Team Assignment. The Architect will email the documents to the instructor and get to them to the Contractor and Owner.

4. Beginning Part 3 of the Project Team Assignment, (Once Part 2 is completed), the plans and specifications will be given to the Construction team. The Contractor will have time to review the documents and prepare any written RFI’s, and review the project to make sure it can be built according to the requirements. RFI’s to the Architect (copy the instructor via email) are due on the date listed on the schedule.(At least one RFI from the Contractor is due as part of this assignment.)

5. RFI Responses from the Architect to the Contractor (and copied to the instructor) are then due on the date listed on the schedule.

6. Once RFI responses have been returned to the Contractor, this signifies the Notice to Proceed on Construction. No change orders will be allowed from this point on this project.

7. Once RFI responses have been returned, the Contractor needs to prepare at least 1 submittal to the architect and have the architect approve the submittal.

8. All projects will be completed by the Contractor and turned in to the Instructor NLT the date listed for Part 3 Project Team Assignment.

Grading- Groups will be graded on the different submittal requirements and the successful completion of the project. Any deadlines missed will be assessed liquidated damages of 5 points per day.

In addition to the assignment instructions above, once the projects have been turned in, the teams are given an analysis form to complete to determine how the project went, and to assign grades to their team members and includes the following questions:

1. How successful was the Owner’s original intent achieved in the final product?
2. How did the Owner’s vision differ from the team’s?
3. How did the division of labor among the project team help to improve the results of the project?
4. Were plans and specs easy to write and sufficient for the builder to complete the project with minimal questions?
5. Did the Owner’s goals get lost in translation? What kind of misunderstandings occurred? Did different team members have conflicting goals?
6. How do you imagine these issues playing out in real-life design and construction projects?

Once the projects and team analysis has been turned in, the instructor looks at the project documentation to determine if the goals of the owner were met and if the projects reflect the plans and specifications of the architect.

Project Evaluations

There are many lessons that can be taught using this project assignment. Many of these lessons came as a result of student responses in their reflection of the activity during their team analysis, as well as from student comments during the simulation and the quality of the projects turned in. Many of the projects turned in did not match the scale or drawing intent and in some extreme
cases don’t even reflect the type of project the owner asked for. For example: one Owner asked for an 18” replica of the Washington Monument to be built out of paper. When the project came in it was only 9” tall and had a flat top instead of a pointed one. Another example was an Owner who wanted a house made out of sugar cubes. The architect drew the house plans with each of the walls being 5 sugar cubes long. When the project was turned in, each of the walls were 7 cubes long. In another case, a group of 4 was created where 2 students were assigned to be competing contractors building the same plans from an architect. The project was to be a pencil holder made from a tin can and popsicle sticks. The two projects submitted looked very different from each other with one being completed skinned in popsicle sticks and the other having a 1” gap between each stick. Lessons on quality and following plans were learned from these projects. Many other examples of projects using the wrong materials, being built to the wrong dimensions or specifications, or even not being built at all or only partially completed at the due date have provided valuable learning experiences for the students.

During the team review process, the students are asked to grade their team members. The students have routinely graded each other very lenient despite the poor quality of the projects. The majority of all team members give everyone on the team a 95 or above even if the project was a failure. The instructor has used the lack of quality of projects that have been turned in and the lenient grading to provide many lessons for the students. Research shows that students need to participate in discussions as a whole group or as a class- to benefit fully from simulations (Goodrum, 2004). So as a final culmination of the activity, the instructor brings in all of the projects into the classroom along with other professors with construction experience or industry professionals and enlists their help in grading the projects openly in front of the class. The instructor also asks the class for help in grading the assignments since the grades given by the groups did not realistically reflect the quality turned in. The instructor points out the quality issues as well as any mistakes in documentation and then proceeds to issue low grades to projects in front of the class. This exercise allows for a class discussion to occur.

Once the grading starts, then some of the greatest lessons from the simulation come into play. Students upon seeing their projects being graded low by other classmates and the instructor begin targeting the other projects and students and giving lower scores to other projects trying to posture themselves in a better position in regards to their grades. Emotions often run hot in this exercise as students start to place blame on their team members and other students. If contractors did not turn in the project on time and liquidated damages were assessed to the entire team the Architect and Owner of these groups become frustrated with the lack of control over the outcome of their grade. In some cases, to entice discussion on the matter and to stir emotions, the instructor will pick one or two contractors each semester and tell them before the project is due to turn in a late project or a substandard project without letting the owner and architect know about it. The instructor feels this practice teaches some of the greatest lessons to those who are the Architects and Owners of those groups. The experience of having strong emotions involved in the experience helps to concrete the experience for students. After the in-class grading is completed, the instructor lets the students know that the assignment is a non-graded assignment and that the low scores they had just been given will not affect their grade. Once this knowledge comes to light, students are then asked to share some of their feelings about the project and the lessons learned from the class discussion and the instructor had found these discussions have taught the students valuable management lessons that they can use in their careers.
Data Collection

The data collected as a part of this activity came from two sources: observations (Clandinin & Connelly, 2000) and student reflections that allowed students to articulate through writing their own understandings from the exercise (Colley, Bilics, & Lerch, 2012). The observations included notes of participants’ behaviors and comments.

Observations of the authors
As the authors observed the students participating in this simulation several lessons stood out. The authors had the opportunity to observe the students throughout the course of the simulated project. The instructor was copied on all of the emails from students, which in some cases were minimal for some groups. The instructor could see that design intent would change from the architect to the student and that many times there was no documentation of changes made. Students would also voice their frustrations with team members and the lack of communication or the lack of progress they were making. As students went through the exercise, it was observed that: students were able to better understand the importance of communication, they had to work on dealing with others who do not perform, students learned the power of emotion in teaching management principles and how emotions can affect their performance, and that many of the challenges experienced in the actual construction industry are evident in even small scale projects in low stakes scenarios such as the classroom.

Examples of Student Reflection
Perhaps the most valuable lessons learned from this simulation were from the students’ own observations and reflections. Some examples of student comments about the experience are given below.

“In class we were destroyed by the “experts of the industry” This helped me realize the importance of documentation and the reality of how important quality is to owners. In my future career, quality control programs will be a very important aspect of my work. Overall this simple project helped us see the relationships that exist among the players on a construction project. It helped me see the importance of documentation, drawings, and quality control. It will help me a lot in my future career.”

“I thought this was a great project because of the emotion it created. The day of reckoning was a great learning experience and taught me some very valuable lessons. One lesson I learned was the value of setting expectations. Because there was no expectation, there was not a whole lot of quality. The greatest lesson is when the instructor went through every project in front of the whole class. My group went first and that was really tough. I didn’t know he was going to go through everyone’s project. I felt picked on and humiliated. When other students started commenting on the quality it made me so mad. Once the instructor started picking at other projects I figured out what he was doing but I still had some strong emotions with me. This is what I liked best about this lesson. Because of the emotions I felt, I will never want to feel those
again. It was such a terrible feeling to get called out that I will never forget it. I will make sure I take pride and never get chastened because of my lack of effort.”

“This assignment was good. This was one of those assignments where the student really gets to connect to real life.”

“This assignment makes me want to be more honest. I don’t want to give people 100/100 for work that wasn’t done correctly. This assignment makes me want to put in more effort. It made me ask myself the question “Why would I turn in garbage work, if my work defines my effort?” The class evaluations were done on a Wednesday class a week and a half ago and yet I am still thinking about the lessons we learned in that class. I think that says a lot about the value of this project.”

“Often times throughout the project I felt like I was being ripped off. Now the group I was with are great guys and I mean nothing against them for their actions. As the architect I came up with designs and specifications and each time I received an email from the contractor everything changes. Most of the time I felt like I was being left out of the loop throughout the project. I tried to keep in contact but the owner and contractor always seemed busy…… In conclusion, this is one of the best experiences I had during my college experience. I will reflect again and again on this experience when I begin my career in construction management. I learned the importance of communication, planning, dealing with emotions, and including best effort to be put into anything I do.”

Findings & Discussion of the Data

The primary researcher was the instructor in this exercise who introduced and facilitated the simulation. He also developed the simulation to focus on issues many project managers face in the construction industry. The intended simulation was to replicate on a small scale some of the issues that construction project managers may face as they deal with project teams to complete projects. The other researchers assisted in analyzing and writing about the simulation. After reviewing the written team analysis responses, and observing the class discussions, the most common lessons learned by students from the exercise included, the importance of communication between team members in the construction industry, the difficulty of separation of roles and recognizing how emotions can affect team and individual performance. The value of having students experience some of the issues on a small scale helps to cement the principles of the activity for the students so that they can then draw upon this experience as they enter to workforce. One of the major experiences that the instructor finds beneficial is the fact that emotions are stirred throughout the project. When students have to rely on other team players to get their part of the project done and then are graded on what others produce, it simulates real life scenarios in the construction industry and reinforces the concepts of effective communication and quality control. When students experience strong emotions it strengthens the lessons taught rather than just having the instructor talk about what should be done. Often students learn in the classroom through prescriptive methods (what should be done), versus the descriptive methods (what is being done). This simulation lets students see how they react to
situations and then evaluate what effect their actions and emotions had on the project. For example, students might agree and nod their head if the instructor were to tell them in class that sometimes people in the industry can be unethical. But the lesson becomes much more meaningful when students get to experience the feeling of a classmate who they perceive to have participated in unethical behavior. For many students, the simulation caused them to reflect on their future interactions with co-workers who might behave unethically on the job. Many of the student responses made distinct connections between their peers who didn’t perform or withheld information and future co-workers who may behave in dishonest ways.

Conclusions and Directions for Future Research

Simulations and experiential learning activities possess the potential to provide unique learning opportunities within the structures of the traditional classroom. Simulations like small scale construction projects allow students to explore complex ideas in a safe environment with low risk involved. Otherwise, students would only have opportunities to learn some of these high-stakes lessons in an on the job environment where risk is maximized. Future research in construction and engineering education should examine opportunities to use simulations that give students unique experiences in educational contexts.

Perhaps just as central to learning as the simulation itself, student reflection should exist as a central feature of successful simulations. In this particular example, reflection occurred at three different times. First, when the students met together as teams to evaluate the project and each other, second when the class met together to grade and then deconstruct the experience and discuss parallels between the simulation and experiences they might encounter in the construction industry, and finally when they were asked to reflect about the whole experience in a reflection paper. The opportunity to engage in dialogue allowed them to not only make clear the relationships they saw, but to learn from others and their experiences as well. Reflection remains a key component to learning through simulated experiences. More research about what conditions all for optimal reflection will invite increased quality and learning from simulated experiences. Finally, a longitudinal study that examines how these simulated exercises influence students’ engagement in communication, ethics, and in specialized roles once they enter the field would also contribute to understanding to the role simulations play in construction management education.

References


