

Students' Perspectives about a Delivery System for a Residential Construction Management Course

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This paper presents the students' perspectives about a delivery system for a residential construction management course at a major university. The project-based course was delivered similarly to a capstone course by combining Residential Methods, Estimating, Scheduling, and Contracts into one class with one overall final project. The course introduced students to land acquisition, land development, construction services, operations, finance, marketing, and sales. Information about the course's 14 different delivery methods is provided in this paper. A survey was conducted to obtain the students' perspectives about the course delivery methods and combination of methods students preferred and found effective. Students also provided insight on additional delivery methods they preferred and found effective from other courses. The results of the student surveys are presented and discussed. Survey results provide information about alternative delivery methods not used in the course and information that may assist educators with developing the appropriate mix of delivery methods.

Key Words: delivery methods, residential construction, project-based learning, students' perspectives

Introduction

The core subjects in construction management are scheduling, estimating and contracts which are typically delivered in a lecture format in standalone classes (Chinowsky, Brown, Szajnman, and Realph, 2006). "The traditional segmented, topic-based approach to construction management curricula clearly has been successful at facilitating the attainment of specialized skills and concepts such as quantity surveying, estimating, or scheduling. However, the world does not always present problems that are topic specific and solved in a non-holistic manner" (Montoya, Kelting, and Hauck, 2009 p. 66). In the traditional construction management curriculum model, students may have a hard time "connecting the dots" between these classes "to grasp the overall process of construction management as a dynamic, synergistic engagement of subject matter and skills until they reach their final term or participate in a single capstone experience at the end of their education" (Hauck and Jackson 2005 p. 72).

Chinowsky, found the following results for students who went through their project-based learning courses:

- Students were more mature with greater communication skills and understanding of industry.
- Students obtained the ability to form questions that extended beyond the normal boundaries of the assignment.
- Students gained a deeper understanding of the construction industry.
- Students recognized they need to address challenges and create solutions to open-ended problems (Chinowsky et al. 2006).

The delivery system described in this paper is similar to the paper Peterson (2008) published in the Associated Schools of Construction Proceeding in 2008. The primary difference between Peterson's course and the one described in this paper was the students. Peterson's course was a capstone course for graduating seniors while the course described in this paper was for second year students. Peterson's class primarily applied knowledge gained from previous courses to the capstone project. The course described in this paper had to deliver new information to assist the students with the final project. Peterson provided the following conclusions about the project based delivery system for residential courses:

- Helps students in the transformation from "academia to industry".

- “Classroom structure and theory” is important for student motivation.
- “Smaller sized groups” helps with keeping all students involved.
- Developing a strong relationship with industry is a vital part of the project based delivery system. (Peterson, 2008, p.114)

Lujan and DiCarlo (2006) recognized that students have preferences for the ways they receive information. They concluded that having knowledge of students’ preferred method of information delivery can help the instructor customize the instruction to meet the individual student’s preferences, assist instructor with overcoming the thought of treating every student in a similar way, and motivate instructors to move away from their preferred mode of information delivery to use others.

Kelting and Hauck (2010) discussed how they delivered a capstone style course for an undergraduate residential construction management course in the second year. The course combined the components of residential construction methods and materials, scheduling, estimating and contracts into one class. The objective was to research how this type of delivery impacted the students’ communication skills, teamwork skills, and their understanding of the final project. They concluded that based on the students’ perspectives, delivering a project based curriculum to every student in their second year successfully prepares them for the homebuilding industry. The reviewers for the *ASC 46th International Conference Proceedings* commented that it would be interesting, for future research, to evaluate which method or combination of teaching methods is 1) more effective and 2) more appealing to students in their second year. This was unique because it focused on all of the delivery methods utilized in the course and the students’ perception of the overall impact on their learning. Kelting and Hauck (2010) included the reviewers’ suggestions and recommended that an area for future research would be to study which method of information delivery (e.g. lectures, field trips, etc.) is more effective and appealing to students. This is a follow up study based on their recommendation for future research and focuses on students’ perspectives of the entire course and its’ delivery methods. This paper also presents a summary and updates to the course delivery methods.

Methodology

Kelting and Hauck (2010) utilized the 5 point Likert Scale to rate the students’ perception of how various delivery methods helped with the students’ communication skills, teamwork skills, and assisted with their understanding of the final project. The survey results led to a ceiling effect which made it difficult to pinpoint the differences among these delivery methods. Due to the ceiling effect generated by the 5 point Likert Scale used by Kelting and Hauck’s (2010) results, the author adopted a forced ranking survey method for the current study. In order to expand beyond the survey questions, the author also utilized qualitative questions to allow students to share their thoughts about combinations of delivery methods and additional delivery methods. The research questions in this study differ from Kelting and Hauck’s (2010) because they focus specifically on which delivery methods students preferred and found most effective.

Research Questions

Based on Kelting and Hauck’s (2010) areas for future research, the following research questions were generated for this study:

1. Which method or combination of teaching methods did students perceive to be more effective in a second year residential construction management course?
2. Which method or combination of teaching methods did students perceive to be more appealing in a second year residential construction management course?
3. What additional delivery methods did students perceive as appealing or as an effective way for them to learn, based on their academic career?

History of the Project Based Delivery System for an Integrated Residential Course

Spring 2008 was the first quarter the faculty officially implemented the delivery system described in this paper. There were many iterations of pilot studies during which the students provided the faculty with feedback that has contributed to the course's current state of development. Montoya, Kelting, and Hauck (2009) discuss some of the student feedback in the areas of space utilization, ensuring individual learning when assigning work in groups as part of the project based delivery system, and the appropriate role of industry in the classroom. Kelting and Hauck (2010) concluded, "students perceived working on a quarter long final project simulating the current market helped them better understand the course material. The most impressive results were the students' perspective of the integration of estimating, scheduling, contracts and building methods. They felt the integration of these core subjects helped promote their understanding of the overall building process."

The average class size was 24 students. They were divided into six teams of four for both the lab assignments and the final project. The class met sixteen hours a week for a ten week quarter in the spring and 32 hours a week for a five week quarter in the summer. The course was taught in a laboratory space that was dedicated solely to homebuilding education. The class combined components of the following four classes: Residential Methods, Estimating, Scheduling, and Contracts. The following teaching methods were used in the class: lectures, lectures with a personal response system, in class activities and discussion, guest lecturers, labs, overall capstone project, peer reviews, exams, quizzes, field trips, reading assignments, homework assignments, working in teams, and student presentations.

Lectures

The faculty strived to immerse students in all aspects of the homebuilding industry through lectures and interactive discussions. The lectures covered material from acquiring land through the warranty process. The instructor introduced students to the following management concepts: land acquisition, land development, construction services, operations, finance, marketing, and sales. Current market conditions were discussed in great detail, as they were vital to the success of the final project. The lectures were designed to give students the information needed to apply the skills learned in the classroom to lab assignments and their final project. The lecture material in this course was designed to be interactive by assigning pre-lecture assignments and short class assignments during the lectures. These assignments led to many great discussions in class.

Lectures with Personal Response Systems

The lectures were delivered in Power Point and multi-media and many of them utilized a clicker personal response system to encourage and assess participation. Each student in the class had a personal hand held device that allowed the student to respond to multiple choice questions electronically. The instructor used the device to measure student understanding during the lecture. It worked like this. Approximately every twenty minutes during the lecture, the instructor asked the students a multiple choice question based on the lecture material previously covered. The students used their personal response system to answer the questions during lecture. The results were displayed in a graph to the students and later inputted into the grade book as part of their class participation grade. The personal response system was also used for class discussion, quizzes, and other activities. All lecture material was posted electronically so that students could refer to it.

Guest Speakers

Guest lecturers from different departments of residential building companies were brought in from industry to discuss various topics of the course, based on their experience. The faculty met with the speakers in advance of their presentation to discuss the students' project. This gave the guest speakers the ability to tie their examples to the class project. The guest speakers were also able to answer general questions students had about the project and offered insight and information that the lectures did not cover. This also strengthened the relationship between the building industry and the students. Two guest speakers were invited to present to the class. An Area Construction Manager gave a presentation on construction operations, scheduling, home owner relations and the warranty process. The discussion entailed current market trends and its impact on the building process. The second guest speaker was a subject matter expert in construction contracts; he discussed residential contracts and construction law.

Labs

A series of labs were assigned throughout the quarter. The labs were designed to reinforce the concepts covered in class and assist the students with their final project.

The quarter consists of four lab assignments:

1. **Lumber Market Lab:** Groups of students tracked the lumber market weekly and created a graph. One group was randomly selected weekly to present the current state of the market.
2. **Foundation Lab:** Students were given two different foundation designs for all homes on the final project. Students prepared a detailed quantity takeoff and cost estimate of the two different designs. They selected a foundation to use for their final project based on their estimate, soils report, risk analysis and additional research.
3. **Hand Schedule Lab:** Students created a schedule by hand on butcher paper of one of their assigned homes. Students calculated the early start, early finish, late start, and late finish for 25-30 activities. In addition, they calculated the free float and total float for each activity.
4. **Scope of Work Lab:** Students compared two different companies' scope of work for the same trade. They provided a detailed list of similarities and differences and a detailed analysis of both scopes of work.

Field Trips

The students went on three field trips during the quarter, two of which were to jobsites. Depending on the stage of the project, the project manager of the jobsite walked the students through pre-drywall or post-drywall orientation of the home. One field trip was to a custom home and the other was to an active adult community. The third trip was to the local truss manufacturing facility. They met with the facility manager and area sales manager. The students were provided with information about the truss manufacturing design and process, as well as their floor joist manufacturing process. After the introduction, the students were taken on a tour of the facility to see the truss and floor systems being produced, sent through quality control and loaded onto the trucks to be delivered to the jobsites. The facility is a LEED certified building and the students learned about the different LEED components as they took their tour.

Final Project

The final project was a series of assignments that were to be completed throughout the quarter and then compiled to compose a final project. The length of time for each assignment was dependent on the difficulty of the deliverables. Each group met with the instructor and presented the deliverables of each assignment at the time of its due date.

The final project consisted of seven assignments:

1. Students prepared a strategic and operational marketing analysis for the project.
2. Students completed a detailed construction estimate and budget including a quantity take-off of all labor, material, and equipment necessary to complete the project. Each student prepared a complete estimate for one home.
3. Students found creative ways to reduce costs by value engineering, purchasing strategies and changing standard amenities of the current plans and specifications.
4. Students prepared a computer generated CPM schedule for one home. The students then determined an overall project schedule based on current absorption rates.
5. The students determined their proposed project management and organization for staffing the project. The students summarized the roles they needed in their organization to make this possible.
6. Students created financial information for the project. They created cash flow projections for the proposed project based on the absorption rate determined from their marketing analysis and schedule. The students were challenged with providing different scenarios based on market fluctuation.
7. The students prepared an Executive Summary, including their recommendation for purchasing the lots.

Peer Review

Periodically throughout the course, students had the opportunity to review each other's work and they provided both compliments and constructive criticism. This gave students the opportunity to display their knowledge of the assignments by critically reviewing other students' work.

Students' Presentations

Students were required to conduct a professional presentation representing their solution to the problem. The students presented to a panel of instructors and peer groups of students at the end of the quarter. The reviewing peer groups of students were able to showcase their knowledge of the project by asking the presenting group questions. The presentations were 20 minutes in length and covered the main topics of the final project.

Additional Methods

In addition to the methods listed above, students were assigned to complete in-class activities, exams, reading assignments, quizzes, homework assignments, and working in teams.

Student Survey

A survey of the students' perspectives of which delivery method they preferred and thought was most effective was conducted in the Spring of 2010 and the Summer of 2010. The survey was created to obtain feedback from the students in order to find out which delivery systems were preferred and effective so that for the faculty could focus on areas that students ranked as the highest and improve on areas ranked the lowest for future classes. The class size was 24 students in Spring 2010 and all 24 students answered the survey. The class size was 24 students in Summer 2010 and all 24 students answered. The Summer 2010 class had 14 construction management majors and 10 construction management minors. Two of the minors were architectural engineering majors and the other eight were architecture majors. The survey was anonymous. The results of the students' perspectives are in Table 1. These results may not be generalizable to all other courses, but may be transferable to some. The questionnaire was developed based on areas for future research in Kelting and Hauck (2010). It was put through a peer review process that customized it for the purposes of this study. The students listed the delivery method preferences on a forced ranking scale of 1 to 14 with 1 being the highest. The students were asked if there was a particular combination of delivery methods they prefer and found most effective. Students were also asked to provide other delivery methods that were not provided in the course, but may be recommended for future quarters.

Survey Results

Each of the six survey items are listed in numerical order below with a discussion of the author's analysis of the results.

Ranking of Delivery Methods

1. Based on your experience in this course, please rank (in order from 1-14) the way you prefer to learn. 1 is the highest and 14 is the lowest.
2. Based on your experience in this course, please rank (in order from 1-14) the most effective way for you to learn. 1 is the highest and 14 is the lowest.

The author performed the following steps to analyze the survey results of the ranking of delivery methods. First, the histograms were generated and evaluated for each individual delivery method for both quarters. The histograms provided a visual means to ensure the author did not have bimodal responses. The evaluation of the histograms demonstrated there was general agreement for all delivery methods. The general agreement allowed the delivery method results to be sorted from lowest mean rank to the highest mean rank. The lowest mean rank was the students' overall delivery method of choice. Both quarter survey results were combined to provide a larger sample size. All 48 students responded to the questions above. A side by side comparison of the preferred and effective

ranks is provided in Table 1 and the following results were derived from the students' perspectives using the methodology stated above:

Table 1

Results of student perspectives

Preferred Rank	Delivery Method	Effective Rank	Delivery Method
1	Field Trips	1	Field Trips
2	In class activities and discussion	2	Final Project
3	Guest Lectures	3	Labs
4	Labs	4	Lectures with Personal Response Systems
5	Lectures with Personal Response Systems	5	In class activities and discussion
6	Final Project	6	Lectures
7	Working in Teams	7	Guest Lectures
8	Lectures	8	Peer Review
9	Peer Review	9	Working in Teams
10	Presentations	10	Quizzes
11	Quizzes	11	Homework Assignments
12	Homework Assignments	12	Presentations
13	Exams	13	Exams
14	Reading Assignments	14	Reading Assignments

Combinations of Delivery Methods

3. Based on the ranked delivery methods, is there a particular combination of delivery methods that you prefer? If yes, please describe.

Thirty students responded with a yes. Their responses were evaluated for common themes and are summarized below:

- Lecture, lab and fieldtrip in order and all on the same topics,
- Lab, peer review and field trip in order and all on the same topics,
- Lecture, fieldtrip and lab in that order and all on the same topics,
- Lectures then working on labs in teams,
- Having guest lectures on field trips,
- Working in teams and peer reviews,
- Working in teams on a final project.

4. Based on the ranked delivery methods, is there a particular combination of delivery methods that are the most effective way for you to learn? If yes, please describe.

Sixteen students responded with a yes. Their responses were evaluated for common themes and are summarized below:

- Lectures with labs in order and all on the same topic,
- Quizzes before lecture and personal response systems during lecture,
- Reading, homework, quiz and exam in order,
- Lecture, homework, exam,
- Lecture and final project.

Other Delivery Methods

5. Based on your academic career, please describe any other delivery method you prefer that was not listed above.

Thirteen students responded. Their responses were evaluated for common themes and are summarized below:

- Lectures with material and assembly samples,
- Job shadowing,
- Interviewing a professional in industry,
- Providing notes for exam preparation.

6. Based on your academic career, please describe any other delivery methods that are the most effective way for you to learn.

Eleven students responded. Their responses were evaluated for common themes and are summarized below:

- Providing additional online resources,
- Providing overviews of previous classes lectures,
- Building outside the classroom with hands on projects,
- Videos,
- In person one on one teacher evaluations.

Discussion

The results of the study identified a ranked order of delivery methods the students preferred and found effective. Five delivery methods were in common within the top six ranked items from the students' perspectives of both preferred and effective delivery methods. These delivery methods are field trips, in class activities and discussions, lectures with personal response systems, labs, and the final project. The author recognizes these as delivery methods perceived positively by the students and is encouraged to continue to focus on them as key delivery method for the course. Field trips were ranked first on both preferred and effective delivery methods.

Five delivery methods were in common within the bottom five ranked items from the students' perspectives of both preferred and effective delivery methods. These delivery methods are reading, exams, homework assignments, quizzes, and presentations. Reading was ranked the lowest on both preferred and effective delivery methods survey results.

The survey results of the delivery method combinations revealed the students' perception of their preferred and most effective combination of delivery methods. In question four, the students expressed that combinations of the traditional delivery methods such as lecture, homework and exam were effective. The author was surprised to see these comments because of the poor ranking of each of these individual delivery methods. The additional delivery methods may be incorporated into the course and are encouraged to be explored by other educators in their courses. Both the combination of delivery methods as well as the additional delivery methods may be explored in this course.

Conclusion

The author agrees with Peterson's (2008) conclusion that developing a strong relationship with industry is a vital part of the project based delivery system. Industry relations have been important for the continued development of current material for activities, discussions, lectures, labs, final projects and continued field trips. In light of the student ranking of delivery methods indicating field trips as the highest rank, industry relationships remain important in order to provide high quality field trips for the students.

As recognized by Lujan and DiCarlo (2006) the author is motivated from the survey results to explore additional delivery methods to customize the instruction in an effort to meet all of the students' educational needs. The author will continue to incorporate the personal response system during lecture and will minimize lectures that do not utilize this system.

Based on the results the author has immediate plans to change and improve two specific areas in this course. These areas are developing hands on building projects outside the classroom, and developing new reading delivery methods. It is important to note that all delivery methods will still be used in the course.

The first area of improvement is to develop hands on building exercises. This is based on the students' suggestion for an additional effective delivery method. The author plans to create building and testing stations. These stations will be used to teach, demonstrate and test applications associated with fast floor framing systems by assembling pre-cut flooring systems, drainage planes by installing housewrap and windows, air leakage by performing duct testing, and thermal leakage by analyzing insulation voids.

The second area of improvement is new reading delivery methods. Since this study ranked reading as the lowest on the scale of preferred and effective delivery methods, the author is encouraged to begin development of new and engaging delivery methods for course reading assignments. One student suggested additional on-line resources would be an effective way to learn. The author is developing an online course offering of 30 lessons through an easy-to-manage system. The author plans to design interactive lessons that include:

- Real-world content with strong image support to increase comprehension of important concepts.
- Content broken into manageable segments to keep the learner engaged.
- Interactive questions embedded into the content to build the connection between prior knowledge and new content, to check for understanding, and to offer opportunities for student reflection on what was learned.
- Immediate, specific feedback to reinforce what the student understands and to provide clarification.
- Assessments to determine whether or not students met lesson objectives.
- Definitions of key terms provided within the content to support student understanding.
- Videos, case studies, and unit engagers to connect lesson content with the residential construction concepts.
- Flashcards to provide students with the opportunity to review key terms and calculations.

Additional surveys may be performed in order to analyze the results of future instructors' exploration of these delivery methods in this course and others. A potential area for further research would be a follow up study to determine whether students find interactive electronic reading lessons more engaging and which aspects of these lessons are more effective and appealing.

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