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Student Perceptions of Instructional Delivery Methods Utilizing Various Teaching Modalities in an Integrated Lab Curriculum

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This paper discusses students' perspectives about the instructional delivery methods they preferred and found effective in four courses at a major university. Different teaching modalities were used, including asynchronous course delivery and a hybrid format which utilized synchronous virtual meetings for lectures and in-person face-to-face hands-on building activities. A survey was conducted, and results indicated that students both preferred and found most effective hands-on and lab activities over all other methods. The results of the student surveys are presented and discussed. The learning laboratories were designed to complement and enhance student learning in fundamentals, building information modeling, residential, and commercial construction courses, and provided opportunities for students to build and virtually design assemblies outside the classroom by applying knowledge first learned through reading and lecture. The laboratory exercises have been designed to reinforce course comprehension by combining them with additional instructional delivery methods allowing students to “learn by doing.” Each hands-on experiential exercise incorporated concepts learned in lecture (recorded or virtual); these exercises included hand drafting, virtual design, framing, exterior systems, door and window flashing and installation, and concrete. This information may assist educational programs that are interested in developing hand-on experiential laboratory exercises to enhance other course delivery methods.

Key Words: Experiential Learning, Hands-On, Project-Based, Curricula, Construction Management

Introduction

Students have preferences for the ways they receive information, and which instructional delivery methods are most effective for their learning. Although many higher education institutions utilize lecture-style courses to deliver theory (Pratt, 1998), this method may not be the most effective or preferred for student learning. In construction management education, where students are expected to solve problems that may connect multiple subject areas including estimating, scheduling, contracts, and ethics, some higher education institutions have incorporated project-based courses to provide opportunities to integrate knowledge from multiple subject areas (Benhart et al., 2017). Alternatively, some programs have integrated hands-on building or experiential learning activities to further connect

the dots between theory and application. While multiple instructional delivery methods may be used in the classroom, having knowledge of student's preferred method of information delivery may help the instructor customize instruction to meet the student's preferences, assist the instructor by 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 (Kumar et al., 2004).

The objective of this paper is to present the instructional delivery methods students perceive as effective for learning, and those they prefer, as well as to determine the effectiveness of hands-on learning exercises that have been integrated into the curriculum. This paper provides a summary of the existing instructional delivery methods utilized and describes the development of experiential learning exercises and the integration and expansion of those exercises into multiple courses in an integrated laboratory style curriculum. Included are survey findings from four courses to gain students' perspectives on which delivery methods students preferred and found effective.

Literature Review

Lecture style courses are often utilized in higher educational institutions to deliver management theory (Pratt, 1998), and construction management education often delivers foundational subjects such as estimating, scheduling, and contracts utilizing a lecture-style (Chinowsky et al., 2006). Segmenting these classes into stand-alone topics develops specialized knowledge, but construction educators are charged with preparing students who can lead and manage the overall construction process, not just specific, stand-alone aspects (Davis & Cline, 2009), since "the world does not always present problems that are topic specific and solved in a non-holistic manner" (Montoya et al., 2009, p. 66). Students must "connect the dots" between classroom theory and practical application. To facilitate this connection, some institutions have developed a single capstone course in the student's senior year to "integrate multiple, interdisciplinary skills and abilities." (Benhart et al., 2017). In contrast, other universities have developed and integrated these capstone classes across the curriculum giving students additional opportunities to solve complex problems (Benhart et al., 2017).

Since students have preferences for the ways they receive information, Kelting and Hauck (2010) evaluated which method or combination of teaching methods is more effective and appealing to students in their second year of study, focusing on all delivery methods utilized in the course and the students' perception of the overall impact on learning. Kelting (2011) found that students expressed interest in participating in hands-on building exercises as part of their construction management education. Kelting and Holt (2012) reevaluated students' perceptions of effective instructional delivery methods and discussed the development of hands-on building exercises to "teach, demonstrate and test applications associated with best building practices" (Kelting & Holt, 2012), but did not include hands-on building exercises as part of their survey. Kolegraff et al. (2019) incorporated hands-on building activities into the survey, and hands-on building ranked highest of all 14 methods.

Although Kolegraff et al. (2019) evaluated students' perceptions of hands-on experiential learning activities, the study narrowly includes activities requiring construction tools and materials. This study expanded on the previous study and asked students to rank which instructional learning activities they both prefer and find effective, going further, incorporating construction activities as well as broader experiential activities inclusive of those completed using software programs.

Methodology

This paper utilized both the Kelting (2011) and Kolegraff et al. (2019) studies which compared students' perspectives about 14 different instructional delivery methods through surveys that used rank order and open-ended questions. A forced ranking survey method was adopted to find out the instructional delivery methods students perceived as more effective and appealing and was used to prevent the ceiling effect generated by the five-point Likert Scale. By using the 14 rankings, respondents were not limited by a five-point scale which would not produce enough variability between the two anchors. For example, if given a five-point Likert-type scale, respondents might be inclined to use only the high end of the scale, limiting variability (Keeley et al., 2013). To obtain additional qualitative data, students were given the opportunity to provide written feedback on the course at the end of the survey.

To maintain consistency between studies, the current study utilized most of the 14 delivery methods from the previous studies (Kolegraff et al., 2019; Kelting, 2011). Due to the Covid-19 modifications required to courses, additional instructional methods or similar methods utilizing new tools or modes were employed in all courses examined. As opposed to expanding the selections, the choices were condensed to ten delivery methods that captured all methods and variations from the previous study as well as currently employed in the courses. The authors consulted with the instructors of the courses to verify that the survey choices accurately captured all of the delivery methods incorporated in their courses as well as adequately differentiated between them.

The authors for this study use: (1) Asynchronous (recorded) Instructor Videos, (2) Asynchronous Online Discussions, (3) Break Out Rooms for team group work or discussion, (4) Hands-on Building/Lab Activities, (5) Individual Assignments, (6) Office Hours/Individual workings sessions with Instructor, (7) Reading Assignments & Video links (not instructor created), (8) Synchronous Zoom Meetings, (9) Teamwork/Group Assignments, and (10) Quizzes & Exams.

Anonymous surveys were conducted fall quarter 2020 in the fundamentals, residential, and commercial construction management courses, as well as the building information modeling (BIM) course. A broader selection of courses was chosen for these surveys from the previous studies in an aim to incorporate a higher number of responses from a wider cross section of courses. These surveys were created to obtain feedback from students on which delivery methods were preferred and effective so faculty could continue to focus on offering high-ranking methods, and reduce use of or improve delivery of the lower-ranking methods. Additionally, the surveys would provide feedback on whether hands-on building exercises inclusive of experiential lab activities were both effective and preferred by students. The survey was conducted in the fall 2020 quarter in nine separate classes, with six different instructors providing course instruction.

Course Formats

Classes were delivered using two separate modalities: (1) synchronously with both virtual class meetings and face-to-face, in-person building activities (hybrid format), and (2) asynchronous online course delivery with independent building activities (asynchronous format). Both modalities utilized a learning management system (LMS) to deliver course materials.

The hybrid format utilized video conferencing for virtual, synchronous class meetings multiple days per week, and building activities, described below. The hands-on building activities, which varied by

course, took place at certain points throughout the ten-week quarter and were designed to augment learning achieved by the students through reading assignments, lectures, video content, class activities, discussions, and homework assignments.

The asynchronous format utilized exclusively recorded video content, reading assignments, activities and online asynchronous video discussions. The experiential activities, which varied by course, took place throughout the ten-week quarter; additional details about each course are provided below. Similar to the hybrid courses, the asynchronous courses' hands-on activities and lab exercises provided opportunities to utilize different building components, construction and management methods, and design and management software, expanding on the material learned through class assignments.

Fundamentals of Construction Course

There were two different sections of the fundamentals of construction course which were taught by two different instructors; one class utilized the hybrid format while the other used the asynchronous method. The hybrid course delivered lab instruction synchronously online twice each week. The asynchronous course had video lectures posted each week for the current deliverable. The class size ranged from 25 to 38 students and, even though the courses had different instructors and course modalities, the material taught, quizzes, lab activities, and exams were identical. This is the first major lab course for all students and the goal for the course is to introduce students to the fundamentals of construction, including: quantity takeoffs, estimating, scheduling, as well as develop visualization skills utilizing modeling software.

The following teaching methods were used in the class: reading assignments, class activities and discussion, lectures, quizzes, exams, homework assignments, and hands-on lab activities. The hands-on lab activities, which students completed independently from their peers, included hand drafting and modeling using varying software systems. Students completed an architectural plan composed of a site plan, first floor plan, second floor plan, and a roof plan as well as corresponding elevations, section cuts, and detail sheets, as well as structural, electrical and mechanical plans. The goal of these lab activities was to develop the students' understanding of the materials utilized in construction, building terminology, as well as understand how building systems are integrated.

Building Information Modeling (BIM) Course

Three different building information modeling sections met during the study period. All sections utilized the asynchronous method and videos were created for all lectures and software system walkthroughs with optional times for students to meet synchronously online with the instructor to review content and ask questions. The class size ranged from 30 to 36 students and all course material, video lectures, lab assignments, and final projects were identical in all sections. The goal of the course was to introduce students to a number of software systems and technologies utilized in the architecture, engineering, and construction industry. The course covers 11 software systems in ten weeks. The course is divided into five teaching modules, including: (1) drawing management and processing, (2) modeling, (3) model-based estimating, (4) project management, and (5) scheduling and 4D (schedule dimension) simulation. Each module utilizes and teaches one or more software systems.

Each module includes an introductory lecture on the topic, an explanation on how it is utilized in industry, a video walkthrough of the software, and an individual lab assignment. The instructors focus

on teaching BIM as an integral tool in industry rather than mastering software. Students were encouraged to learn by doing and make mistakes to understand the correct way to utilize certain tools for real-world construction problems. Each lab activity and final project was completed individually.

Residential Construction Course

The residential construction course is typically taken at the end of the student's second year. Two different residential course sections met during the study period using two separate modalities; the hybrid class had 20 students, and the asynchronous class had 23 students. The faculty strived to immerse the students in all aspects of residential construction covering topics from land acquisition to building materials and the warranty process. The course combined estimating, scheduling, residential methods, and contracts into one project-based integrated lab. Classes are structured into weekly topic areas to reinforce the sequencing of installed components on an actual project. The following teaching methods were used in the class: reading assignments, activities and discussion (online), lectures (live or recorded), quizzes, exams, homework assignments, working in a team, final project, and hands-on building.

The hybrid class utilized teams of four to six people for team assignments and building activities; the asynchronous course utilized teams of three to four for team assignments but building activities were completed independently. The virtual classes met synchronously several times each week for a ten-week quarter, and the faculty utilized virtual lectures and interactive discussions, and students prepared for virtual lectures through reading assignments, then faculty reinforced main concepts through online interactive lectures and discussions. In the hybrid course, for two weeks during the quarter, students transitioned from the virtual classroom to an in-person hands-on building project to apply and reinforce their knowledge learned from the previous weeks' assignments and discussions. Alternatively, in the asynchronous course, all recorded content developed by the instructor, as well as a curated list of online resources, was delivered through the LMS. Optional times for students to meet synchronously online with the instructor were also provided to review content and ask questions. For the final six weeks of the quarter, students completed independent building activities to reinforce the knowledge learned each week.

Commercial Construction Course

Two sections of the commercial course met during the fall quarter 2020 in the hybrid format with nineteen and twenty students. Students were divided into teams of four or five students for group assignments and building activities. The sections met synchronously with a mix of virtual and in-person face-to-face instruction including ten days of in-person hands-on building activities that met on campus with appropriate precautions. All lectures and discussions were conducted virtually and synchronously through video conference. The course content was delivered in a range of instructional methods including reading assignments, lectures, video content, discussions, activities, quizzes and exams, assignments, working with a team in person and virtually, and hands-on building.

The commercial course concerns all aspects associated with large commercial and institutional construction operations and include topics such as building system analysis of foundations, waterproofing, structural framing, exterior cladding, and finishes. In week three, students received safety and shop training for the hands-on activities. In weeks four through seven, students met on campus twice per week where each group built a ten-foot long, ten-foot tall commercial exterior wall system with at least one corner and one window system. Weeks four through seven, students alternated in-person with virtual instruction, requiring students to apply what they had learned

virtually through various learning methods with hands-on building activities including forming and pouring concrete, installing CMU, metal studs, exterior sheathing, siding, stucco, and finishing.

Survey Findings

The survey items are listed below, with a discussion of the analysis of the findings. Students were asked the following:

- Please rank the instructional methods listed below by order of preference (in order from 1-10). Please place the method that you prefer the most, at the top.
- Please rank the instructional methods listed below by order of effectiveness (in order from 1-10). Please place the method that you think is the most effective, at the top.

A side-by-side comparison of the preferred and effective ranks is provided in Table 1, the following findings were derived from the students’ perspective using the methodology described above.

Table 1

Findings of Student Perspectives

Preferred Rank	Delivery Method	Effective Rank	Delivery Method
1	Hands-on Building/Lab Act.	1	Hands-on Building/Lab Act.
2	Synchronous Zoom Meetings	2	Synchronous Zoom Meetings
3	Asynchronous (recorded) Instructor Videos	3	Asynchronous (recorded) Instructor Videos
4	Office Hours/Individual workings sessions with Instructor	4	Office Hours/Individual workings sessions with Instructor
5	Individual Assignments	5	Individual Assignments
6	Break Out Rooms; for team group work or discussion	6	Asynchronous Online Discussions
7	Teamwork/Group Assignments	7	Break Out Rooms; for team group work or discussion
8	Asynchronous Online Discussions	8	Quizzes & Exams
9	Reading Assignments & Video links (not instructor created)	9	Teamwork/Group Assignments
10	Quizzes & Exams	10	Reading Assignments & Video links (not instructor created)

Discussion

Feedback was obtained from 124 students. The respondents were students in either their second or third year of university instruction; 105 respondents were male, 16 were female, and the remainder

choosing not to specify gender. The survey findings of the delivery method ranking revealed the students' preferred and effective delivery methods, as well as the delivery methods they considered least effective. The top three ranked items for both effectiveness and preference were common across both categories; these delivery methods were: hands-on building, synchronous zoom meetings, and asynchronous (recorded) instructor videos, with hands-on building and lab activities ranking first.

The bottom three ranked items were also in common across both categories from the students' perspectives of both preferred and effective delivery methods. These delivery methods were reading assignments and video links for additional information (not instructor created), asynchronous online discussions, and quizzes and exams. Quizzes and exams were ranked the lowest in both categories.

In reviewing the data, the frequency of responses for each category for both effectiveness and preference was also analyzed. In conclusion, 45% of student's preferred hands-on building and lab activities over all other categories, and 49% of students ranked hands-on building as the most effective method. Additionally, very few students ranked hands-on building and lab activities with a rank of 7 or below, 8% of students for effectiveness, and 7% of students for preference.

Synchronous Zoom meetings ranked second overall for preference and effectiveness, with 26% of students indicating a rank of 1st, 27% ranked second, 11% ranked third, and 8% ranked fourth, with only 28% of student ranking it fifth or below for preference. In addition, 25% of students ranked synchronous Zoom meetings first in effectiveness, 31% ranked second, 13% ranked third, and 6% ranked fourth, with 26% of students ranking it fifth or below.

The lowest ranked category in preference quizzes & exams ranked 8th in effectiveness. It received a high number of ranks ninth; 23% for preferred and 16% for effectiveness, and tenth, with 16% preference and 9% for effectiveness. Quizzes and exams also received a consistent spread of rankings through all other ranks. In preference, 17% of students ranked exams in the top 5, and for effectiveness, 42% of students gave it a ranking of fifth or better. Although exams are the lowest rated for preference and ranked 8 of 10 for effectiveness, they only slightly trail the other categories according to the respondents. Reading assignments and Video links (not instructor created) had the lowest overall combined ranking. It was ranked ninth in preference and tenth in effectiveness. An overwhelming 90% ranked reading assignments fifth or below in preferred and 80% in effectiveness.

Figures 1 and 2 shows the percentage of students who selected the corresponding rank number for each delivery method. Figure 1 shows each delivery method's effectiveness rating and Figure 2 shows the preferred ranking frequency for each delivery method; items are listed in ranked order.

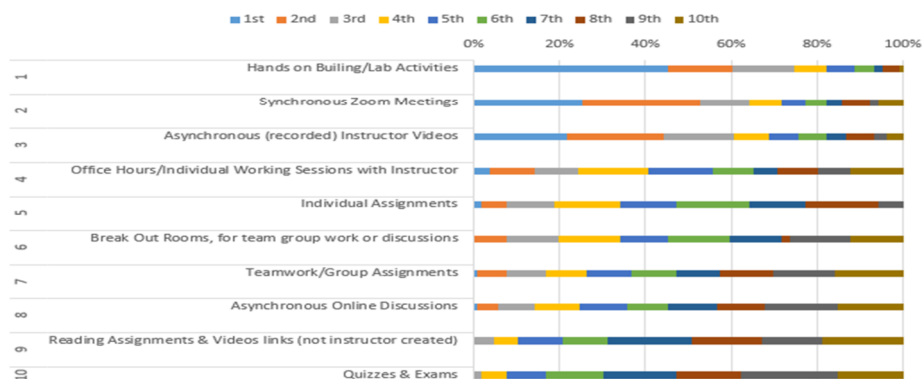


Figure 1: Delivery Method Rating Frequency – Effective Rating

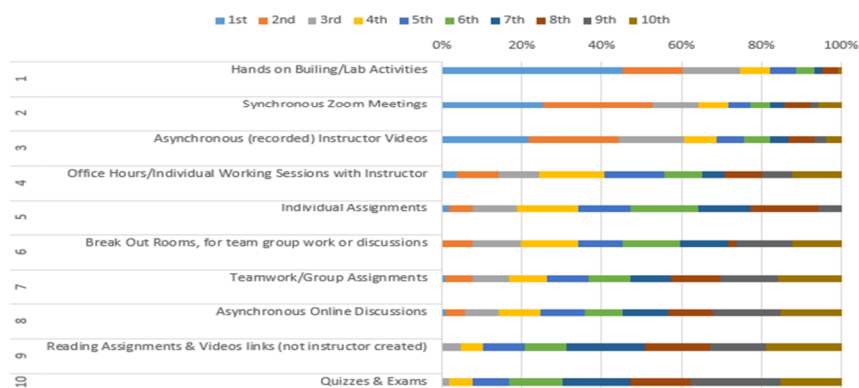


Figure 2: Delivery Method Rating Frequency – Preferred Rating

Conclusion

The instructional delivery methods identified in this paper were all included in the presented project-based courses; these courses have been designed to “connect the dots” and bridge classroom theory with real-world understanding. Although past studies reviewed which delivery methods students preferred and found effective including hands-on building activities, and evaluated students’ perceptions of hands-on experiential learning activities, the studies narrowly included activities requiring construction tools and materials. This study expands on previous studies asking students to rank which instructional learning activities they both prefer and find effective, going further, incorporating construction activities as well as broader experiential activities inclusive of those completed using software programs

The highest survey findings in the students’ survey reinforced the faculty’s decision to integrate hands-on building and lab activities to the project-based curriculum. The most impressive findings were the students’ ranking of hands-on building and lab activities, with nearly half of the students giving it the top rating. According to the students surveyed, the incorporation of these activities into the course were an effective and preferred way to learn course content. Synchronous Zoom meetings, asynchronous instructor recorded videos, and office hours/individual time working with the instructor also received high ratings, and faculty should continue to include these items in the curriculum.

Exams, quizzes, typically used as a summative measure to determine understanding of the course material and reading assignments typically used to deliver preliminary information to prepare students for lecture discussion, or activity are among the lowest-ranking items. The faculty should evaluate additional summative measures for material comprehension, but for some students this seems to be a preferred and effective final determiner. The faculty will also evaluate reading assignment to ensure the reading is applicable and corresponds to the content provided in lecture; an evaluation of the text and its content will also be performed.

The authors conclude that students perceive hands-on building exercises and the expanded definition to include more broad activities including using software as effective and are preferred ways for students to learn course material. The authors will continue to use this survey, along with student

outcomes and feedback, to improve the delivery methods described in this paper as COVID-19 modifications continue and evaluate items to retain when delivery modes are able to return to predominately in-person modalities.

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