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Challenge of Delivering Construction Courses in an Online Environment Based on Faculty Experiences

Sanjeev Adhikari, Ph.D.
Kennesaw State University
Marietta, GA

Rachel Mosier, Ph.D., P.E.
Oklahoma State University
Stillwater, Oklahoma

Sandeep Langar, Ph.D., LEED AP BD+C
The University of Texas at San Antonio
San Antonio, Texas

Online education has seen rapid growth through teaching and learning in university degrees. Higher education faculty have identified challenges while transitioning from face-to-face to online because of time management issues and the different instruction modalities. This study analyzes how construction faculty feel about the delivery of online instruction. A survey was developed to determine construction faculty expertise in delivering online content and their level of expertise after the changes due to the pandemic. The survey was conducted during the pandemic (May/August 2020). We asked faculty to reflect on the pre-pandemic vs pandemic perception course delivery method. The relevant survey questions focused on teaching experience, different delivery types, online teaching experience, course management resources, and proficiency of online teaching. While most responding faculty indicated traditional lecture was typically used for content delivery, the remaining faculty indicated "*project-based learning, experimental laboratory course, or computer lab studio*," as the content delivery method. From the faculty responses, there are challenges in delivering online construction courses having components of project-based learning, experimental laboratory course, and computer lab studio. The survey responses identified specific concerns about online courses from construction faculty members. Online delivery is difficult for teaching hands-on or experimental lab types of construction courses. Some construction faculty also identified concerns about academic integrity in the online delivery of construction courses.

Key Words: Construction education, Online delivery challenges, Online delivery experiences, Construction courses, Delivery format

Introduction and Background

During the Covid-19 pandemic, many universities closed or moved to virtual learning. Due to these changes, faculty who had not previously taught online or may not have provided synchronous or asynchronous instruction were thrust into new course delivery methods with little notice for training. Online delivery has less peer-to-peer interaction and may be challenging to accommodate different learning styles (Pashler et. al 2008; Dembo and Howard 2007). A survey was developed to determine faculty expertise in delivering online content and their level of expertise after the changes due to the

pandemic. Other items of interest in the survey included which construction courses can be delivered online.

Before the pandemic, many institutions began offering online courses (Parsad and Lewis 2008), but the level of faculty enthusiasm and effectiveness in these online courses is not known. Teaching online courses is not simply just moving content from the classroom to an online Course Management System (CMS). A CMS system such as Canvas, Blackboard, D2L Brightspace, and others helps students access course content. Using the CMS system, faculty post online course materials and stream/record video content to provide the most effective learning environment. The online discussion component helps to improve the interaction between faculty and students as part of the course. Kelting et al. (2016) evaluated the delivery system for an online construction management course, and the findings suggested the discussion forums are an essential tool for enhancing the course delivery. As institutions move to online education, more virtual methods are utilized, with synchronous methods preferred over asynchronous methods. Students and faculty attend virtual classrooms in real-time during synchronous methods through software such as Zoom, Microsoft Teams, or the CMS itself. Using asynchronous methods, students and faculty do not attend real-time, but faculty usually post videos and other content on the CMS and provide students direction to access learning materials.

Construction courses are usually delivered through lectures, experimental laboratory exercises, project-based learning activities, and computer lab studios. Delivering online hands-on laboratory, project-based courses, or computer labs is challenging versus the more traditional face-to-face environment. Faculty feel that teaching "*lecture only*" online course materials through streaming/recorded video content is most effective, while students feel that online education requires additional time and reduces interaction (Kinney et al. 2012) with faculty and peer students. Similarly, Schmidt et al. (2013) also suggested that online teaching requires more time than face-to-face teaching. Alungbe et al. (2008) examined online teaching of Engineering Economy to construction management students, finding that online teaching is much more time-consuming because of an increase in demand from students for online courses. Although most students seemed satisfied in an online environment, several students expressed concerns related to student-to-teacher interaction and student-to-student interaction (Gao et al. 2009). While many lab exercises are intended to be performed in a face-to-face environment, some areas of innovation are needed. Certain types of courses and their associated lab exercises or homework may be more appropriate for flipped classrooms or online delivery. Courses focused on software, such as Computer-Aided Drafting (CAD) may be more easily translated to an online format (Gao et al. 2009). Xie et al. (2006) suggest that teachers can share the view of their virtual classroom experiences with others by using Augmented Reality (AR) processes in virtual study groups. The teachers engaged in the AR program will have the opportunity to post questions relevant to the subject, and students can seek ways of understanding and improving learning.

Gao et al. (2009) suggested that to be successful at online construction education, the key factors are a) the requirements for computer hardware and software, b) the method of delivery, c) course content and d) communications between the instructor and students. The faculty should re-evaluate educational delivery frequently so that it will help to enhance student learning (Gao et al. 2006). Ahmed et al. (2016) addressed the key success factors for online classes and based on their study, students praised online construction courses for their convenience and portability, and their ability to provide a broader world of industry view and technical depth. Educators praised increasing course enrollment as less difficult than traditional face-to-face classes. Fifty-one core competencies (Smith 2005) have been identified for success as an online instructor. Smith (2005) suggested that an instructor training and support program is essential in successfully delivering online courses. Having teaching support via mentorship may increase self-efficacy for instructors (Chang et al. 2010). In

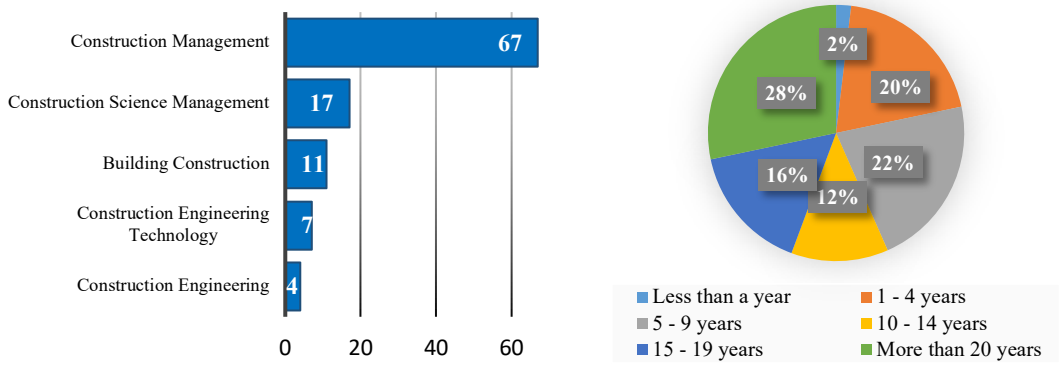
addition to peer support, administrative support and teaching resources strongly correlate with self-efficacy (Han et al. 2018). Although few studies exist that depict the challenges with online education (Kelting et al. 2016; Schmidt et al. 2013; Gao et al. 2009; Xie et al. 2006), at the time of such studies, limited faculty participation with the online learning environment was observed. The study presents the faculty perceptions post-pandemic, especially when almost all educators have had the experience with the online learning environment. Therefore, there is a need for research to find out the challenge of delivering construction courses in an online environment based on faculty experiences along with the perspective of post-pandemic.

Methodology

This research was implemented via a survey questionnaire. The survey was conducted during the pandemic (May/August 2020). We asked faculty to reflect on the pre-pandemic vs pandemic perception of the course delivery method. Respondents were construction-focused faculty from the United States. The survey questionnaire was generated in Qualtrics and emailed to the faculty members associated with construction programs across the US. Nearly 1000 educators were identified as the population (ASC 2021; Collins et al. 2019) that were associated with ASC and ACCE (ASC 2021; Collins et al. 2019). Using 950 construction educators as a general population, 100 responses indicate a confidence level of 95% and a margin of error around 9.1%. Email addresses were obtained from the ASC (Associated School of Construction), ACCE (American Council of Construction Education), and ASEE (American Society of Engineering Education), with 106 faculty members responding. The survey consisted of both multiple-choice and open-ended questions. The survey questions were designed in such a manner that the respondents could complete the study within 10 minutes. The survey instrument was subjected to a pilot test to assess its reliability and validity. Pilot study respondents analyzed the instrument in the areas of aesthetics, the flow of questions, ease of understanding the survey questions, instrument reliability, grammatical errors in the survey (if any), and any additional parameter that was deemed necessary to evaluate.

Data Analysis and Results

The survey was conducted during the pandemic (May/August 2020). We asked faculty to reflect on the pre-pandemic vs pandemic perception of the course delivery method. A total of 106 construction members responded to the survey. Since this survey-based study is focused on construction educators, it found that most construction faculty are associated with one of five different programs or departments. Figure 1A shows the faculty associated with their program. Even though all faculty teach construction education, 67 (63.2%) faculty considered themselves to be from construction management, 17 (16%) faculty from construction science management, 11 (10.4%) faculty from building construction, 7 (6.6%) faculty from construction engineering technology, and 4 (3.8%) faculty considered themselves from construction engineering. When asked about total teaching experience, Figure 1B shows that the majority of the respondents (28.3%) identified as having more than 20 years of total teaching experience, and the lowest respondents (1.9%) identified as having less than 1 year of teaching experiences. Figure 1B shows data of less than a year, 1 - 4 years, 5 - 9 years, 10 - 14 years, 15 - 19 years, and more than 20 years of total teaching experience. It indicates that construction respondents had substantial experience of total teaching experience within the academic realms. When asked about the average annual teaching load (in credit hours) in the program for the last three years, the average was 13.89 credit hours. The minimum teaching load and maximum teaching load were 2 and 30 credit hours, respectively, with a standard deviation of 6.32. Based on the responses provided for the average teaching loads, the results indicate that the responding educators are typically teaching-based or have heavy teaching loads within their programs.



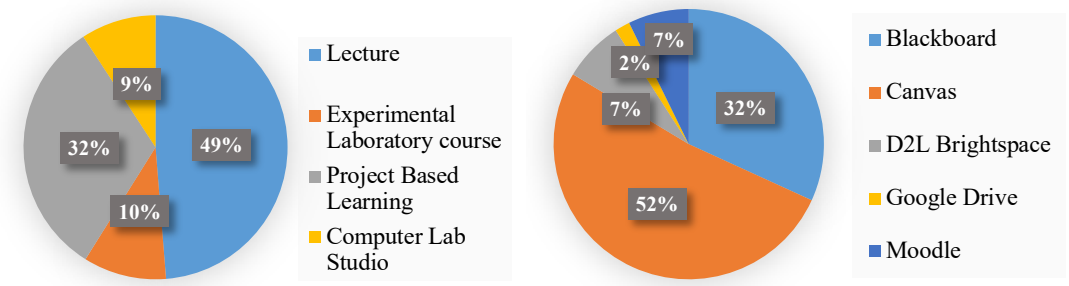
A) Department/Program associated with faculty B) Faculty teaching experience

Figure 1: Faculty associated with construction program and total teaching experience (n=106)

Construction Courses Delivery Analysis

The survey asked if the construction course delivery format and course management system are typically utilized by construction educators. To determine the teaching format, a question was given to the construction faculty on the delivery type and typical teaching format. Respondents indicated four basic formats of course delivery, which included lecture, experimental laboratory course, project-based learning, and computer lab studio. Figure 2A listed the format that respondents have taught in the spring of 2020. The majority of the responding faculty (49%) indicated "*lecture*" delivery was used on the content delivery, followed by 32% of the responding faculty indicating "*project-based learning*", followed by 10% of the responding faculty indicating "*experimental laboratory course*" as the content delivery. Only 9% of the responding faculty indicated "*computer lab studio*" as the content delivery. The about 49% lecture format teaching indicates faculty are more actively involved in a class by frequently involving students by asking questions to keep the students attentive. About 51% of the respondents (project-based + hands-on lab + computer lab) indicated students are actively engaged in investigating complex questions and project-based problems that challenge students during class time and beyond.

To determine the course management software used in construction course delivery, a survey question was asked: "*What course management system do you typically use*?". The majority of the responding faculty (52%) identified Canvas, followed by 32% of the responding educators who indicated Blackboard as the system used in construction programs. Figure 2B shows respondents used Blackboard, Canvas, D2L Brightspace, Google Drive, and Moodle on their Course management system.



A) Course delivery format B) Course management system

Figure 2: Faculty response on delivery format and course management system of construction courses

Online Resources and Delivery Experiences

Online resources provided by the university/program and construction educators' experience are another area of interest. Educators were asked, "*Did the University offer resources that improved the delivery of content in an online medium?*". Approximately 78.3% of the responding faculty indicated the existence of resources at the university level to improve the delivery of content in an online medium. At the same time, about 9.4% of the responding faculty indicated that there are no resources at the university level. Also, about 50% of the responding faculty indicated the existence of resources for the construction program to improve the delivery of content in an online medium, whereas 35% and 15% indicated the existence of no such resources and no knowledge of resources, respectively. Figure 3 shows the faculty response on resources for the online medium between the university and the construction program. Resource availability of the online medium in construction programs shows 50% yes and 50% no or no knowledge, indicating the challenges of getting online resources among construction courses.

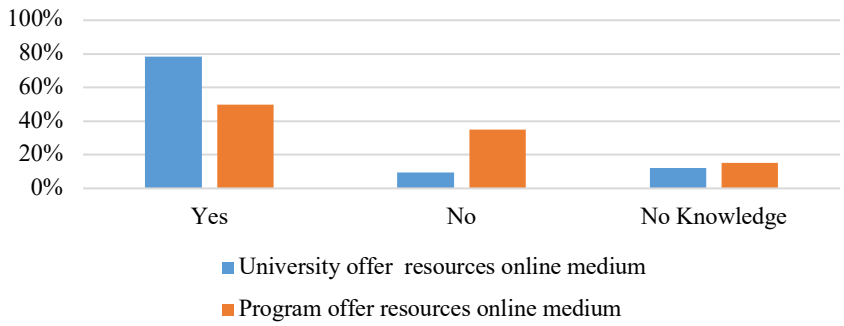


Figure 3: Online medium resources provided

When asking educators: "*Have you ever taught using an online method?*", approximately 68% of the responding faculty indicated they have experience in online teaching. In contrast, about 2% of the responding faculty indicated online content delivery was typical in construction programs. About 93% of the responding faculty indicated face-to-face content delivery was the main method in construction

programs. Figure 4 shows the faculty response to content delivery experiences at the construction program. From the faculty response, there are challenges to the online delivery of construction courses.

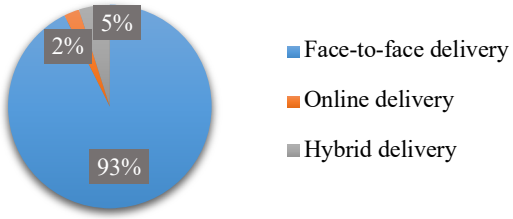


Figure 4: Faculty response of content delivery experiences (n=106)

Discussion of Online Delivery and Challenges

Construction faculty were asked to self-identify their proficiency with the delivery of online content. Since COVID-19 has created a new need to adopt remote education, faculty were asked their proficiency level in delivering online content before COVID-19 and during COVID-19. Figure 5 shows the construction faculty experience level in online delivery due to the transition during COVID-19. Online delivery experiences are categorized into "*Never Interacted, Novice, Advanced Beginner, Competent, Proficient, and Expert"*. When comparing pre-COVID and during COVID, the number of faculty reporting as Expert are similar. Proficient and competent levels of online delivery have increased due to the transition during COVID-19. It indicates the COVID-19 pandemic has caused a significant change that improved competencies in online construction education instruction. The transition to online delivery was required due to COVID-19 precautions and regulations. Impacted construction educators adopted the paradigm in response to the situation. Even after these transition experiences with online teaching, construction educators still do not believe construction education can be delivered completely online.

Construction faculty were asked: "*Based on your experiences with online teaching, do you think construction education can be delivered completely online?*". About 56% of the responding faculty indicated "no" to delivery completely online and about 46% of the responding faculty indicated "*maybe or yes*" to delivery completely online (Figure 6). Since 56% of the responding faculty indicated "*no*" to delivery completely online, an additional survey question asked faculty to identify construction courses that cannot be offered in an online environment based on experience.

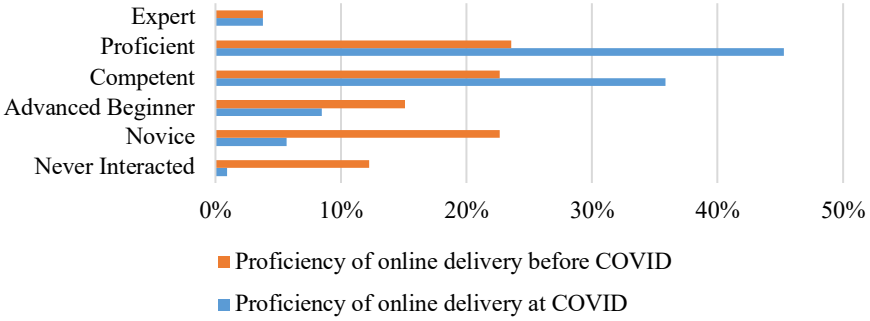


Figure 5: Faculty response of online delivery experiences due to transition of COVID-19 (n=106)

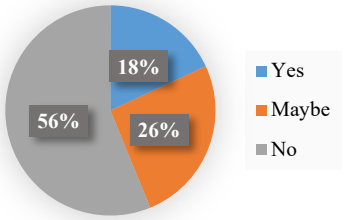


Figure 6: Can construction education be delivered completely online (n=105)

The majority (55.7%) of the responding faculty indicated that construction courses cannot be offered in an online environment, and only about 18% indicated that the same could be delivered in an online environment (Figure 6). Further, about 51% of the responding faculty indicated that materials labs, including concrete and soils and surveying labs, are difficult to offer online, whereas 21.3% indicated that Mechanical-Electrical-Plumbing lab and Capstone are also difficult to offer online. It is indicated lab-based and project-based construction courses are considered the most difficult to offer online. In referring to Figure 2A above and Figure 7, 49% of courses are typically lecture-based, leaving about half of the courses necessitating a face-to-face delivery.

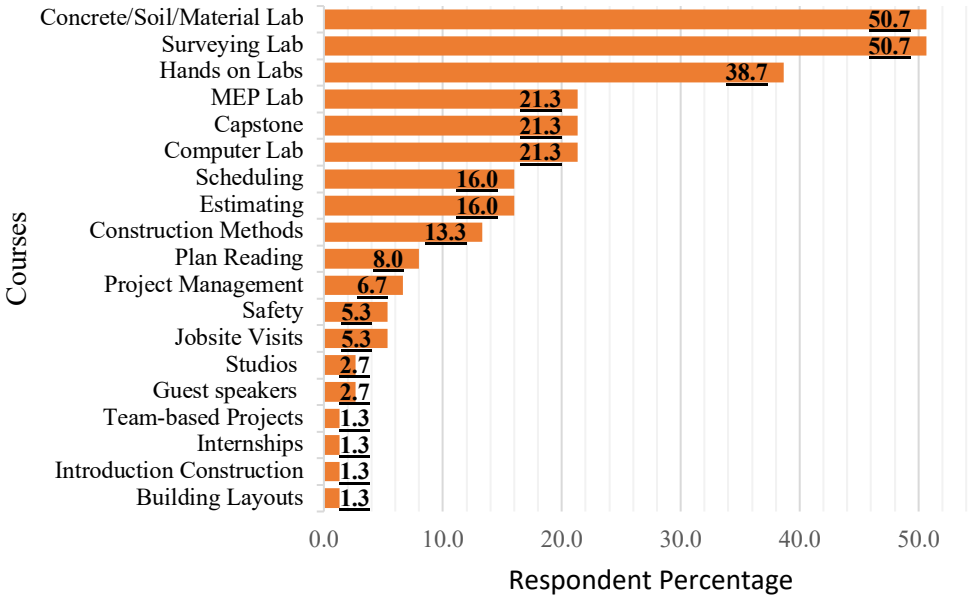


Figure 7: Construction courses cannot offer online based on the respondent (n=75)

Faculty Concerns with Online Delivery

To determine the respondents' concerns with the delivery of content online, respondents were provided an opportunity to identify their concerns in the form of the text box. Faculty concerns about online delivery have been divided into four categories (Table 1). These concerns are a) Hands-on

learning, b) Peer-to-peer interaction, c) Learning styles, and d) Academic integrity. Summarization of all these concerns of online delivery of construction courses are tabulated below:

Table 1: Faculty Concerns with Online Delivery

a) Hands-on learning	**b) Peer-to-peer interaction**
1. Loss of hands-on learning (technical skills) such as touching/feeling/sensing the equipment and material that goes into construction as well as experimental lab activities 2. Lack of availability of software (Project, CAD, BIM, GIS) to students and challenge of coordinating in team works 3. The construction industry is a people-intensive/interaction-based industry and online achieving learning outcomes will be significantly impacted	1. Loss of personal connection with students and less peer-to-peer interaction with students and challenge to learn from others 2. Loss of student self-motivation and engagement and little or no direct feedback from students 3. Less personal interactions, missing the "fun" environment that can be created in class
c) Learning styles	**d) Academic integrity**
1. Difficult to accommodate different learning styles in an online environment 2. Lack of active learning lessens feedback from students during class 3. Showing more than one screen at a time and lack of the whole picture of the entire class progress	1. Students cheating to get work completed and hampered academic integrity 2. Difficult to measure student understanding or attention 3. Students "forgetting" about tests, papers due, etc. until long after the deadline

Summary and Conclusion

Construction faculty are typically what is considered "teaching" faculty or have a heavy teaching load with high student contact hours. This may be attributed to university construction programs offering a very applied major. When considering moving to an online environment, faculty are hesitant to lose face-to-face time. The survey was conducted during the pandemic (May/August 2020). Approximately 68% of the responding faculty indicated they have experience in online teaching before the COVID-19 pandemic. In contrast, about 2% of the responding faculty indicated online content delivery was typical in construction programs. However, the transition to online delivery was impacted due to COVID-19. The COVID-19 pandemic has caused a significant change that improved competencies in online construction education instruction.

Construction courses are usually delivered through lectures, experimental laboratory exercises, project-based learning activities, and computer lab studios. Delivering online hands-on laboratory, project-based courses, or computer labs is challenging versus the more traditional face-to-face environment. Faculty feel that teaching "lecture only" online course materials are most effective using streaming/recorded video. With 50% of the courses being lecture and the others being problem-solving and lab-based, it is difficult to conceive how to deliver these courses online. Lack of access to

software and materials for testing are two major concerns for faculty and must be overcome if construction programs are to move online in the future. Other concerns include academic integrity issues and social interaction.

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