Faculty Experience in Team Teaching in Construction Management Higher Education

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Introduction

Effective collaboration is one of the expected student learning objectives in construction higher education [1]. One of the reasons for this is because construction professionals deal with a diverse group of professionals in architecture, engineering and construction. In addition, there is an expectation within the construction industry of 18% growth in the use of Design-Build delivery method over the years of 2018 to 2021 [2]. Design-Build can be considered a more collaborative delivery method than Design-Bid-Build due to the engagement of contractor and designer during the initial development of a project. The rise in use of more collaborative delivery methods, such as Design-Build, Construction Management at Risk, Integrated Project Delivery, as well as previous research [3], [4] indicates the need for improving collaboration from an industry perspective. Additionally, construction programs are aware of the need to train our students to be effective collaborators and seek to integrate teamwork in their curriculum [5].

Despite encouraging students to work in teams, faculty rarely teach in teams in construction higher education. Faculty collaboration may occur in research endeavors, but team teaching is not often employed on a large scale in R1 (very high research activity) institutions and other peer institutions. This happens despite previous research showing the benefits of team teaching to students [6]. A few published exceptions of team teaching in construction programs are Ball State University [7], [8], Colorado State University [9] and Purdue University [10]. From these, only Jones and Mezo [8] provide a brief insight into faculty thoughts about the new teaching dynamics and all of them only cover the experience of teaching one course.

The present exploratory paper proposes to add to the previous team-teaching literature in construction higher education by providing reflections and lessons learned from two faculty from the School of Construction Management Technology at Purdue University, who have team taught together two courses and two modules in another two courses focusing on design and construction integration topics during Fall of 2019. Previous studies focused on team teaching of one module or one course, so the authors will provide a unique point of view by sharing experiences of teaching team across multiple courses during one semester.

The paper uses a phenomenology approach focusing on faculty experiences, rather than students' perceptions. The rationale for this choice was because despite the benefits of team-teaching being known and highlighted by previous literature, in most cases the driving factor for it to be used is the willingness of faculty to collaborate. This paper can be used by construction program administrators and instructors considering team teaching in their courses.

Background Literature

Team teaching definitions and strands

There are many definitions and strands of team teaching in higher education. Team-teaching may often be called different names and display different characteristics within different contexts [6]. In the present study we will use Easterby-Smith and Olve [11] definition, which indicates team teaching as involving "two or more trainers or teachers collaborating over the design or implementation of the same course" (p. 221). However, other researchers have used definition of team teaching that includes prescribed logistics of how the course is delivered or a minimum number of faculty or instructors [6].

There are many different naming conventions for team teaching, such as co-teaching and cooperative teaching. These terms are related to team teaching and often account for different nuances in the instructional strategy [12]. In fact, cooperative teaching is a term most often linked with special needs education and likely a precursor to co-teaching [13]. Co-teaching is a more widely accepted term in higher education, though it is still much more common within special education research [14] and team teaching is more frequently used in general higher education, though some researchers might classify co-teaching and team teaching as two different processes (see [15]). The term co-teaching is defined by Cook and Friend [15] "…two or more professionals delivering substantive instruction to a diverse, or blended, group of students in a single physical space" (p.2), therefore prescribing the physical presence of two or more instructors in a teaching space.

As noted in Cook and Friend [15], some different models of co-teaching are helpful to consider:

- *one teaching, one assisting* – in this mode there is a clear instructor that leads, while a second instructor acts secondarily and mainly focuses on observing students. This format may lead into issues given that one instructor can be perceived (or feel) more important than the other;
- *station teaching* – in this mode the class can be divided into smaller sections for which instructors teach separately. Once the module is finished, instructor trade places and teach the other half of the room. While this mode can benefit students and instructor with a lower student-teacher ratio, it can have issues related to the noise produced by two concurrent modules in one room, transitions not being well made, and if both instructors are not finished at the same time, one might have to wait until the second is done;
- *parallel teaching* – in this mode, the instruction is planned jointly by both (or more) teachers, but it is delivered to only half of the class. An example given by researchers is the use of this type of teaching to explain different points of view of a same topic where each half of the class is instructed on the same topic, but through two different points of view. Then, the whole class can come back together and discuss on the topic using those two points of view;
- *alternative teaching* – in this type of co-teaching, one instructor is responsible for a larger group of students while a second instructor in in charge of a smaller

group of students to provide pre-teaching, re-teaching or a greater emphasis on certain subject that is of shared interest to all in the smaller group;

- *team teaching* – in this mode, both teachers may be present in the room, but they perform either different activities (such as one talking, one note taking) or may play different roles in a discussion. Researchers indicate that this mode "…requires a high level of mutual trust and commitment" (p.7) [15].

In the aforementioned list, Bacharach and Heck [14] made some modifications by dividing *one teaching, one assisting* approach to *one teach, one observe* and *one teach, one drift*. While in *one teach, one observe*, the focus of the secondary teacher is on observation of students, in the one *teach, one drift*, the second teacher is more involved with students, helping with assignments and transmitting the message from students who often are hesitant to participate. They also proposed a *supplemental teaching* as a second teacher to provide more support to students who need extended help or remediation, and slightly changed the definition of *alternative teaching* to *alternative (differentiated) teaching* to describe two instructors delivering the same topic using different methods of instruction.

As one can see, a plethora of models for sharing the responsibility of a group of students exist. The variance in these models are important to accommodate different contexts. Regardless of the model adopted, previous research indicates that, if done well, these approaches have several benefits to students as well as a few drawbacks that should be taken into consideration when considering co-teaching as an instructional strategy [14], [15], [16].

Benefits and challenges of team teaching

Limited research exists in co-teaching in higher-education outside the area of special needs, however what has been published is encouraging and indicates benefits of co-teaching to students. For example, after analyzing 372 responses from sixteen different courses, Bacharach and Heck (2007) indicate that having diverse points of view in class and having a lower student/teacher ratio are the top two benefits to a co-teaching approach in class. Other researchers also indicate the benefit for students of having multiple perspectives about a topic during class, allowing for more challenging classes, increased student dialogue and participation, improved quality in the evaluation of students' work and performance (because students would benefit from a diverse team of experts evaluating their work), improved retention rates and soft skills [6], [16], [17].

According to Bacharach and Heck [14], successful co-teaching can be linked to four main factors: (1) mutual instructor respect, (2) well planned and follow through transitions, (3) instructors communicating the co-teaching model they use to students, and (4) an equitable division of instructional time among instructors. All of these factors involve coordination and communication between instructors and between instructors and students. Coordination and communication can create issues for the students if not properly addressed. Potential student issues identified by previous research include: (1) confusion about which instructor to go to; (2)

confusion about grades; (3) issues with time allocation per instructor while students would have a preference over one instructor or one instructor's style of teaching; and (4) issues of course organization [14].

In addition to benefits for students, previous research has addressed some benefits of co-teaching for instructors. Some examples are the mentorship aspect that a young professor can have when paired with a more seasoned instructor, and reducing the feeling of isolation in academia, as well as creating the environment for more creative ideas to emerge [11], [16], [17]. However, there are also challenges to co-teaching that have been recognized as well, and these may vary from a K-12 to a higher education perspective. For example, the worry about how the increased time requirement affects the tenure process and the division of a shared course in individually allocated credit hours are worries specific to higher education. Drawing from previous research [6], [16], [17], the authors summarize some points that need to be addressed when considering co-teaching:

- *Autonomy and Ownership*: individual decisions and last-minute changes are more difficult in a shared course. It is also difficult for faculty leaders to control other faculty, such as requiring and holding other instructors accountable for late grading and feedback to students. Finally, instructors who were senior in a course or participated more on the planning of the course may feel they own the course more than others who came on board later on, causing power issues within the course;
- *More time requirement*: planning, organizing and collaborating during the semester requires more time than one would need to teach a course by themselves. An open communication channel should be established in the team, with previous research indicating the benefits of regular meetings for improved process facilitation. This additional time requirement can have clear implications especially for faculty that are also expected to perform research.
- *Compatibility between instructors*: research suggest that teams of teachers should have compatible work styles. This does not mean the same teaching style, but rather that they can work as a team to improve the class learning. It is also important to understand if co-taught courses have a hierarchical organization or a more distributed organization and that this decision is agreed and clear to all participating instructors. Research appears to be unclear on the benefits of one or multiple leaders in a co-taught course [17]. In addition, it is important that instructors of co-taught courses be mindful of potential team issues that may arise and how to respond to those issues with a team mindset. This can mean delaying a decision or a response to a student after communicating with other team members.
- *Instructors' expertise diversity*: in order to work well, co-taught courses should be taught by instructors with different areas of expertise, so they their presence in class is complementary to each other.

Finally, researchers suggest that a mix of instructors with different genders, cultural or academic backgrounds in co-taught courses may benefit students' learning by recognizing the importance of diversity [6], [17]. Institutional support is critical to the success of co-teaching in higher education because of the allocation of credit hours may not reflect the actual work put into developing and deploying a shared course and the difference in instructors' ranking (for example associate versus assistant) teaching the same course may result in power issues during the course [16].

Team teaching in construction higher education

As mentioned previously, limited research has been published on the experience of team-teaching construction related courses in higher education. Within the specific construction literature, Jones and Mezo [8] describe the experience at Ball State University faculty in team teaching a construction engineering and management capstone course. Some of the benefits of the team-based approach noted is the opportunity that faculty involved in the capstone in team teaching can evaluate and reflect on their other courses, correcting and adjusting the lower level courses as necessary. In addition, some benefits and challenges mentioned in their work echo previous research in team teaching and co-teaching. Benefits included allowing for mentoring of new faculty by more experienced faculty and fostering more dialogue within the department faculty. Challenges include making sure collaboration and communication among faculty is in place to portray unity to students and recognizing faculty work using credit hour allocation. For Jones and Mezo [8], an additional challenge was posed because only a single faculty member was allowed to be credited for the course in a given semester their institution which can be a disincentive for the proposal and deployment of shared courses. Some of the alternatives found by Ball State University faculty to manage the challenges posed by team teaching of the capstone course were to only use co-teaching when it was necessary, having some presentations recorded and recruiting the help of teaching assistants when scheduling conflicts cannot be resolved [7], [8].

Another study within the construction education field is by Metzinger et al. [10]. Team teaching is not the focus of the study, it described the development and deployment of a recent team-taught course with five instructors at a large, research intensive university. Some of the lessons learned included in Metzinger et al. [10] also resonate with previous research on co-teaching and team teaching. Among those lessons learned, two are specific to the team teaching of the course: (1) the importance of communication between all instructors (in their case through a weekly meeting) to improve group cohesiveness as well as evaluate how to improve topic transitions; and (2) transitions between topics has proved to be an area that could be improved upon further course iterations.

A third experience in team teaching for construction undergraduate students presents the experience of two instructors co-teaching two courses – one in English and on in construction management. The unique course was focused on improving the integration of communication skills within construction education [9]. In their description of the experience, Killingsworth et

al. [9] described the development of integrated activities between English and construction management. In addition, the researchers performed a pre and post survey to the co-taught courses and verified that by the end of the course students considered themselves better writers, though other survey results were not significant. Finally, benefits and challenges of the implementation of the shared course echoed previous research: benefits were that students appreciated the improved cohesiveness between the technical (materials and methods) and the non-technical class (English) and "instructors felt great support in their individual teaching owning to the intense collaboration" (p. 7), [9]; while challenges with the deployment of the experience included issues of faculty loading in higher education.

Co-teaching and team teaching for construction undergraduate education has had a growing interest in the past decade, though still little published material exist that can provide insight into specific challenges and benefits from the instructional as well as the students' perspectives. The present paper adds to the existing literature by providing another faculty perspective in not one, but multiple team-taught classes within one semester.

Teaching Context

The teaching context for the present courses and modules is somewhat unique because the construction management department is currently going through a curriculum restructure in which team teaching is encouraged. The college is very supportive of new learning experiences, especially those focused on active learning. In addition, the two authors are currently involved in the development of a construction major with more design related courses, to act in more collaborative delivery methods and as a liaison between construction and design teams. The curriculum restructure was started about two years ago, along with the new proposed major, though due to some internal issues the latter is expired and under restructure as well with the hopes of reopening for enrollment at the end of the spring semester.

The courses and modules co-taught for this study cover a broad range of topics and class sizes that are focused on the new design-construction major curriculum. The four courses and modules are noted in Table 1. Class sizes, course information and the percentage of instruction for each faculty member are noted in the table and following the summary table, a brief description of each course or module is provided.

Table 1. Courses and Modules Co-Taught in Design and Construction Integration Curriculum

Course #	Course Length	Course Format	Course Information	Number of Students	Percent Faculty A	Percent Faculty B
CM 23301	3 Credits	2 meetings per week | 1-hhour lecture + 1-hour lab per meeting	Basic mechanical, electrical and plumbing course for constructors and architects	31	50%	50%
CM 33000	6 Credits	4 meetings per week | 2 1-hour lectures + 2 4-hour studios	Design studio for construction-oriented students (Residential Focus)	6	80%	20%

CM 20000 (module)	8 Hour Module	2 2-hour lectures and 2 2-hour labs over 2 weeks	Introductory design and construction integration module construction students	109	70%	30%
CM 30000 (module)	33 Hour Module	1 3-hour meeting per week for 11 weeks	Module focused on lean construction, risk management and project delivery	5	20%	80%

CM 23301 (3 credits) – Mechanical, Electrical and Piping Systems in the Built Environment. This is a basic Mechanical, Electrical, and Plumbing (MEP) course for both interior design and design and construction integration students. The course has been offered for many years but was recently modified to incorporate co-teaching and active learning. The modifications include the addition of a semester long project, divided into smaller deliverables with a presentation at the end of the semester. The course was also modified to have more lab time for the students to work on their projects. Lectures were mainly taught by the individual faculty and there was not a significant number of lectures that both faculty delivered together. Notable exceptions where when there were special guest speakers, tours of facilities, and presentation of the projects.

CM 33000 (6 credits) – Design and Construction I. A course which introduces students to projects and the design as a communication tool representing space and proportion. The course has both lectures and studio work. The course culminates with a final design of a small residential unit and includes MEP systems conceptual design, as well as building construction cost estimation. Faculty "A", who has the architecture background, provides the majority of support for this course. Both faculty participate in the design studio. Lectures are taught by only one faculty member based on their area of expertise. Both faculty participate in the support of the design and for assessment of incremental and final projects.

CM 20000 – Design and Construction Integration Introduction Module (8 Hour Module). CM 20000 is a project course focused on the pre-construction phase of commercial and residential construction. As part of this course an 8-hour module is delivered that provides students an introduction to design and construction integration. Lectures include some active learning activities (such as discussions and mini presentations) and focus on the importance of communication and coordination, as well as lean construction concepts. Labs are provided over the two-week period that focus on the process of working as a collaborative team of designers and constructors. Co-teaching is used in at least half of the module.

CM 30000 – Design and Construction Integration Module (2 credits). CM 30000 is the follow on to CM 20000 and covers more advanced pre-construction activities for commercial construction including scheduling, estimating, safety, structural design and accounting. As part of this course the students enrolled in the design and construction integration major have small group lecture sessions. Though labeled formally as lecture, the breakout group focuses on small group meetings and industry panels to discuss risk management, project delivery and lean

construction. Both faculty developed the course and faculty "B" takes the lead for the lectures and while industry panel discussions are moderated by both faculty.

The faculty involved in the experience reported in this paper have different backgrounds. Faculty A is a female assistant professor, with architectural background, professional experience in residential and commercial construction, and 3 years of academic experience. Faculty B is a male associate professor, with mechanical engineering background, with professional experience in industrial engineering design background and 18 years of academic experience.

Methodology for Reflections

For the present paper, the authors have used a phenomenology approach as defined by [18], who have indicated it as "… the study of the world as it appears to individuals when they lay aside the prevailing understandings of those phenomena and revisit their immediate experience of the phenomena" [18, p. 495]. One of the requirements of the study is that all involved be involved with the issue at hand. In this sense, both authors were intrinsically involved in the experience and motivated to further understand how team-teaching has influenced their work during the Fall 2019 semester. Despite not using data from objective instruments, phenomenology has its advantages in that (1) it can be used to analyze various educational situations; (2) the data originated from the interview process can be very detailed, and (3) its procedures are very straight forward [18].

For data collection, the authors propose reflections upon the Fall 2019 semester using a semi-structured questionnaire. The questionnaire was prepared based on the previous literature and reviewed by both authors together, resulting in eleven prompt questions. Once the questions were reviewed and approved by both authors (see Table 2), each instructor has individually provided written answers for each of the questions. Once the responses were finalized, each author read the other's reflection. Then, a meeting was scheduled, during which the reflections were discusses and distilled into lessons learned points presented in this paper. After the meeting, one author consolidated individual answers in narratives for each question presented in the following section.

Table 2. Debrief Questions

#	Question prompt	Topic(s) area(s)
1	How was the decision to partner for these courses and modules made?	Compatibility between instructors
2	How was team planning for the development of those courses/modules?	Autonomy Ownership Instructor Expertise Diversity
3	How did you format and schedule the courses to be shared between the both of you?	Autonomy Ownership Instructor Expertise Diversity
4	What was the process of communicating to students as a team (including grading)? Was this confusing to students?	Autonomy Ownership
5	How did you communicate between yourselves during the semester?	More time requirement Compatibility between instructors
6	How were last minute adjustments handled?	Autonomy Ownership

7	Did you feel you learned something from team-teaching that you would not from teaching a course by yourself?	Instructor Expertise Diversity
8	How was it having multiple team-taught courses at once impacted your other academic obligations?	More time requirement
9	What were the challenges team teaching you have faced during the development, deployment and closing of the course?	General
10	What were the benefits of team teaching you have faced during the development, deployment and closing of the course?	General
11	If posed with the possibility to team-teach these and other courses and modules again, what would be your main considerations?	General

Faculty Reflections

How was the decision to partner for these courses and modules made?
Both instructors mentioned a self-selection to participate in the new design-construction related major as the main driver for team-teaching the courses and modules. However, timing for each faculty was different. Faculty A was involved from the beginning on the development of the courses and modules, and faculty B, though interested in the beginning, became more involved after the retirement of another faculty member that was also helping with curriculum development.

How was team planning for the development of those courses/modules?
For this, it is clear that each course and module had a different development strategy. For the new studio course the main course schedule and project prompts were already developed by faculty A before faculty B came into the curriculum development. For the 8-hour module, because Fall of 2019 was its third iteration being team taught by both faculty A and B, there was not much planning needed for the Fall 2019 iteration. Similar to the MEP systems course, because both instructors have taught the course before, there was not much planning needed. Finally, planning for the 33-hour module was probably the most collaborative. Despite its development being led by faculty B, both faculty collaborated on the development of schedule iterations, text book selection and course content development. Although faculty A had developed course learning outcomes for the 33-hour module, faculty B provided a more engineering lens, which both faculty agreed would be a nice complement to the architecturally focused studio course.

How did you format and schedule the courses to be shared between the both of you?
Again, there were different approaches depending on the course or module. The MEP systems course was divided taking into consideration achieving a balance between both instructors while taking into consideration interests from both. The studio course had most of the lectures taught by faculty A, who has an architecture background. Faculty B was mainly in charge of lectures that related to building systems and estimating. Both faculty were present in the studio sections, though faculty A provided more input to the students due to the content and goals of the course.

The 33-hour module was the opposite, with faculty B taking the lead and covering more lean topics, project delivery methods and risk management topics, and faculty A providing more input in topics that were more related to her area of expertise. Finally, the 8-hour module was a bit more challenging due to scheduling conflicts and though both instructors would like to be present in it, half of the module only had one instructor present in the room. Within all courses and modules, both instructors had to be flexible to accommodate changes in schedule due to out of campus meetings and conferences, as well as other teaching obligations.

What was the process of communicating to students as a team (including grading)? Was this confusing to students?
Faculty A mentioned having more struggles with communicating with students during the first third of the MEP systems course. This is because both instructors were in charge of the plumbing module and that became a bit confusing to the students. After the initial plumbing module there was always a clear lead for the students that made communication coordination easier. Grading was only shared in that course for the first semester project deliverable and presentations. A few questions that students for the first deliverable were handled jointly by both instructors and there were no questions for the presentation. For the other courses, except for studio course semester project presentations, each activity was clearly led by a faculty, so there was no confusion about grading. Finally, for the studio course semester project, both faculty were present for all presentation and equally commented on students' work. Students received a final grade that was an average from the instructors, as well as written comments from both faculty A and B without any confusion.

How did you communicate between yourselves during the semester?
During the semester most communication occurred through informal and formal meetings, Informal meetings were more frequent and shorter, and formally scheduled meetings tended to happen less often, though ran longer to accommodate feedback from all of the courses faculty A and B were team teaching during Fall of 2019. Both faculty A and B mentioned that having a weekly meeting routine as something they consider moving forward.

How were last minute adjustments handled?
Faculty A and faculty B both recognized their counterpart as being very flexible to last minute changes. Both agreed that this was due to the newness of the curriculum as well as both being new to team-teaching.

Did you feel you learned something from team-teaching that you would not from teaching a course by yourself?
For this question, each faculty provided a different input. For faculty A, learning more techniques for improving teaching as well as engaging students and having access to a broader network of professionals and academics was something gained from team teaching. For faculty

B, the main gain of team teaching was acquiring knowledge in an area outside of his area of expertise.

How was it having multiple team-taught courses at once impacted your other academic obligations?
Again, there were different aspects brought by each of the faculty. Faculty A mentioned struggling to balance the higher time commitment for team taught courses (especially the time commitment related to coordination meetings) with other academic obligations required for the tenure process. Faculty B also indicated that, not only the team teaching resulted in higher time commitment, but also the fact that the longer module and the studio course were both offered for the first time in the Fall of 2019 made the semester especially challenging.

What were the challenges team teaching you have faced during the development, deployment and closing of the course?
For this question, both faculty mentioned the logistical challenge to manage both faculty schedule and understand who needs to be where and when. In addition, faculty A mentioned the challenge to find a good meeting time that was consistent week to week since both faculty had constantly changing weekly schedules. The result was having meetings at inconsistent times during the semester. Another challenge was changing the mindset from course to course because they all focus on the similar design-construction subject matter and because three of the courses had similar students enrolled. Finally, faculty B mentioned the challenge of working with material that was developed by another faculty (faculty A) and making sure the intended outcomes were being met and the class was progressing as planned. Although he acknowledges that this might also be because this was a new course offering.

What were the benefits of team teaching you have faced during the development, deployment and closing of the course?
In this question, both faculty mentioned the ability to create a better course for students from the perspective of teaching and student engagement. This is not only a result of co-teaching, but also the formal and informal coordination meetings throughout the semester, during which both faculty could discuss things that worked well and things that could be improved in next course or module iterations. Faculty B also mentioned the ability to learn more on areas that were new to him, and faculty A mentioned the ability to have some schedule flexibility.

If posed with the possibility to team-teach these and other courses and modules again, what would be your main considerations?
Both faculty provided complimentary comments. As a tenure-track faculty, faculty A mentioned being concerned about how the team-teaching higher time commitment and effort will be recognized during the tenure process. She also mentioned the need to really evaluate and match team member meaningfully, so that faculty involved in team teaching of a course or module have

complementary experience and background, and have aligned expectations for what the team wants from it and the students. Faculty B indicated that not all course types or material is conducive to team teaching, with more active learning course types, such as studio or labs during which students are building or designing as something he would consider when deciding in the future to team teach a course or not.

Lessons Learned

After reading each other's reflections, both faculty decided on the top lessons learned from the teaching experience during Fall 2019. They are:

- *The need for regularly scheduled meetings.* The informal meetings during Fall of 2019 were essential to jointly managing the courses and modules, but having a fixed time to meet would help ensure consistency throughout the semester, so meetings were not sometimes short or sometimes too long.
- *The benefits of complementary skills.* Having complementary skills was very useful not only for students to learn from different points of view, but also for faculty that were involved in the experience because they have learned different ways of teaching and also about other construction and design related areas outside of their main expertise.
- *The benefit of having a faculty lead.* Having a clear faculty lead in some of the courses helped manage communication with students. This is also beneficial in terms of course planning and deployment, because with one faculty lead certain small decisions (such as an extension in an assignment) can be made by one faculty, leaving the most impactful and meaningful points to be shared.
- *Acknowledging the higher time commitment.* Shared course development and deployment does take more time commitment than regular, individually taught courses. Even when sessions are not co-taught, shared courses still require coordination meetings to make sure content and learning outcomes are being met by all instructors in the course. This higher time commitment is not officially translated in credit hours and can result in an increased teaching load that administrators should take into consideration. This can have a significant impact in the careers of tenure-track faculty that have high research expectations.
- *The importance of alignment.* Having a shared vision for the major was essential for the good development of the shared courses and modules, because both instructors could have a higher-level view of how all those contribute to the formation of the design-construction professional. For example, both instructors agreed upon a more design-oriented studio focused on residential construction because we both planned a more engineering focused module (the 33-hour module).
- *Having an open mindset to learning how to team teach.* Team-teaching is not very common in higher education and there is limited research on how to do it effectively, therefore there is a learning curve to improve coordinated communication as well as the

dynamics of a co-taught class. The team needs to have an open mindset that it might take some time until the team dynamics reaches an optimum level.

- *The team-teaching – co-teaching compromise.* Throughout the planning and deployment of the courses and modules, we have acknowledged that not all course sessions needed to be co-taught to provide students with different mindsets that would be beneficial to their work. This is especially important if we consider the required balance between teaching and other academic expectations. For example, the input of a second instructor during highly technical sessions might not be as beneficial as their contribution during a more open-ended discussion session. Examples of open-ended discussions are semester project presentations, review of quality assurance and quality control in the design and construction process, and during studio sessions when students are working on both the aspects of design and construction.

Discussion and Future Directions

The experiences the authors provide in the paper echo previous research in terms of compatibility between instructors, more time requirements and instructors' diversity of expertise. Because most of the team-taught courses in this experience resulted from a major that is currently being developed by both faculty, the instructors already had a good alignment for student expectations, which facilitated planning. Despite course ownership issues being mentioned in previous research [16], it was not an issue for the present courses and modules. In addition, because of the previous experience working together (though not teaching together), both instructors were already familiar with each other work styles. During planning, both faculty were aware and took into consideration the area of expertise from each one of them and, as semester progressed it was clear that the teaching style of both instructors were complementary. Also, there was much to be learned by both faculty on design and construction topics that were outside of their main areas of expertise, and this also became clearer as the semester progressed, prompting very productive conversation about expertise and curriculum in general. The benefits for instructor compatibility, diversity and co-learning is also something mentioned by previous research in team teaching and co-teaching [6], [16], [17].

The confusion originated by having two faculty in charge of a course, which was mentioned in previous research [14], was also felt by the instructors in the beginning of the semester, but it was offset later, when each module or class had a clear faculty lead and instructors compromised the use of co-teaching to only when more open ended problems or assignment were posed to students This approach also helped both instructors manage the increased teaching load resulting from having a multitude of team-taught courses which was also noted by Jones and Mezo [8].

Finally, the need for increased time commitment is something that needs to be recognized and supported by administration [17]. The regular meetings and communication were mentioned by several previous researchers [10], [16], but started to become a struggle when multiple classes and modules are team-taught in one semester, so it was difficult to find a regular meeting time

and formal and informal meetings took place throughout the semester. This was not much of a problem because both faculty were flexible and willing to keep an open mind-set to adapt.

As the Spring semester begins, both instructors prepare to teach one course and one of the modules from Fall again. In addition, a second studio course will be added and Faculty B will lead that with Faculty A's support. Regularly scheduled meetings have been set up for all semester, so coordination flows steadier. For other programs considering team teaching in their courses, the authors recommend looking at previous literature from construction and from other areas for best practices, including the present work. In addition, administrators and faculty should consider the impact of time commitment for team-taught courses towards other academic obligations before committing. This is especially true for tenure-track faculty that are expected to have a high research productivity and to secure outside funds.

Finally, limitations to this exploratory study exist. Even though the phenomenology approach was adequate to provide an in-depth analysis for this exploratory study, the responses here are based on the experienced of the two authors for one specific semester. Further studies could include: (1) a broader survey research of other construction faculty that have team taught courses; (2) a longitudinal study of faculty that incorporate team-teaching in their construction related courses; and (3) students' perceptions of team-taught classes in construction.

References

[1] ACCE-American Council for Construction Education (2018). "*Document 103B: Standards and criteria for accreditation in construction."* San Antonio: ACCE. 2018.

[2] FMI (June 2018). Design-Build Utilization. Combined market study. Retrieved from: https://www.fminet.com/wp-content/uploads/2018/12/Design-Build-Market-Research-FMI-2018.pdf

[3] Baiden, B. K., Price, A. D., & Dainty, A. R. (2006). The extent of team integration within construction projects. *International journal of project management*, *24*(1), 13-23.

[4] Bresnen, M., & Marshall, N. (2000). Building partnerships: case studies of clientcontractor collaboration in the UK construction industry. *Construction management and economics*, *18*(7), 819-832.

[5] MacLaren, A. J., Wilson, M., Simmonds, R., Hamilton-Pryde, A., McCarthy, J., & Milligan, A. (2017). Educating Students for the Collaborative Workplace: Facilitating Interdisciplinary Learning in Construction Courses. *International Journal of Construction Education and Research*, *13*(3), 180-202.

[6] Anderson, R. S., & Speck, B. W. (1998). "Oh what a difference a team makes": Why team teaching makes a difference. *Teaching and teacher education*, *14*(7), 671-686.

[7] Jones, J., Mezo, M., & Warner, J. (2007). "Team Teaching the Capstone Construction Management Course: How and Why." In *ASC Annual Conference Proceedings*, Flagstaff, AZ. 2007.

[8] Jones, J. & Mezo, M. (2014). "Capstone = Team Teaching + Team Learning + Industry." In *ASEE Annual Conference and Exposition.* Indianapolis, IN. 2014.

[9] Killingworth, J., Ogden, M. & Elliot, J. (2017). “Integrating Composition Skills within Construction Curricula: A pilot study.” In *ASC Annual Conference Proceedings*, Seattle, WA. 2017.
[10] Metzinger, J., Cabral, J., Debs, L. and Zimpfer, M. (2019). “Construction Management Curriculum Transformation through Project-Based Learning: Initial Implementation.” In *ASC Annual Conference Proceedings*, Denver, Colorado. 2019.
[11] Easterby-Smith, M., & Olve, N. G. (1984). Team teaching: making management education more student-centred?. *Management Education and Development*, *15*(3), 221-236.
[12] Welch, M., Brownell, K., & Sheridan, S. M. (1999). What's the score and game plan on teaming in schools? A review of the literature on team teaching and school-based problem-solving teams. *Remedial and Special Education*, *20*(1), 36-49.
[13] Murawski, W. W., & Lee Swanson, H. (2001). A meta-analysis of co-teaching research: Where are the data?. *Remedial and special education*, *22*(5), 258-267.
[14] Bacharach, N., Heck, T. W., & Dahlberg, K. (2007). Co-teaching in higher education. *Journal of College Teaching & Learning (TLC)*, *4*(10).
[15] Cook, L., & Friend, M. (1995). Co-teaching: Guidelines for creating effective practices. *Focus on exceptional children*, *28*.
[16] Morelock, J. R., Lester, M. M., Klopfer, M. D., Jardon, A. M., Mullins, R. D., Nicholas, E. L., & Alfaydi, A. S. (2017). Power, perceptions, and relationships: A model of co-teaching in higher education. *College Teaching*, *65*(4), 182-191.
[17] Letterman, M. R., & Dugan, K. B. (2004). Team teaching a cross-disciplinary honors course: Preparation and development. *College teaching*, 76-79.
[18] Gall, M. D., Borg, W. R., & Gall, J. P. (1996). Educational research: An introduction. Longman Publishing.