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Preparing CM Students for Design-Build Projects: Lessons from an Interdisciplinary Integrated Planning and Design Course

Maryam Kouhirostami[1], Kelsey Ginori[1]
[1]California Polytechnic State University, San Luis Obispo

Early collaboration is fundamental to integrated project delivery, yet undergraduate programs often isolate disciplines and provide limited opportunities for students to practice effective teamwork. This study reports lessons from an Interdisciplinary Mass Timber Studio that brought together students from Construction Management, Architecture, Architectural Engineering, and Landscape Architecture to work collaboratively on a shared conceptual building project. Using a mixed-methods approach - including pre- and post-course surveys and a faculty interview - the researchers examined changes in students' collaboration behaviors and disciplinary awareness. Findings revealed that students shifted from viewing teamwork as task division and deadline management to engaging in criteria-based decision-making and role ownership. Persistent challenges included uneven participation and misaligned schedules across departments. Faculty reflection underscored both the benefits of interdisciplinary engagement and the logistical and pedagogical challenges of aligning content, time, and expectations across multiple programs. Overall, the studio advanced students' collaboration from cooperation toward integration and broadened their understanding of project delivery as a reciprocal, multi-stakeholder process. The findings suggest that mass timber's authentic design and construction constraints, combined with intentional interdisciplinary practice, accelerate collaborative learning and clarify construction management's early-stage value. Practical insights are offered for educators seeking to implement interdisciplinary, project-based learning in construction education.

Keywords: Collaboration; Interdisciplinary Curriculum; Mass Timber; Construction Management; Construction Education

Introduction

Construction projects increasingly demand integrated decisions across design, engineering, fabrication, and delivery (Irizarry, et. al. 2010). University programs prepare students well within disciplines, but there still exists two gaps: how students practice collaboration in authentic settings, and how faculty structures that practice so it is visible, repeatable, and assessable (Van den Beemt et al. 2020). Design-build is a suitable context for interdisciplinary learning due to the collaborative nature of the projects, and mass timber is a timely context because span, fire, prefabrication, logistics, and cost trade-offs surface early, inviting CM input before drawings harden (Kouhirostami & Dharmapalan, 2025). This paper documents an Interdisciplinary Mass Timber Studio that joined

Construction Management (CM), Architecture (ARCH), Architecture Engineering (ARCE), and Landscape Architecture (LA) students in cross-disciplinary teams. The studio's aim was to provide students with regular, structured opportunities to negotiate decisions with peers with different thought processes. The following research questions were asked:

- How do students' perceptions of interdisciplinary collaboration change from before to after participating in a pilot interdisciplinary course?
- What challenges and benefits of implementing a pilot interdisciplinary course in the context of a construction management program are revealed through faculty reflection?

Literature Review

Collaboration and Interpersonal Skills in Construction Management Education

A recent shift in project execution thinking and the growing number of large capital investment projects in construction have emphasized the significance of collaboration. The complex nature of construction projects necessitates effective collaboration among all stakeholders in the project lifecycle, including owners, engineers, architects, and contractors, because typically, no one single organization can execute the entire project alone (Han et al., 2018). Despite technological advancements, construction projects are fundamentally human centered, and human relationships that foster trust, commitment, and reliability are enablers of project success (Deep et al., 2019). Posillico & Edwards (2024) found that for a construction manager's role, there is "an overwhelmingly strong preference from academia for interpersonal skills and competencies (i.e., 'teamwork', 'communication', 'leadership' and 'listening/understanding') rather than more technically focused skills and competencies". Interpersonal skills and competencies must be fundamental aspects of CM curricula for employability and career readiness of the students (Jayathilake & Wijewickrama, 2025; Posillico & Edwards, 2024).

Several studies have explored how collaboration and teamwork are experienced and developed in CM coursework. For example, Rokoeei and colleagues (2023) examined postsecondary construction and engineering students' perceptions of teamwork, finding that the ideal team size was four students, and that colocation and regular feedback from professors were particularly important for effective collaboration, especially among construction students. Both groups expressed positive attitudes toward feedback and strongly endorsed the use of project-based activities in their courses. Additionally, students emphasized the value of teamwork in various forms—including collaboration within their own major, across different majors, and in mixed-gender teams. The authors suggest that future research could examine factors influencing team formation, determinants of successful collaboration, rules governing educational teams, and the effects of working with familiar versus new peers (Rokoeei et al., 2023). Ali (2019) found that after a structured learning experience in an interdisciplinary course of students in three AEC majors, preconceived notions about each major were challenged and students ultimately expressed greater appreciation for and interest in the various fields.

Weidman et al. (2017) found that an experiential learning opportunity (marshmallow dodgeball simulation) with CM, CE, and facilities management students led to reflection on their team interactions, and how to maximize the benefits of specialization through coordination and learned lessons about communication. These studies demonstrate the potential of project-based learning to develop CM students' collaboration and teamwork skills, both with each other and with students in related majors. While several studies have explored the impact on students' perceptions, there has been less emphasis on understanding instructor perceptions of successes and challenges.

Interdisciplinary Education in Construction Management Programs

The need for interdisciplinary education in the architecture, engineering, and construction (AEC) fields has been widely recognized in both research and practice. Studies consistently point to the gap between traditional disciplinary training and the collaborative skills required in the industry. For example, Irizarry, Meadati, and Gheisari (2010) reported that while collaboration has become a standard practice in the AEC industry, educational programs often fail to prepare students adequately. Their survey showed that less than half of architecture alumni believed their programs developed the ability to work effectively in interdisciplinary teams, emphasizing the importance of teamwork and communication as top-ranked skills.

Similarly, research has highlighted the role of emerging tools and pedagogies in bridging this gap. Bozoglu's (2010) interdisciplinary course integrating Building Information Modeling (BIM) demonstrated how technology can serve as a platform for real-time collaboration and problem solving across disciplines (Wang, Leicht, & Solnosky, 2025). In a comparable effort, Monson and Dossick (2014) described how interdisciplinary studios mediated by digital technologies encouraged students to engage in joint problem solving and knowledge transfer, reinforcing the link between technology and collaboration. These findings align with the broader review of interdisciplinary engineering education by Van den Beemt et al. (2020), which concluded that most successful teaching practices in this area are structured around collaborative teamwork. However, the same review pointed out that assessment strategies remain underdeveloped, creating uncertainty about how best to measure outcomes such as teamwork and communication.

Case-based and project-oriented approaches have also been tested with promising results. Korkmaz (2012) examined a multidisciplinary graduate class on sustainable buildings, using case studies, role play, and collaborative learning. Students not only improved their understanding of sustainable delivery methods but also benefited from exposure to peers in other disciplines. Likewise, Badawi and Abdullah (2021) found that interdisciplinary design courses improved students' satisfaction and understanding of integrated design, even though challenges such as time constraints and uneven levels of experience often complicated team dynamics. These findings echo Brncich, Shane, Strong, and Passe (2011), who used integrated student teams in sustainable design and construction projects to demonstrate how cross-disciplinary collaboration strengthened students' communication and teamwork skills prior to entering industry.

Despite these successes, gaps remain. Several studies stress that while interdisciplinary experiences help students develop essential soft skills, programs still lack consistent frameworks for curriculum integration, long-term evaluation, and scalability (Clevenger et al., 2016; Van den Beemt et al., 2020). Industry surveys confirm the ongoing demand for graduates with both technical knowledge and collaborative breadth (Wang et al., 2025), yet the educational models are often experimental, localized, or elective rather than embedded within core curricula. Furthermore, while many interventions have focused on general AEC or sustainability themes, few have investigated interdisciplinary education in the context of emerging construction technologies such as mass timber, which inherently requires coordination among architects, engineers, and construction managers (Kouhirostami & Dharmapalan, 2025).

The existing literature suggests a strong foundation demonstrating the benefits of interdisciplinary education for teamwork, communication, and problem solving, while also highlighting the need for structured assessment, faculty perspectives, and exploration of specialized areas such as mass timber. To address these gaps and the evolving demands of the AEC industry, the present study examines an interdisciplinary course on mass timber to understand the unique challenges and successes of implementing an interdisciplinary course in the context of a CM program.

Methodology

Research Design

This study adopts a mixed-methods, embedded single-case design focused on the course *Integrated Project, Design, and Program Management*, offered as part of an Interdisciplinary Mass Timber Studio at a mid-sized, teaching focused four-year university on the west coast. The studio deliberately integrates students from Construction Management (CM), Architecture (ARCH), Architectural Engineering (ARCE), and Landscape Architecture (LA) into cross-disciplinary teams that mirror professional settings in the Architecture, Engineering, and Construction (AEC) industry, where collaboration across disciplines is essential. This approach responds to well-documented gaps between discipline-specific academic preparation and the collaborative demands of practice, while aligning with existing research highlighting teamwork, communication, and integrative problem-solving as critical competencies for emerging professionals.

Participants and Setting

Participants included all CM students enrolled in the *Integrated Project, Design, and Program Management* course during two consecutive academic terms (Winter and Spring 2025). Each internal CM team of two to four students collaborated with three to four students from the partnering design disciplines (ARCH, ARCE, or LA). Instruction was co-led by CM faculty and supported by recurring participation from industry mentors representing diverse sectors, including life-cycle assessment, structural and architectural design, forestry, manufacturing, CM, and fire code consulting. The course structure combined weekly interdisciplinary lectures and critiques with hands-on design-build exercises and field site visits to large-scale mass timber and higher-education projects.

Learning Activities

The studio's instructional design incorporated two primary integration-focused learning mechanisms aimed at strengthening interdisciplinary collaboration and applied problem-solving:

1. Collaborative Design Sessions: Each week, CM students engaged in approximately two hours of structured collaborative sessions with their interdisciplinary teammates to plan, coordinate, and develop a conceptual commercial building project led by architecture students. These sessions emphasized real-time communication, role negotiation, and iterative feedback across disciplines.
2. Interdisciplinary Assignments: In addition to collaborative design sessions, students completed a series of assignments intentionally structured for interdisciplinary teams. Tasks included case study evaluations, structural system selection, cost estimation, early-stage life-cycle assessment reasoning, value engineering, and safety or means-and-methods planning linked to the concurrent field site visits. Each team presented their work at defined milestones, receiving expert critiques from faculty and industry mentors to simulate authentic, practice-based evaluation.

Together, these activities formed a coherent pedagogical intervention that situates interdisciplinary collaboration as both process and learning outcome, bridging academic instruction with the collaborative realities of AEC practice.

Data Sources and Analysis

To answer the first research question, researchers developed and administered a pre/post-course survey (during Week 1 and Week 10) over two quarters, with 13 out of 26 students in quarter 1 taking the survey, and 17 students out of 20 in quarter 2 completing the survey, resulting in a total of 30 response sets for analysis. Students were informed that participation in the survey was voluntary and would have no bearing on course grades. The survey was administered through Microsoft Forms and did not record any identifying information. IRB approval was gained prior to the study. The survey consisted of 5-point Likert-scale items that were designed to capture self-efficacy and attitudes toward interdisciplinary collaboration, and mass-timber construction. Likert scale responses were coded numerically, then scores for items were grouped together by skill (see Table 1) to result in an average score for each skill, which was used for comparison and to identify trends. For example, students ranked their ability to encourage participation from all team members, and this item was grouped together with similar items related to contributing to a team's success. The survey also included brief open-ended prompts to elicit student perceptions of the course, following survey structuring common in AEC education studies (Irizarry, et. al. 2010). The course learning objectives were used as a priori codes in analysis of the survey.

To answer the second research question, a sixty-minute semi-structured interview was conducted with the faculty instructor of the course. An interview protocol was developed with questions intended to elicit reflections and lessons learned from the pilot course. The interview was recorded and transcribed using built-in Zoom software. The interview transcript was read and re-read, then coded for broad themes that related to benefits and challenges of designing and implementing the course. Each researcher individually completed this process before coming together to refine the themes. Combining both data sources resulted in a more holistic approach to analysis, considering where the perspectives of students and faculty may align or differ. Together, they provide evidence from the pilot interdisciplinary course to inform future directions.

Findings and Discussion

The analysis of survey responses, reflections, and faculty interviews revealed clear evidence of student growth in both collaborative practice and interdisciplinary awareness throughout the Interdisciplinary Mass Timber Studio. Consistent with research highlighting the value of experiential, team-based learning in construction education (Korkmaz, 2012; Weidman, Johnson, & Choi, 2017), the course provided students with authentic opportunities to navigate the complexities of integrated project delivery. The discussion that follows is organized into two parts: students' perceptions of interdisciplinary collaboration and faculty reflections on the benefits and challenges of designing and facilitating an interdisciplinary studio. Collectively, these findings illustrate how structured, authentic, and cross-disciplinary learning environments can enhance collaboration, strengthen professional readiness, and inform the continuous improvement of construction management curricula.

Students' Perceptions of Interdisciplinary Collaboration

This section begins with a table overview of the survey results, before thematic descriptions.

Table 1
Students' Self Perceived Skills in Teamwork and Collaboration - Pre- and Post-Course Comparison

Skill Category	Pre Course Mean	Post Course Mean	Change
Delegation and task management	4.41	4.79	0.37
Verbal communication	4.29	4.64	0.35
Conflict resolution	4.35	4.57	0.22

Providing constructive feedback	4.18	4.36	0.18
Written communication	4.41	4.57	0.16
Working effectively as part of a team	4.65	4.79	0.14
Receiving constructive feedback	4.82	4.93	0.11
Contributing to a team's success	4.82	4.86	0.03
Time management within a team setting	4.41	4.43	0.02

Learning Objective 1: Development of Collaboration Skills

Before the course, students described teamwork largely in logistical terms—dividing tasks, maintaining schedules, and “getting the job done.” Conflicts were commonly resolved through quick compromise to save time. By the end of the quarter, students articulated more deliberate and reflective collaboration practices. They reported using explicit decision-making structures, such as establishing criteria before voting and applying feedback loops during design development. This shift reflects findings by Han, Love, and Fong (2018), who emphasized that complex construction projects require structured collaboration among diverse stakeholders, and by Deep, Ahmad, and Yusof (2019), who identified trust and communication as key enablers of effective teamwork. Students mentioned that “*Faculty focused on flexibility, and the class felt like a team*,” echoing Posillico and Edwards’ (2024) conclusion that interpersonal competencies—teamwork, communication, and leadership—are central to successful construction management education.

Students also reported measurable improvements in communication and feedback exchange. Many identified a growing comfort with both giving and receiving constructive critique, attributing this to repeated peer reviews and interdisciplinary desk critiques. These observations align with studies showing that experiential and project-based learning environments foster collaborative growth and reflective communication (Weidman, Johnson, & Choi, 2017; Korkmaz, 2012). However, some teams still observed unequal participation, suggesting that while the course successfully fostered confidence, equitable engagement remains a challenge—an issue also noted by Badawi and Abdullah (2021) in interdisciplinary design settings. Several students described rotating presenters and implementing short “go-rounds” to ensure all voices were heard—an emergent strategy for inclusive engagement that mirrors Brncich, Smith, and Sullivan’s (2011) call for structured approaches to balance participation in cross-disciplinary teams.

Coordination and time management were recurring themes in both pre- and post-course reflections. Early comments emphasized frustration with unclear deliverables and mismatched timelines across disciplines. Post-course reflections, however, cited improved coordination through shared task boards and milestone tracking, though students continued to call for earlier alignment of interdependent deadlines across ARCH, ARCE, LA, and CM tracks. These comments underscore that while coordination structures improved, dependency mapping between disciplines remains a pedagogical opportunity for further refinement. This pattern is consistent with Van den Beemt et al. (2020), who noted that interdisciplinary learning often lacks clear assessment and scheduling frameworks, and Irizarry, Meadati, and Gheisari (2010), who found that gaps between academic preparation and collaborative industry practice persist without intentional curricular integration. Collectively, the qualitative data suggest that the interdisciplinary studio advanced students’ collaborative maturity—from cooperation (dividing labor) toward integration (negotiating reasoning and priorities across roles)—paralleling Wang, Leicht, and Solnosky’s (2025) argument that interdisciplinary learning directly enhances professional readiness and teamwork effectiveness.

Learning Objective 2: Awareness of Other Disciplines and Integrated Practice

At the start of the course, students often defined other disciplines by their deliverables (“architects make drawings,” “engineers size beams”) rather than by their decision logics. By the end, responses demonstrated a deeper understanding of why each discipline approaches design choices differently. This evolution supports Irizarry, Meadati, and Gheisari’s (2010) finding that AEC programs often fail to adequately prepare students for interdisciplinary collaboration, highlighting the need for more intentional exposure to diverse disciplinary reasoning. Students referenced specific interdisciplinary trade-offs—structural span versus fire protection, landscape shading versus constructability, or façade expression versus cost—and described how collaboration within the models made these tensions visible and negotiable. These observations reflect Bozoglu’s (2010) conclusion that digital collaboration tools like Building Information Modeling (BIM) enhance real-time coordination and shared understanding across disciplines, as well as Monson and Dossick’s (2014) evidence that technology-mediated studios facilitate joint problem-solving and knowledge transfer between design and construction students.

Post-course reflections also revealed a new awareness of the broader stakeholder ecosystem. Students mentioned industry guest lectures and site visits as transformative experiences that connected classroom coordination to real-world preconstruction and fabrication contexts. This experiential exposure mirrors Korkmaz’s (2012) study, which found that project-based and case-oriented learning helps students contextualize theoretical knowledge through real projects and multidisciplinary teamwork. Students quoted: “*liked having the mass timber field trip, it helped me visualize and see the aspects of what really goes on a mass timber project site. I also liked having the IPD side of the class, working with the other majors.*” and “*I think that it would be beneficial to go on more field trips to learn and see mass timber itself. I thought it was nice to listen to industry professionals when they were giving their presentation and insights on mass timber*.” These insights align with Brncich, Smith, and Sullivan’s (2011) findings that integrated, real-world projects enhance student appreciation of cross-disciplinary interdependence.

They began to recognize the timing and value of early contractor input, reporting that exposure to preconstruction pricing, procurement logistics, and lead times “made decisions feel real.” This shift echoes Han, Love, and Fong’s (2018) argument that early collaboration among project stakeholders drives more efficient, informed decisions and fosters accountability throughout the project lifecycle. In contrast to the pre-course perception of the Construction Manager as an “executor after design,” post-course comments redefined the CM role as an early design partner influencing cost, risk, and constructability through integrated decision-making. This redefinition supports industry expectations for Construction Management professionals to serve as active contributors in preconstruction and design phases (Wang, Leicht, & Solnosky, 2025), and reinforces Deep, Ahmad, and Yusof’s (2019) assertion that human-centered collaboration—rooted in trust and shared understanding—remains central to project success.

Faculty Reflections on Benefits and Challenges

Theme 1: Building an Interdisciplinary Course Required Extensive Planning and Institutional Collaboration

The instructor described the creation of the interdisciplinary course as an intentional response to the college’s goal of promoting collaboration across majors in the university’s construction and architecture college. The course was initiated with strong administrative and industry support, but its design demanded considerable coordination and planning. As the faculty member explained, *“The* *first point was the need from the college to have a course that is interdisciplinary—between all the majors in the CAED department… They tried it a couple of times before, and they wanted to do it again to see if they could improve the experience."* To achieve this, faculty spent an entire quarter in weekly meetings, combining individual curricula and developing a shared plan. *"We started by sharing our own class curriculums… then created an Excel file… and thought about how to combine things,"* the instructor noted, emphasizing the collaborative but time-intensive nature of the design process. Although there was no pushback from colleagues, coordinating across departments and aligning course content represented a major logistical challenge. This echoes the finding of Van den Beemt et al. (2020) in that interdisciplinary projects require clear assessment and scheduling frameworks. The experience underscored that while interdisciplinary innovation was widely supported, it required substantial faculty time and institutional flexibility to implement effectively.

Theme 2: Student Collaboration Varied by Personality, Openness, and Disciplinary Mindset

Faculty reflections revealed that students' experiences in interdisciplinary teams were shaped by their attitudes and willingness to engage across disciplinary boundaries. The instructor observed that while *"some students really enjoyed being exposed to other majors—talking and listening to other experiences,"* others struggled, finding collaboration difficult and at times frustrating. The instructor linked these differences to personality and mindset: *"Students who were friendly, open to new ideas… enjoyed the process more. But some students were more closed off—more rigid, focused on the industry misconception—and they found it harder."* Challenges included communication breakdowns, uneven participation, and differing expectations about timelines. For instance, the instructor noted that *"some students sent multiple emails without getting replies… one even received a rude response."* Yet, examples of success also emerged, especially among teams that practiced flexibility and proactive communication. The instructor recalled that, when realizing it would take longer than expected to receive the architecture student's designs, instead of waiting for the finished product, *"They asked questions and adapted. Those groups achieved higher understanding and better project results."* This theme highlights that interpersonal dynamics and professional communication were critical determinants of interdisciplinary learning outcomes. Despite technological advancements, construction projects are fundamentally human centered, and human relationships that foster trust, commitment, and reliability are enablers of project success (Deep et al., 2019)

Theme 3: Reflective Insights Emphasized Structural Improvements and Enduring Benefits

In reflecting on lessons learned, the instructor identified both the benefits of interdisciplinary learning and opportunities for course refinement. Time management surfaced as a major structural challenge: *"We only had about four shared hours per week… That wasn't enough for students to share updates, listen, and work collaboratively."* The instructor also recognized the need for clearer guidelines and better scaffolding for teamwork: *"I'd give students more collaboration time and provide a clear, written structure for collaboration—what's expected from each side and how to contribute."* Despite these constraints, the instructor emphasized substantial student growth, particularly in their understanding of cross-disciplinary perspectives. *"The greatest learning outcome was seeing through the eyes of other disciplines,"* they reflected, adding that students learned *"how architects, engineers, and constructors approach design and what challenges they face."*. This finding aligns with Ali and colleagues (2019), who also found that interdisciplinary teamwork challenged students' preconceived notions of each discipline's role. The instructor concluded that future success would depend on closer faculty coordination, dedicated preparation time, and designing the course as interdisciplinary from the outset rather than merging existing classes. *"It's better to build a dedicated interdisciplinary course from scratch,"* they explained, reinforcing the value of intentional design for meaningful collaboration.

Summary

Across both objectives, students progressed from procedural collaboration to reflective, integrated engagement. They demonstrated greater agency in facilitating discussions, clarifying roles, and understanding how design and construction decisions interdepend. Persistent challenges—unequal participation and late-stage schedule conflicts—point to future refinements in facilitation scaffolds and cross-course coordination. These results confirm that interdisciplinary, project-based learning environments can meaningfully strengthen both collaborative competence and interdisciplinary literacy among construction management students when supported by intentional process design. Faculty reflection revealed that implementing a pilot interdisciplinary course offered rich learning opportunities but also exposed structural and interpersonal challenges. Faculty commitment, student openness, and institutional support emerged as key factors in realizing the benefits of interdisciplinary education within construction management.

Conclusion

This study examined the implementation of an Interdisciplinary Mass Timber Studio that brought together students from Construction Management, Architecture, Architectural Engineering, and Landscape Architecture to collaborate on a shared design project. Using surveys and a faculty interview, the research explored how students' collaboration skills and disciplinary awareness evolved through structured, practice-based learning. Findings revealed that students progressed from dividing tasks to engaging in deliberate, criteria-based decision-making, and reflective communication. They developed greater confidence in giving and receiving feedback, gained a stronger understanding of each discipline's design logic, and recognized the Construction Manager's role as a proactive partner in early design and preconstruction phases.

Despite these successes, the study also identified challenges common to interdisciplinary initiatives—uneven participation, limited joint time, and misaligned departmental schedules. Addressing these requires clearer collaboration frameworks, synchronized milestones, and institutional support for faculty coordination. Overall, the interdisciplinary mass timber context proved to be an effective platform for developing integrative thinking, teamwork, and communication—competencies central to modern AEC practice. By embedding such experiences into core curricula, construction programs can better prepare students to operate in the collaborative, technology-driven environments that define today's industry.

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