

Cross College Faculty Collaboration for the development of a new major in Design and Construction Integration

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Introduction

In recent years, efforts to bring together architecture, engineering, and construction (AEC) in design and construction endeavors is becoming increasingly more common within industry. These collaborative efforts are important for the AEC industry and have been linked to increased project success.^{1,2} This collaboration of AEC disciplines is also linked to the rise of collaborative technologies and delivery methods, such as Design-Build and Integrated Project Delivery (IPD).³ In collaborative construction approaches, stakeholders must work together more and earlier in the process in order to produce holistic solutions for complex buildings.⁴ Correspondingly, academic programs have tried to provide students from AEC disciplines with the skills needed to support this collaborative environment.

Following this trend toward collaboration in the industry, there have been efforts to bring together the architecture, engineering, and construction (AEC) disciplines within the academic environment through undergraduate interdisciplinary courses, such as courses at Mississippi State University, or experiences and programs, such as the ones at University of Washington and Auburn University.⁵⁻⁷ This need for cross disciplinary collaboration is further reinforced by requirements from accrediting bodies of AEC disciplines, such as the American Council for Construction Education (ACCE),⁸ the Landscape Architectural Accreditation Board,⁹ the National Architectural Accrediting Board (NAAB),¹⁰ the Council for Interior Design Accreditation (CIDA),¹¹ and the Accreditation Board for Engineering and Technology (ABET).¹² Accreditation requirements for construction management, civil engineering, and interior design explicitly mention the need to function in multidisciplinary or interdisciplinary teams;^{8, 11, 12} the landscape architecture accreditation⁹ mentions the need to provide students with “an educational context enriched by other disciplines;” and the architecture discipline’s accrediting body, the NAAB,¹⁰ emphasizes the need for the architect to “... reconcile the needs of [client, contractor, architect, and other key] stakeholders.” The NAAB¹⁰ also points out that architects “...rely on a spectrum of collaborative skills to work successfully across diverse groups and stakeholders.”

Despite the expressed desire by many in higher education to increase collaboration across disciplines, Leathem et al.⁷ indicate some barriers to the success of AEC collaborative academic experiences. These barriers include “...timing, cultural divide, team building and communication skills, and academic divide,”⁷ which are directly related to faculty and academic structure, rather than students’ capacity to function in a multidisciplinary team.

Even though faculty collaboration is necessary in order to achieve success in team-taught and interdisciplinary academic experiences, few papers describe the challenges and benefits of this collaboration from a faculty member’s point of view. In their paper, Leathem et al.⁷ did describe challenges in faculty involvement during the development of a collaborative studio of

construction management and architectural students. Some of the challenges mentioned by Leathem et al.⁷ included time commitment and assessment, which required faculty to empathize and understand each other's discipline needs. Additionally, Hatipkarasulu, Canizaro, and Murphy¹³ studied a five-year experience in which faculty designed a collaborative course for architecture, interior design, and construction management for first year students at the University of Texas in San Antonio (UTSA). In the UTSA case study, two major challenges related to faculty participation were presented: faculty's resistance to change and ownership of the created common curriculum.

Even though few of the previous studies focused on a faculty's perspective of the process, most have described opportunities and challenges related to collaboration across AEC disciplines at academic institutions. This study provides a faculty-oriented view of the curriculum development of a new design and construction major and the selection of its design core skills and competencies.

Research Context

In light of this need for increased collaboration among AEC professionals, Purdue University – a large Midwestern research university – is developing a new undergraduate major in Design and Construction Integration (DCI) within its college of technology. The major has the goal of providing professionals with competencies to manage this collaborative process. The major will have a construction management core with accreditation from the construction accrediting body (ACCE) supplemented by coursework to enhance students' teamwork skills and roughly two semesters of study in a design discipline.

A diverse body of industry professionals was assembled for the program's advisory board, including representatives from construction companies, owners, developers, engineers, designers, and lawyers. These professionals were invited in March of 2016 to participate in a day-long workshop to discuss the program in Indianapolis, Indiana. During that time, participants were given an overview of the major ideas for the program, were asked to provide input regarding employability of this future DCI graduate, and participated in break-out sessions to discuss curriculum priorities. For potential professional placement of DCI graduates, workshop participants validated the list previously elaborated by organizers, which included positions in the following areas:

- Design/Build Manager
- Owner's Representative
- Developer Representative
- Business Developer
- Design Manager
- Program Manager
- Finance or Insurance
- Regular Construction Management (CM) positions

Although the major will be hosted within a construction management technology program, a portion of the curriculum (24 credits, from a total of 120 credits) will focus on design education and appreciation. The main goal for this design education is to expose DCI students to design within the built-environment rather than to create professional designers, which is similar to what Holley and Emig³ stated in their case study of a new post-professional degree in the U.S. Instead of creating new courses focusing on collaboration, this major will direct its students to take traditional and ongoing design courses, and DCI students will interact with regular students from various design disciplines.

To accomplish this, outreach to other educational units across campus has proven to be extremely beneficial. The planned DCI curriculum has sought contributions from a group of faculty coming from four different departments (Construction Technology, Interior Design, Landscape Architecture, and Mechanical Engineering Technology), which are located within three different colleges (Liberal Arts, Agriculture, and Technology) of the same institution. These faculty members have collaborated to identify existing courses within their departments that could provide the expected learning outcomes related to built environment design for DCI students. Through this collaboration, students would be able to choose a design concentration they prefer: Interior Design, Landscape Architecture, Mechanical-Electrical-Plumbing (MEP), or a combined experience from multiple design disciplines.

This curriculum concept was presented to industry representatives during the March, 2016 workshop, and one of the break-out sessions of the day included a curriculum discussion. Breakout groups, which consisted of four participants and a moderator, validated the new major and expressed enthusiasm about producing construction management students who are more familiar with the design process. Some of the benefits and challenges mentioned by industry professionals regarding the design concentration credits within the DCI degree are indicated in table 1.

Table 1 – Benefits and Challenges of Design Course Credits within DCI curriculum

Benefits	Challenges
<ul style="list-style-type: none"> • Allow students to understand the research component of design (information based decision making). • Allow students to understand the design process, and therefore have an appreciation for design. • Allow students to understand modeling within construction. • Students will be exposed to more project based learning environments. • Students will have interdisciplinary exposure. 	<ul style="list-style-type: none"> • How to integrate knowledge from design courses into construction (for example: budget and scheduling implications)? • How to assess construction management DCI students in design courses? • Studio courses are usually time intensive. • Concentrations could be less concentrated (provide opportunity for more breadth than depth).

Results obtained in the workshop showed positive feedback from the industry. However, some areas of concern arose, and three of them are directly related to the selection of design courses for the major. In order to address those issues, the faculty involved are still working on a variety of design options for students, considering the opportunity for more breadth of design coverage (design courses in multiple design programs at Purdue University). Ultimately, the goal for the DCI student is not to create practicing designers, but to allow students to establish a common vocabulary and shared viewpoint. This awareness and acceptance of different but shared viewpoints would then allow for enhanced communication and increased efficiency during the management of the design and construction process.

During the year 2016, the faculty from Landscape Architecture and Interior Design drafted a list of suggested courses for the design concentration in their areas. Table 2 presents the initial draft of those courses. These drafts are still a work in progress and are being revised in an iterative process between the colleges involved. The design concentration consists of either 29 credits (landscape architecture option) or 30 credits (interior design option). The difference of one credit in the landscape architecture option will be balanced with one more credit for a free elective in the last semester of the program. The participating faculty are still drafting the mechanical, electrical, and plumbing option (MEP).

Table 2 – Landscape Architecture and Interior Design concentration courses and credits (draft)

Landscape Architecture (14cr)	Interior Design (15cr)	Common Courses (15cr)
LA 101 Survey of Landscape Arch. (3cr)	AD 125 Intro to Interior Design (3cr)	AD 113 Basic Drawing (3cr)
LA 246 Site Systems I (4cr)	AD 320 Interior Lighting Design (3cr)	LA 216 Land. Arch. Design Studio 1 (3cr)
EAPS 113 (NRES 290) Intro to Environ Science (3cr)	AD 230 Interior Design Studio I (3cr)	LA 250 Arch. Design* (3cr)
LA 226 Landscape Arch. Design Studio II (4cr)	AD 285 Interior Comp. & Materials (3cr)	Design Elective (3cr)
	AD 250 Interior Design Studio II (3cr)	AD 397 Sust. in the Built Environ. (3cr)

*May be substituted by (LA 166) History of Landscape Architecture, for students in the Landscape Architecture option

Another concern indicated by industry professionals directly relates to adaptability of the students to the studio pedagogy commonly used in design courses. Of primary concern is how well DCI students will adapt to the time commitment of studio courses and how assessment will take place for regular design students and DCI students in the same course. These concerns have been and still are being discussed among the faculty members who are working in the design options on the curriculum.

Methodology

This paper presents a case study of the authors' experience in developing the design portion of the DCI curriculum and the accommodations necessary to meet the needs and concerns of the

different disciplines involved. All six authors of the present paper were contributors in the development of the DCI curriculum. As mentioned previously, the authors have different academic and professional backgrounds and serve in three different colleges from Purdue University, being two faculty from the College of Liberal Arts (Interior Design program), one faculty from the College of Agriculture (Landscape Architecture program), and three from the Purdue Polytechnic Institute (two faculty from Construction Management Technology, and one from Mechanical Engineering Technology). The authors' academic ranks also vary, including four assistant professors, one associate professor, and one full professor.

The methodology for this study includes collecting individual reflections from the faculty involved. Faculty members were provided with twelve guiding questions to help them focus on their expectations about this collaborative process and experience during the early planning process. All faculty members involved in the DCI curriculum development chose to participate and provide reflections. The guiding questions were:

- 1) How did you get involved with the Design and Construction Integration (DCI) curriculum?
- 2) Why did you choose to participate in this collaborative process?
- 3) What were your initial expectations for the process?
- 4) Do you think there are benefits to this experience? If so, what are they?
 - a. Do you have concerns about this experience? If so, what are they?
- 5) Can you describe how the DCI curriculum collaboration process has gone within your discipline?
 - a. How did you select/suggest courses? What were the main criteria?
- 6) Do you see benefits/issues for students (DCI and your major) in this process? If so, what are they?
- 7) From a faculty point of view, what are the benefits of this collaboration?
 - a. What about issues/concerns in participating in this experience?
- 8) What do you personally expect to gain/lose from this experience?
- 9) What do you think your program has to gain/lose from this experience?
- 10) What do you think your students have to gain/lose from this experience?
- 11) Which are the main challenges to be overcome in the near future?
 - a. How about in the distant future?
- 12) What are your next steps in this process?

Analysis of the written documents will focus on reporting perceived opportunities for faculty members individually and as a part of their program. Reflections were organized in an excel document and grouped into main themes by one of the faculty. This allowed the faculty to group the findings into topics for presentation. After the summary and analysis of the documents, the final report was sent to participating faculty for validation of the analysis. Challenges and future steps that need to be discussed by the group in order to further this collaboration will also be presented at the end of the analysis.

Reflections summary

The reasons for involvement given by participating faculty collaborators outside the construction management (CM) department varied. For collaborators within the same college, it was a matter of extending regular and already ongoing collaboration. However, for collaborators outside of the college, it required the DCI program faculty, as well as the construction management department head, to reach out to faculty and departmental contacts of Landscape Architecture and Interior Design.

Faculty participating in the development of DCI were invited by their departments or directly by the DCI program to participate and they had a choice of declining the invitation. When asked about the reasons for agreeing to participate in the process, three of the four participants from outside of the construction management department indicated the ability to bring different disciplines together, as they do in a real work setting. One of these participants says: "I agreed to be a collaborator because academia should reflect the multi-disciplinary type of work that already exists in industry." The fourth faculty participant indicated that collaborative and interdisciplinary work is seen positively in academia; this was the factor that motivated this faculty member to participate. Participating faculty from within DCI as well as collaborating colleges also noted the ability to increase cross disciplinary research.

Initial expectations also varied from faculty to faculty. Expectations were clear for the program creator, who expected faculty from other AEC areas to collaborate in the development of the curriculum and in the teaching of courses for the Design and Construction Integration major. On the other hand, initial expectations were unclear for some other of the collaborating faculty, especially during the initial development of the program. Expectations were especially unclear for collaborators who were relatively new to academia. One collaborator indicated believing initially that the project was a "straight up curricular shuffling of cards. Here is how one class can slide in here, how a different class can slide in [...]. It became much more and much better and broader than that. That was my initial thought of just [...] the liaison between plans of studies. And it became [a whole program]." The breadth of the program, and the fact that it would require the collaboration of multiple colleges and programs towards the creation of an undergraduate major, was not perceived at the beginning of the process, but it was slowly incorporated into the minds of participating faculty.

Collaborating faculty helped in selecting courses as well as acting as facilitators within their departments. This required them not only to help with selecting or providing feedback for selected courses but also to discuss within the departments possible changes in their course requirements and content to accommodate potential DCI students taking those courses. Faculty from each of the represented DCI design areas (Landscape Architecture, Interior Design, and Mechanical, Electrical, and Plumbing) made the original proposal of courses to the group. These lists were then reviewed by the CM-DCI faculty and discussed on both sides in an iterative process in order to accommodate credit hours needed as well as scheduling issues between other CM regularly scheduled courses.

Suggested courses were put together by faculty in Interior Design (ID) to allow for DCI students to “learn how to develop a design concept, apply their concept into actual space design, and visualize their design solutions.” The MEP faculty, on the other hand, has selected courses based on relevance to the DCI major and profession, focusing on heating and air conditioning (HVAC) and building controls. This design option is still under development. Finally, faculty from Landscape Architecture (LA) mentioned their department’s intention of offering a landscape architecture minor, which served as a basis for the design concentration requested by the DCI major faculty. The LA design concentration developed for the DCI major also included the practice (studio practice) of LA design, which the faculty from the Landscape Architecture department mentioned was not the original intent of the previously planned LA minor. This change was made at the request of the DCI leads, and it reflected the suggestions from the March workshop with AEC professionals. From a CM perspective, the course selection involved two main criteria: (1) the program would still be ACCE accredited and therefore must meet the minimum requirements for the accreditation; and (2) the program would provide for progressive exposure of DCI students to design of any type, especially if courses included collaborative work in a studio environment.

Benefits of the experience

As also reported in previous literature, many benefits can be gained from the development of a cross college effort. Here, the focus is on the reported benefits for each original department (Landscape Architecture, Interior Design, and Mechanical Engineering Technology), for students from the collaborating programs, for DCI students, and for participating faculty.

From a department perspective, the main benefit identified by the faculty is the possibility of improving their program by providing a more realistic perspective on the profession by involving students with diverse AEC backgrounds. Other secondary benefits mentioned by faculty for each participating department included: (1) the possibility of national and international department recognition because of the uniqueness of the program; (2) raising awareness in each of the participating AEC disciplines about what professionals from other departments are qualified to do; and (3) the possibility of increasing multidisciplinary research.

For students, the primary benefit is, again, the ability to replicate a professional environment, that relies on cross-disciplinary collaboration during their academic training. All faculty mentioned that having students work together and share ideas regardless of their college or AEC related program is the greatest outcome of the Design and Construction Integration major. As one of the faculty mentioned, “They are going to see the reality that just because they had the idea, it doesn't mean that it is doable or even the best idea.” One other faculty participant mentioned the potential benefits for all participating departments to be gained from improving student collaboration and communication skills as a result of working with students (and faculty, in the case of DCI students) from different backgrounds.

Expected benefits for the faculty included gaining a better grasp of how to deal with curriculum development and approval processes, increasing collaboration in research, attracting more students to the courses they teach, and broadening their academic network.

Concerns about the experience

Even though identifying the benefits of the new major is the main goal of the curriculum development process, it is also important to recognize that this is an ambitious project that will necessarily bring challenges. In their reflections, all collaborating faculty indicated their concerns regarding challenges for their originating departments, the students (DCI and other collaborating majors), and for themselves.

Participating faculty mentioned three main concerns at the departmental level: space, increased need for faculty, and program failure. As enrollment increases, studio space would be an issue with at least one of the collaborating colleges. The rise in enrollment would also trigger the need for more faculty lines, especially for studio taught classes. Additional faculty lines are necessary due to external accreditation for programs such as Landscape Architecture, which requires the ratio of faculty to students to be one faculty per a maximum of 15 students. Finally, program failure is a major concern because faculty from all collaborating departments are spending valuable time in developing and refining this new curriculum, as well as reaching out to their departments to accommodate the needs of DCI students taking courses within their departments. In order to reduce the risk of program failure, at least two participating faculty mentioned the importance of attracting students to the new major.

In some departments, such as Interior Design, non-major students are not allowed in studio courses that are specific to that major. From a student's perspective, some faculty are worried about allowing non-majors into core discipline courses. Allowing non-majors to take certain courses within their core design program might take too much faculty attention so that other students would not receive adequate guidance towards success in their degrees. One faculty fears this might be negatively perceived by students from the original program and could create a non-welcoming atmosphere for DCI students. Another issue mentioned by two of the faculty is the expectation for DCI students, who do not come from the design side, to work alongside design students in a studio setting. This classroom dynamic would require student teams to be aware of their own team organization to make sure all points of view (design and construction oriented) are heard during the design process.

Because studio pedagogy and design methodology are very different from the usual pedagogy used in construction management courses, some students might struggle to adapt to this new environment. This is also a concern mentioned by professionals during the March 2016 workshop. One faculty fears that some students from studio design oriented programs might "get so stuck trying to figure out everything that you never actually start". When asked for clarification on that statement, the faculty explained that design students collaborating with construction management students might increase their awareness of construction based constraints. These constraints would be added to previously identified design constraints; and

when trying to address all constraints, some design students might find themselves unable to start the design process by fear of not being able to address all the issues.

Four faculty brought up personal concerns with participating in the project, all related to time spent on the project. One faculty is worried about the loss of time and energy in case the program fails. Another is worried about having the effort recognized by the college and wonders whether it will count towards promotion and tenure. Two faculty are worried about maintaining a healthy work life balance when adding the DCI major project to other personal and professional projects. Time management, whether in accommodating more students in regular courses or through time spent in curriculum development, is a concern for the involved faculty.

Future challenges

Future challenges mentioned by collaborating faculty include:

- Faculty acceptance of the multidisciplinary plan of study in each of the colleges involved;
- Administrative acceptance of the multidisciplinary plan of study in each of the colleges involved;
- University acceptance of the multidisciplinary plans of study;
- Attracting an initial cohort of students to the new multidisciplinary major (and future degree);
- Physical space, especially studio space, if enrollment increases in the original program and DCI program;
- New faculty lines for studio in order to keep faculty-student ratio for studio based courses that fulfill accreditation requirements;

Conclusion

The curriculum development process for the new major in Design and Construction Integration has been evolving over the course of 2016. Faculty in charge of the DCI curriculum reached out to professionals in March to validate the idea of the major as well as gather concerns and suggestions to refine the idea. The faculty have also reached out to other collaborating AEC industry programs within and outside the Purdue Polytechnic Institute (college level), but still within Purdue University. Through iterations of meetings and curricular discussions, the collaborating faculty from the Landscape Architecture and Interior Design departments have finalized a list of courses, totaling 29 or 30 credits, which DCI students will have to take as a part of their major.

As can be seen, the DCI program is a collaborative effort involving four programs of three different colleges. This paper summarizes the authors' reflections about the process in terms of benefits and challenges from a departmental, student, and self-reflection viewpoint. Benefits for departments and students, as expected, are mainly connected with the cross disciplinary aspect of the experience. All participating faculty welcome the effort to bring AEC disciplines together in order to mimic the professional world and include students with differing mind sets in their

courses. From a personal point of view, some of the faculty mentioned that working together might increase their academic network and help develop cross disciplinary research.

For challenges about the experience, faculty mentioned space and faculty limitations as enrollment grows in the DCI and collaborating programs. Faculty also worry about the new classroom team and course dynamics that would arise from having students with different points of view work together. Even though the cross disciplinary aspect of the program is seen as beneficial, there is also an adaptation period that will have to take place. The main concerns to be addressed in this period are (1) faculty adapting their courses, which are traditionally for majors only, to accommodate the needs of non-majors, and (2) understanding and helping teams of students deal with diverse points of views in the studio setting. Helping individual DCI students understand and succeed in studio based courses is also a concern for faculty from studio design based programs.

Some of the participating faculty are worried about time spent with the curriculum development. Concern was expressed about their promotion and tenure requirements competing with the necessary time for curriculum development. Other faculty are worried about having to shift or delay other projects in order to concentrate efforts during the development phase of the DCI major. Apprehension that the program will not succeed led to reflections that collaborating faculty might have “lost time” that could be spent elsewhere.

Judging from experience, the authors conclude that this is a unique project calling for cross-college collaboration. Even though all participating faculty are excited about the prospect of collaborating and transmitting real work challenges to undergraduate students, there is concern about aligning different educational pedagogies and expectations to provide students with the guidance they need to succeed and become more holistic thinkers in the design and construction world. Even though this case study is specific to our experience, these same challenges and opportunities may be similar to other programs and could inform future initiatives that require faculty collaboration across several colleges.

Next Steps

Because of the breadth of the proposed major, the next key step for the construction management faculty is to get final approval for the major within the university (the proposal was approved along with a curriculum modification for the construction management program by the curriculum committee and faculty senate of the college in November of 2016). Faculty from other colleges also need to approve changes dealing with pre-requisites and allowing non-majors into certain courses and also modify certain courses to facilitate the transition of DCI students. Construction Management faculty have started and will continue the effort to attract students to the Design and Construction Integration (DCI) major.

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