

A Retrospective of Five Years of a Collaborative Student Design Competition

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As Integrated Project Delivery (IPD) continues to grow in popularity, educators in the Architecture, Engineering and Construction (AEC) fields need to teach students the collaborative skills that will be necessary for their careers. This paper explains the process and outcome of the fifth year of a sponsored, annual, two-week long interdisciplinary design competition among architecture, construction, interior design and graphic design students at Mississippi State University. The competition brings together fourth-year students from each discipline to develop proposals that meet the needs of a client from the local community. Using qualitative and quantitative data from surveys conducted at the outset and conclusion of the competition, the paper will discuss how the students' knowledge and perception of IPD and the other disciplines changed as a result of the competition. The paper will also discuss changes made from year to year to improve student learning outcomes, and reflect on lessons learned by the faculty in organizing and facilitating the competition.

Key Words: Building Information Modeling, Collaboration, Integrated Project Delivery, Interdisciplinary

Introduction

Construction productivity has declined at a rate of -0.32% per year for the 48 year period from 1964-2012. (Teicholz) Inefficiency in the delivery of construction projects is one of the driving forces behind the shift toward integrated project delivery (IPD) (Kent et al 2010). By having the parties collaborate throughout all phases of a project, from the early design phase to occupancy, IPD seeks to improve efficiency in the delivery of projects. The American Institute of Architects California Council (AIACC) defines IPD as "a project delivery approach that integrates people, systems, business structures, and practices into a process that collaboratively harnesses the talents and insights of all project particpants to optimize project results, increase value to the owner, reduce waste, and maximize efficiency through all phases of design, fabrication and construction" (AIACC, 2007, p.1). Early and ongoing collaboration among the parties allows the project to evolve in a way that meets the needs of all project participants (Ghassemi et al 2011). When efficiency is improved, errors are reduced, and adversarial relationships are reduced and / or eliminated (Kent et al 2010). In a 2010 survey of 415 owners, architects, engineers, general contractors, and construction managers, 24.7% of survey respondents reported being both inexperienced and uninformed about IPD, yet approximately two-thirds of all respondents believe IPD will become the project delivery system of choice in the United States (Kent et al 2010).

Building Information Modeling (BIM) plays an important role in IPD. BIM is a parametric modeling system that relies on informational databases to create multi-dimensional models that can be used to "generate space calculations, energy efficiency analyses, structural details and traditional design documents" (Sabongi 2009). Whereas traditional two-dimensional architectural drawings have representational limitations, a BIM model can show multi-dimensional construction and design details. It can also allow multiple groups of people, from architects to general contractors to subcontractors, in various locations to work on the same model, thereby helping reduce conflicts among the parties and trades. A 2009 survey of 424 respondents who primarily consisted of architects, engineers, contractors, construction managers, BIM consultants, and owners, indicated that nearly two-thirds of the respondents utilized BIM on more than 60% of their projects. Furthermore, nearly 23% of the respondents indicated that they use BIM on all of their projects (Becerik-Gerber et al 2010).

With regard to BIM education in academia, a study of 45 colleges and universities that are members of the Associated Schools of Construction (ASC) shows that 62% of survey participants found that BIM education was inadequate at the undergraduate level and is only being addressed in approximately 10% of undergraduate programs (Sabongi 2009). In his article, "Notes on the Synthesis of BIM," Randy Deutsch takes the position that Integrated Design, also known as IPD, is more than a delivery method. Deutsch describes the "ideal synthesis" - the synthesis of "design and construction, BIM and IPD" - as allowing for: "BIM's inherent complexity, the complexity of the construction process, the design profession's discomfort with addressing means and methods, the constructor's discomfort with addressing intent, and technology to work hand-in-hand with sociology" (Deutsch 2010). Despite BIM technology facilitating collaboration, some parties are still hesitant to commit to IPD – known as a sociological barrier. Solutions to overcoming the sociological / cultural barriers include collaboration, communication, and confidence in the capabilities of the parties involved (Ghassemi et al 2011).

In addition to implementing BIM education in academia, educators can also focus on overcoming the sociological barriers by developing collaborative and communication skills, and confidence in the other disciplines involved in a project while students are still in school. To that end, faculty members in architecture, construction, interior design, and graphic design in the College of Architecture, Art and Design at Mississippi State University, with the support of Brasfield & Gorrie General Contractors, conducted the fifth annual student design competition at the beginning of the Fall 2015 semester.

The Competition

The design challenge required the students to develop a proposal to renovate an existing industrial building for the tenancy of a local microbrewery. The building is located in downtown Starkville, Mississippi and is currently unoccupied. Students were also tasked with creating signage and branding merchandise for the microbrewery client. The microbrewery will sell its products to distributors, with no direct sales to the public. However, the client may conduct tours of the brewery and could have a tasting room where tour participants may sample the beer in the tasting room. Students were also required to demonstrate how LEED Certification could be achieved through their proposal.

The competition began on the first day of class for the Fall 2015 semester. Sixty-eight students were divided into ten teams, with each team containing two to three architecture students, one to two construction student(s), one to two interior design student(s), and one to two graphic design student(s). For the two-week duration of the project the classes met on Monday, Wednesday and Friday for four hours per day.

On the first day of class the students were placed into groups based on the results of a questionnaire they completed prior to the start of the project about their personality type (such as whether they tend to be a leader or follower in a group) and study habits (such as their preferred time of day to work). Students were placed in groups with like-minded individuals with the idea that by placing people who tend to lead in a group together, those individuals will learn to work with other strong-willed people. Similarly, placing individuals who tend to be less active participants in a group forces one or more of them to take a more active role in the group. The project was then introduced, and a site visit was conducted. Because of the tight two-week schedule each group was assigned a research area to gather and share background information about the site, zoning, Americans with Disabilities Act (ADA) requirements, traffic patterns, demographics of the city, etc. Each group then shared its findings for all of the groups to use in developing their proposals. The remaining class days were devoted to each group working together on its proposal with intermediate critiques with faculty.

At the conclusion of the competition all ten groups had the opportunity to present drawings, renderings, a proposed schedule and budget, graphics and way-finding signage in a science fair-style review where the competition sponsor, client and other invited guests mingle throughout the space and ask questions in a more informal setting. That process was followed by a more formal review where the top three teams, selected by the faculty the day prior, presented their projects to the sponsors and invited guests, who then ranked the three teams at the conclusion of the reviews and announced a winner. The top three teams were awarded a monetary prize based on their ranking at the conclusion of the presentations.

Method

At the beginning and conclusion of the project students received an e-mail with a hyperlink, inviting them to anonymously complete an online survey via Survey Monkey. The purpose of the surveys was to assess how their understanding of IPD, collaboration, and the other disciplines changed because of the competition. Sixty-eight fourth-year students took part in the competition from the disciplines of architecture, construction, interior design and graphic design. Sixty-seven students completed both the initial and final surveys for a response rate of 98% for both surveys.

Results

Sixty-eight students took part in the competition: 28 fourth-year architecture students enrolled in a 5-year B.Arch program, 13 fourth-year (senior) construction students, 13 fourth-year (senior) interior design students, and 14 fourth-year (senior) graphic design students. Of the 68 students, 39 were male and 29 were female.

To assess their impressions of IPD at the outset of the competition, the students were asked what characteristics they believed were essential to successful IPD, the results of which are indicated in Figure 1, below.

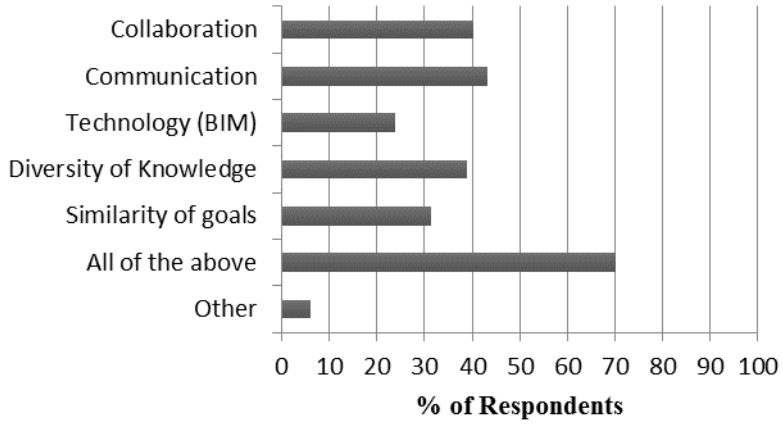

Figure 1: What characteristics do you think are essential to successful integrated project delivery? (select all that apply)

To assess students' prior experience with interdisciplinary group projects and how that may impact the competition, students were asked a short series of questions regarding prior experiences. The results shown in Figure 2, below, reveal that frequent collaboration is beneficial to students. This can be evidenced by the 78% of students who responded they believed their prior teamwork would positively impact the outcome of the competition either because they have better communication skills because of the prior teamwork or because they have a better idea what to expect from the other disciplines because of the prior teamwork.

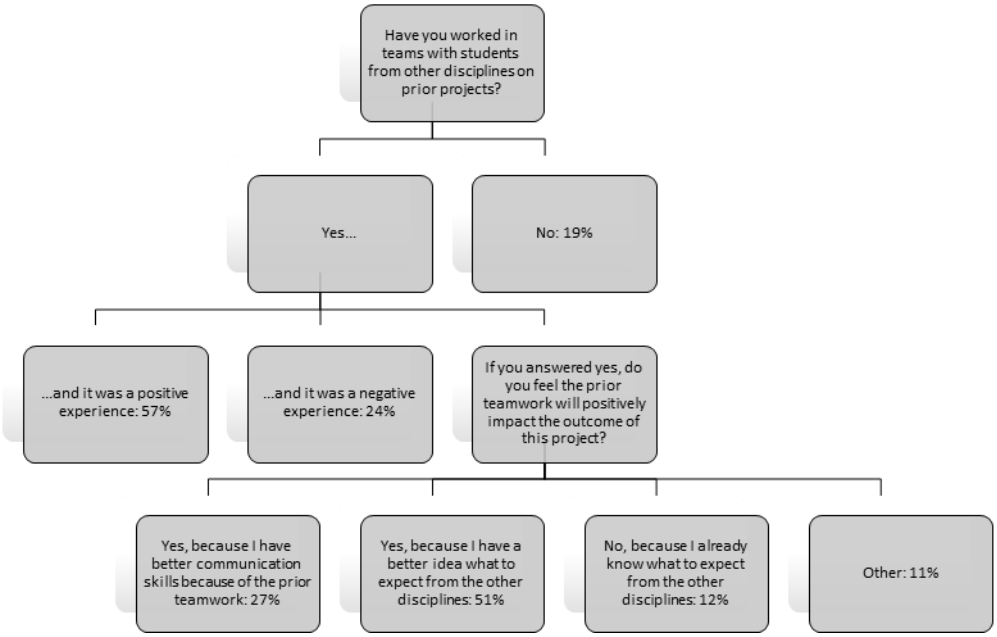

Figure 2: Questions regarding prior interdisciplinary group projects.

Students were also asked to rank their goals for the competition on a scale of one to five, with one being least important and 5 being most important. Despite their occasional frustrations with collaborative projects, students recognize they need to be prepared for collaboration that will take place in their careers, as shown in Figure 3, below, with nearly seventy percent of students ranking that statement as most important on a scale of one to five.

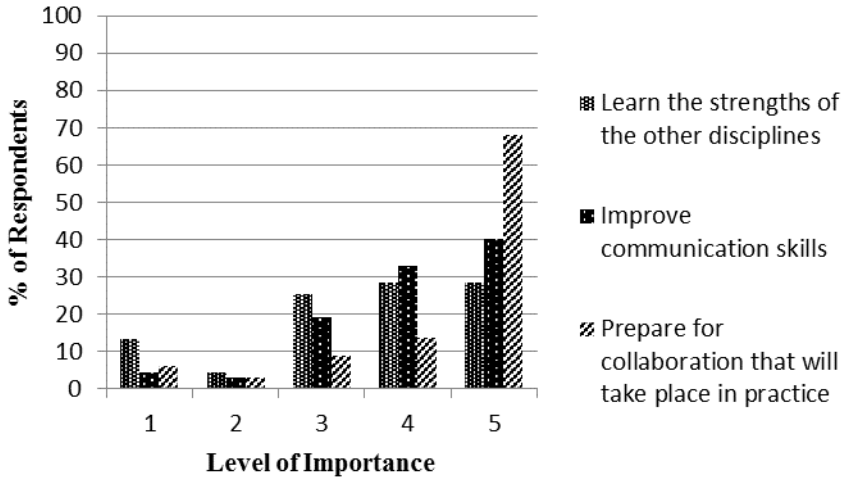

Figure 3: What are your goals for this collaborative project?

Additionally, the students were asked about their perceptions of the strengths and weaknesses of all of the disciplines, based on prior experience and/or stereotype. This question was posed before and after the competition to determine if their perceptions of the disciplines changed as a result of the competition. For the sake of space this paper will focus on the results that pertain to construction students however, data was also gathered about the other disciplines as well. A sample comparison of the initial and final results of the perceived strengths of the construction students is shown in Figure 4, below.

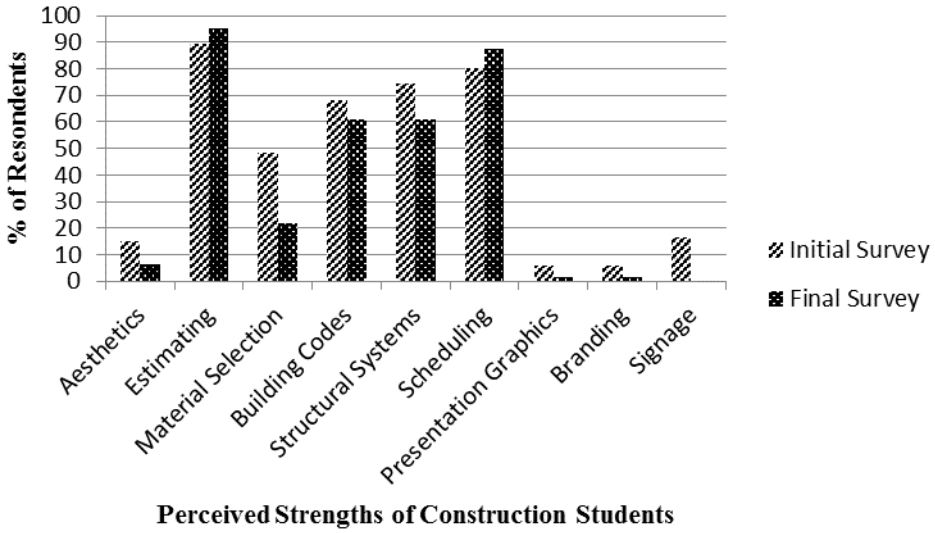

Figure 4: Comparison of initial and final perceived strengths of construction students.

It is important to note that the results indicated in Figure 4, above, are illustrative of the students' perceptions of construction students throughout the competition. After working together for two weeks, there were slight changes between the perceived and actual strengths. Although it is difficult to discern the reason(s) for the slight changes there are several possible explanations: (1) eighty-one percent of the students had prior interdisciplinary experience and therefore already had some understanding of the strengths and weaknesses of the other disciplines, (2) the students were working with the other disciplines in a new context that challenged different skills than prior collaborative exercises have, and (3) based on the short project duration students may not have had time to fully understand the strengths of the other disciplines.

In order to assess the students' perception of how work would be divided among the disciplines, the students were asked which discipline(s) they anticipated being responsible for certain project deliverables, and at the conclusion of the competition the students were asked which disciplines were actually responsible for those same deliverables. As shown in Figures 5 and 6, below, students anticipated architecture students playing a larger role in estimating and scheduling than they actually did in the end. The initial percentages for estimating and scheduling for architecture students were 42% and 25% respectively. Those numbers decreased to 15% and 2 % respectively. Similarly, 80% of students initially thought construction students would play a larger role with respect to building code compliance, with that number dropping to 59% in the final survey. These results do not necessarily indicate a weakness on the part of these disciplines, but could simply represent a better understanding of the role each discipline plays in a collaborative project. Furthermore, where one discipline decreased on a particular topic, such as the construction students' decrease on building codes, another discipline increased – in this case interior design students, which may indicate students were not previously aware of the level of knowledge interior design students have with building codes.

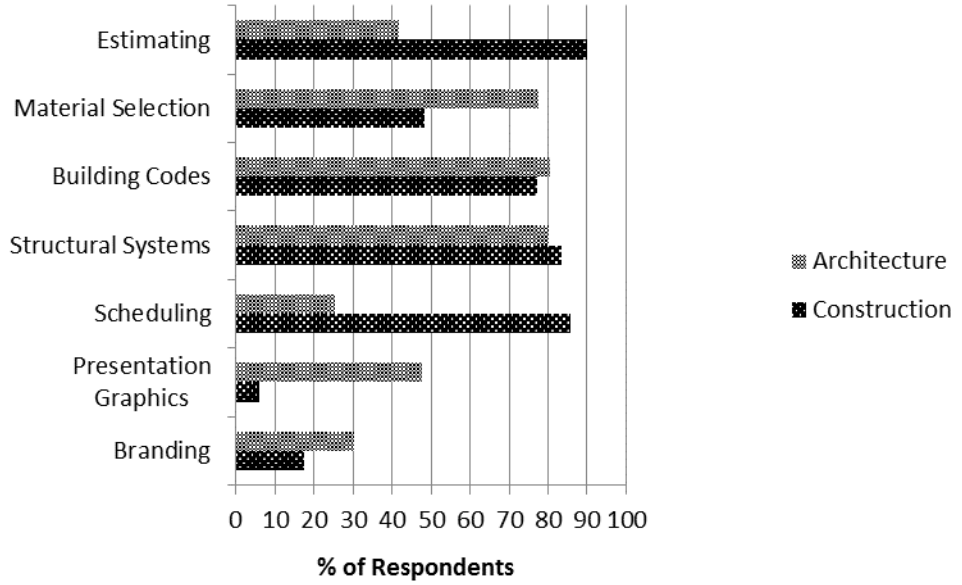

Figure 5: Which discipline do you anticipate being responsible for the following?

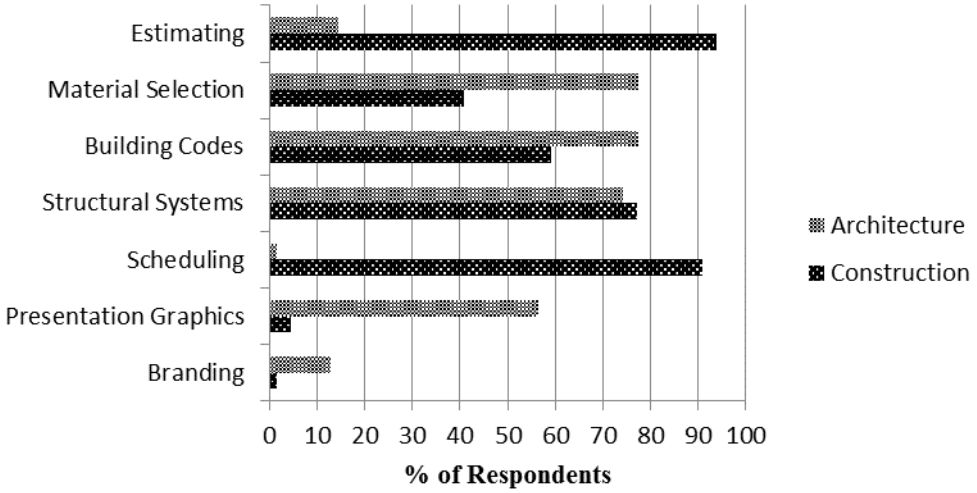

Figure 6: Which discipline was primarily responsible for the following?

Students were also asked if their perceptions of each discipline changed as a result of the competition. Overall, the results from the final survey indicate the competition was a beneficial experience for the students. As shown in Figure 7, below, the students' perception of each discipline changed in a positive way by more than 50% for each discipline. Additionally, results from other questions reveal that 79% of the respondents indicated that their goals for the project were realized. When asked if they enjoyed the project, 48% indicated yes, because they met new people who contributed something they could not, while 24% indicated yes, because the end result was something better than they could have obtained on their own. Sixty-nine percent of the students indicated they would recommend a collaborative project like this to other students. Although the project duration is brief the fact that a combined 72% of the students indicated that they enjoyed the project, which was just one of many collaborative opportunities presented to the students in their respective curricula, gives them yet another opportunity to improve communication and other collaborative skills that will be necessary in their careers.

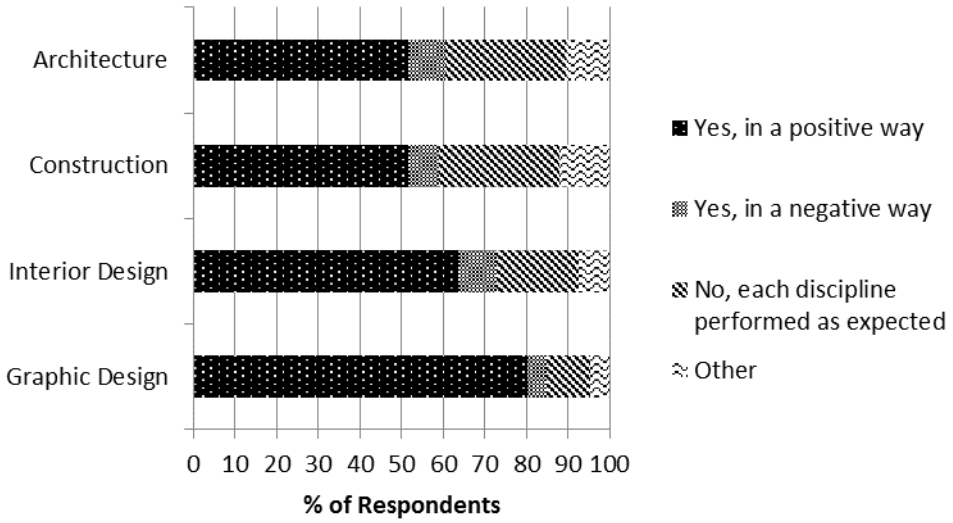

Figure 7: Has this project changed your perception of the following disciplines?

Prior Competitions

2015 marked the fifth year of the annual design competition. Slight modifications have been made each year in order to improve the experience and outcome of the competition. Several key factors have made a difference in both the student outcomes and perceptions of the experience: similar curricula, scope of the project, group formation, faculty input, and physical space.

Similarities and overlaps in several of the disciplines' curricula facilitate collaboration of this type. All four disciplines have a studio-based curriculum. Architecture and construction students have the same studio meeting times and also share several core curriculum courses. These similarities in course structure and schedule make it easier to align the disciplines for this type of competition. Although interior design and graphic design do not normally meet at the same time as the other disciplines, adjustments are made to their schedules for the duration of the project to facilitate the collaboration.

Because of the short duration of the project, the faculty learned from the prior years to limit the scope of the project to a relatively small square size of approximately 3,000-5,000 square feet. When presented with larger programmatic challenges in earlier years of the competition students became overwhelmed by the magnitude of the project in such a short duration. While the faculty recognize a longer competition duration could be beneficial, the duration has been limited to two weeks because of the logistical challenges of coordinating schedules and ensuring that each discipline is able to fulfill its individual course requirements.

In prior years the faculty have also experimented with how the student groups are formed. Options have ranged from faculty members randomly placing students in groups to allowing students to self-select their groups. While the primary goal has always been approximately equal distribution of the disciplines within each group, both of those methods presented challenges: when faculty selected the groups at random the students' perception was that the pairings were not random. When students select groups they do so based on social relationships, which does not always result in positive working relationships. In 2014 and 2015, when the groups were formed based on student input regarding personality and work habits, far fewer group conflicts emerged.

Another element that has been adjusted from the initial competition is how faculty members provide input throughout the competition. In an effort to ensure each group received feedback as the competition progressed, in earlier years the faculty members would split up and rotate among the groups. Students often expressed frustration about what they perceived to be conflicting advice from different faculty members. In response to this feedback, the faculty members decided for 2014 and 2015 to all meet with each group at the same time. This allows students to

observe dialogue among faculty members while also ensuring continuity when questions arise about project deliverables. Another benefit of this method is that is allows students the opportunity to observe how the faculty from different disciplines collaborate with each other and approach the same project with different viewpoints.

Although it may seem trivial, the physical space in which the groups meet makes a difference. We have found that neutral space that can accommodate all of the students helps to avoid territorial/inferiority issues. For example, if students work in the architecture studio space, the students from the other disciplines often feel as though there was an imbalance in the group dynamic. In 2014 and 2015 this issue was remedied by renting space in the student union so that all of the groups could meet in the same, neutral space.

Conclusion

Students, faculty and industry acknowledge that collaboration is necessary and becoming increasingly important for collaborative project delivery methods such as IPD. Teaching collaborative skills in academia presents a variety of challenges, many of which can be overcome through the efforts of faculty who are willing to take on the challenge and who are willing and able to collaborate themselves. Numerous opportunities for collaboration at various points in a student's education can help the students better understand the other disciplines and prepare them for the collaboration they will face in their careers. When the disciplines have a better understanding of each other, the cultural barriers to IPD will be reduced and/or eliminated.

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