

Exploring Interdisciplinary Design in Relation to Workplace Success and Campus Community

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Stacy Benjamin has 20 years of experience specializing in innovation strategies, ideation, and user-centered engineering design. She worked for nine years at IDEO, in the Boston and Chicago offices, where she led projects and innovation workshops across a broad range of industries including medical, business, industrial, and consumer products.

Stacy currently directs the Segal Design Certificate program at Northwestern University and she is a member of the Executive Committee for the Segal Education Council. Stacy is the lead instructor of the Interdisciplinary Design Projects sequence where students work on real projects with real clients in a learn-by-doing format in an atmosphere similar to a small design firm. In addition to design methods, the teaching team also provides contextual training in professional communication and in effective team dynamic strategies and tools.

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Introduction and Research Questions

Answering calls from industry and government, engineering design programs have proliferated in colleges over the last 20 years¹⁻⁷, with design being introduced as early as the first year and now even being integrated into K-12 STEM education^{8,9}. Commonly defined as a systematic and intelligent problem-solving process in which designers meet the needs of clients and other users for new devices, systems, concepts, and processes¹⁰, the design process replaces or supplements traditional, predominantly theoretical engineering education with more practical design education and introduces students to “what engineers actually do” (p. 5).

At Northwestern University, a mid-sized, Midwestern research university in Evanston, Illinois, all first-year students are required to take a project-based, interdisciplinary design course, and, since 2004, Northwestern’s Segal Design Institute (in the McCormick School of Engineering and Applied Science) has offered an elective certificate in design for all undergraduates that expands this introductory experience into a 4-year program. While the certificate program was originally developed for the engineering undergraduates, so that they would not have to wait until senior year for more design experience, it is being expanded to attract students from across the university. Following the inspiration of our engineering dean, a proponent of “whole brain thinking,” design is now featured as a “hallmark” of Northwestern University in our 2011 strategic plan, which emphasizes the importance of bringing together students from engineering, business, education and the arts to do the creative thinking necessary to solve the complex design challenges of the future across a broad range of industries. One extracurricular program in the engineering school, Design for America, takes an interdisciplinary approach to design, encouraging students from all fields to collaborate in designing for social good, and a new prototyping space that is closely allied to the engineering school, “the Garage,” also brings together students from all our schools who are interested in innovation, entrepreneurship, and design.

As faculty in design education beginning a project to assess the effectiveness of our design certificate program and DFA, we began to wonder whether the Segal Design Institute’s cross-disciplinary programs also align with another Northwestern University priority– the effort to build a stronger, more diverse, and more inclusive community. This goal is also clearly articulated in the university’s strategic plan, aligning with research studies that, for the last three decades, have shown the value of communities of practice to the workplace¹¹ and the larger importance of community to civic engagement. Following Robert Putnam’s groundbreaking study of community in *Bowling Alone: The Collapse and Revival of American Community*¹², researchers and policymakers (including President Obama) have been concerned about the decline of community in the U.S., diminished social capital, greater income inequality, and the threat of individualism to society¹³. Educators began to question whether university students in the United States feel sufficiently supported on their campus communities, and scholars have identified inclusiveness and community as key attributes of American education, the place where

we educate our future leaders^{14, 15}. Even large research universities have established programs, policies, and facilities to foster inclusiveness, diversity, and community (e.g. Brown University¹⁶; Harvard University¹⁷; Northwestern University¹⁸; Washington University¹⁹). If the designers of tomorrow are to meet the tremendous social and environmental challenges of the future, what the National Academy of Engineering²⁰ considers the “grand challenges of engineering,” then certainly students in design engineering, like others, must learn how to work successfully with others in diverse, inclusive communities at school and at work. At the same time, students in other fields should see how an understanding of design process can add value to problem-solving in practically any area of life.

Seeing that our required first-year design courses have already helped our engineering students benefit from working on teams that are diverse along many dimensions (ethnicity, gender, nationality, economic class and potential majors)^{6, 7}, we decided to add questions about community to our assessment about the effectiveness of our cross-disciplinary design programs. We designed a study to answer the following questions: (1) to what extent do the design certificate program and DFA help prepare students for the workplace, and (2) do these interdisciplinary design opportunities help the students develop community while they are in school or help them become better community members in the future? Exploring both of these questions in a systematic way, as described in this paper, could help us decide how to modify or expand our design programs in the future. In addition, while exploring the relationship of our design programs to notions of community is a newer interest of ours, results could reveal useful insights about how small communities at the school affect students’ perceptions about inclusiveness and community. Finally, our results should prove useful to other educators in design as they strive to educate students across academic boundaries and disciplines.

Methods and Participants

This ongoing study began with interviews of five faculty from our two interdisciplinary undergraduate design programs in the Segal Design Institute -- the Design Certificate Program and Design For America (DFA)--to define the intended benefits of the programs for the students. The certificate program begins with the introduction to design required of all our first-year engineering students and is open to, and seldom (but increasingly) taken by, students in the university’s other schools (arts and sciences, music, communication, education and social policy); and both programs supplement the capstone design experience that engineering students receive in every major. In the interviews, faculty were asked what benefits they believe students receive from being involved in these programs, how the programs help them prepare for the future, and whether they believe our students’ feelings of community are positively affected by being involved with design. All of the faculty/staff interviews were audio recorded, and four were transcribed and coded for key insights.¹

These insights were then used to develop a pair of surveys to gather feedback from students who had been involved in the Design Certificate Program and DFA: one survey for alumni and one for current undergraduates. The surveys were essentially identical in the sections that collected

demographic information, the students' experiences with design, and what benefits they felt they had received from design at Northwestern, but the alumni survey also included a section that asked alumni to reflect on the skills they gained from being involved with these design programs and how their design experiences affected their postgraduate careers.

In the summer of 2015, surveys were distributed via email to approximately 160 alumni who had participated in the design certificate program. Forty-three alumni responded, all of whom had received a design certificate: 35 were engineering alumni, some of whom had graduated with dual degrees in other programs, and eight were from other schools (not engineering). Thirty-two survey respondents indicated that they were willing to participate in a follow-up interview; of these, 5 were contacted and interviewed, and 3 of these interviews have been recorded, transcribed, and coded for key insights. Survey respondents included 23 males and 20 females who graduated between 2008 and 2015. One complication is that until 2014, the design courses and the design certificate were not advertised outside of the engineering school, so participation by non-engineers was low. In 2015, however, a new introductory course was added to the curriculum specifically to introduce non-engineering students to design thinking. This course will serve as a gateway to other design courses and programs and allow us to more effectively recruit a diverse set of students, with the expectation that this will also increase the effectiveness of the design process, the learning of design thinking, and the sense of community.

In Fall 2015, surveys were sent to approximately 60 current DFA students and 49 DFA alumni. Seven alumni responded, three of whom were engineering alumni (2 of whom also received the design certificate) with four being from other schools (3 from arts and sciences and 1 from education and social policy; 1 arts and sciences student also completed the design certificate). Respondents included 6 females and 1 male. Thus far, four respondents have been interviewed. Eleven current undergraduates also completed the survey, including 8 engineering students, 2 students from arts and sciences and 1 from journalism. Of these respondents, 7 were female and 4 were male. Six are pursuing the design certificate (5 engineering students and 1 from arts and sciences). To maintain confidentiality in this paper, all student and alumni respondents were given pseudonyms. Also, slight changes in quotations were occasionally made to enhance readability.

Background - Program Goals and Descriptions

Program Goals

Our engineering school is committed to creating leaders who thrive at acquiring and applying the knowledge required to solve global challenges. Using a variety of innovative programs and courses, we teach engineers to tackle large, complex problems using a human-centered design process. These programs and courses emphasize real-world experience and outcomes, and our students, from first-year to graduate students, deliver solutions to real clients while considering social context and impact. Our programs teach students how to better serve society, and by offering such opportunities, we help retain socially-minded students within engineering. Our

current initiatives include efforts to not only add depth to our programs but also to foster design-thinking and more opportunities to be involved in design across the university.

Design Certificate

The design certificate comprises six courses that allow students from any undergraduate degree program at the university to apply design thinking in team-based, interdisciplinary settings. Team formation and project selection varies in each course. In the first-year design class, students are typically grouped based on their housing location in order to encourage collaborative work, and the projects are assigned by faculty. Later classes allow different combinations of self-forming teams, projects rankings, and self-identified projects. In the capstone design course, the project and team assignments are done by faculty according to the skills and interests of each student and the particular demands of the projects. However, all teams are small (usually three to five members), and all projects allow students to work in diverse groups and gain experience in project management and team leadership.

The certificate program has grown from one engineering student receiving the certificate in 2004 to 30 students from 11 different majors in 4 schools expected to receive the certificate in the 2015-2016 academic year. This interdisciplinary composition encourages the students to look at both challenges and potential solutions from multiple perspectives, in turn learning how individuals from diverse backgrounds define and solve problems differently. The students must also learn how to relate to each other, how to communicate their different areas of expertise, and how to synthesize this expertise as they collaborate in their classes and on their projects. The students cannot work in silos, but must learn to build on each other's strengths.

Design for America (DFA)

DFA is a nationwide network of interdisciplinary student teams learning how to apply human-centered design to solve local social challenges through non-credit student-led design studios. Approximately 30 colleges and universities have DFA studios. Each year, DFA teams tackle challenges in education, health, the economy and the environment. Students on DFA teams have the opportunity to apply what they learn in the classroom to real world challenges and to use their technical expertise to bring innovative solutions to life and improve the lives of others. Teams for these projects are also small and sometimes self-selected.

Findings

Although research is ongoing, our current findings suggest that the interdisciplinary undergraduate design programs are reaching their primary goals; that is, they give students a positive design experience and prepare them for success in the workplace. Findings also yield some insight into whether the programs enhance community and could be used to further explore an argument about whether design initiatives at our school help build community.

Interdisciplinary design experience as preparation for workplace success

In the interviews, faculty identified five benefits associated with design that are characteristic of advantages described in the literature:

- Learning an iterative problem-solving process that is appropriate for solving complex, ambiguous problems
- Experiencing—and overcoming—failure as part of the problem-solving process
- Improving one’s communication skills
- Developing team collaboration and team management skills
- Gaining engineering knowledge while learning how to prototype

Alumni surveys and interviews suggest that alumni recognize and have gained many of these benefits, as the following faculty comments and alumni findings show.

- *Learning an iterative problem-solving process that is appropriate for solving complex, ambiguous problems*

As one faculty member explained, “design thinking is the phrase everybody uses now,” but the process has been around for decades, “if not centuries,” and teaches people how to “go divergent, convergent, and look at a lot of options” systematically (Faculty 1). Designers learn how to ask the right questions that, after going “around and around and around” a problem eventually allows them to identify “real needs” and “solve really big problems” (Faculty 3). Design education helps students become “more comfortable thinking creatively,” which our faculty identify as “important” (Faculty 4). Central to these design experiences is that the students have real clients and work in teams to solve real problems. As one instructor explains,

If you want to do anything in business, business is all teams. If you want to start your own company, you know some of the projects have a real entrepreneurial slant to them so you get some exposure to that. . . . [You] get that taste early on of what that’s like and . . . whether you work for a Fortune 500 company or a not-for-profit it doesn’t really matter; it’s small working groups working on projects and having to communicate and collaborate and it’s just kind of how stuff gets done.” (Faculty 3)

In the alumni survey, average ratings were high for questions asking whether “being involved with design was beneficial for me” (M=4.86 on a scale of 1-5) and “gave me skills which extend beyond professional and academic settings” (M = 4.74 on a scale of 1-5). The 33 surveyed alumni who are currently working in industry (as opposed to in graduate school)-- 19 of whom went on to work in design-- on average strongly agreed that being involved with design at Northwestern helped prepare them for their work (M=4.39). One interviewee explained how he uses the skills he learned in design:

[In my job] either you have a customer you want to reach or a technology you want to monetize; my job is to figure out who that customer really is or- or how that technology should be applied to reach that customer . . . in terms of creating new opportunities for

businesses, that's where I specialize and that's where the skills that I've learned [in design] come in handy." (Caleb)

Thirty-seven out of 39 respondents agreed that it was good that the design programs forced them to deal with ambiguous problems early in their career (M=4.61 on a scale of 1-5). Of the four alumni interviewed, one said "there wasn't a whole lot" he "picked up" about problem-solving (Jerome), but another said, "You're equipping yourself with a toolkit that will be useful no matter where you go later in life." (Caleb).

- *Experiencing—and overcoming—failure as part of the problem-solving process*
As one faculty member explains,

You can learn more from an interesting failure than you can from a boring success. There's really not much to be learned from tackling a simple--you know building a bridge out of popsicle sticks and rolling a bowling ball over it, eh it's clever but it doesn't teach you anything. Having your client refuse to let you into the space to take the measurements that you need to do your design . . . [or] having the client.... introduce new requirements late in the process . . . Or [trying to make something] work in metal and plastic [that couldn't be implemented]. These are disappointments, these are painful, but they are tremendously informative, instructional learning experiences [so] they're great. I want our students to get some experience of recovering from failure and learning from failure now while the stakes are low before they go out on their first internship, first job, where the stakes are higher. (Faculty 3)

Another espouses the value of prototyping ideas in a "low fidelity way" to create buy-in and see what succeeds and what fails as a way to eventually create a new product or even change in an organization (Faculty 4).

Thirty-nine survey participants answered the question asking whether "being involved with a design program at Northwestern forced you to deal with experiencing failure," and of those, 33 (84.62%) answered affirmatively. Those 33 were then asked to rate how beneficial it was to have to learn how to handle that failure, and on average they answered that it was very beneficial (M=4.45 on a scale of 1-5). They also said that it was good that our design programs challenged them to deal with failure early in their careers (M=4.21 on a scale of 1-5). Six said the question was not applicable to them, meaning they did not feel they had experienced failure in the program.

Comments from interviews reinforce this affirmation:

- "I think one of the most important lessons that anyone can learn is just that the first idea you have is not necessarily the right idea, and the things that you think satisfy your requirements will not satisfy your customer's requirement or the users' requirement, and so that process of failing the first time--of designing something that

you think is awesome and putting it in front of someone and having them tear it apart—is one of the most important lessons you can learn because it’s unavoidable; you can put that product in front of as many people as you want, but it’ll still have the same defects and so it forces you to reconsider your infallibility [sic.] as a young person.” (Caleb)

- “[Coming] out of Northwestern I still wasn’t super comfortable with failure; it took me a while to learn it, especially because almost immediately after [. . .] I went to work in start-ups and I failed quite a few times. It was very emotionally draining and very stressful, but then I thought about Northwestern. . . I remember from there . . . that failure was part of the process, and you don’t really believe it when you hear it the first time, but I think that once you go through it a few a few times and when you see enough examples of failure being a part of the process you start to believe it yourself, so I’m glad that they try to infuse in the education. . . [This] helped me change my mindset in that I shouldn’t. . . always value success based on positive venue stream coming in, but also [on] how much you are learning, and if you’re not learning that’s the real failure of the process.” (Terrence)

One student specifically notes the value of letting iteration happen in a “safe” space:

In DFA I remember making changes over and over in an environment where it’s safe. It’s better to work with a professor and be gently told to correct it. At work you could get a boss detracting from your ratings at the end of the year, or getting really embarrassed and getting mad at you. (Samantha)

A recent article in the *Wall Street Journal* reinforces this idea, saying that early experiences with failure in design can help students develop the “resilience” they will need in the future

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- *Improving one’s communication skills*

Echoing the sentiments of many industry leaders, one faculty member explains, “There’s really nothing that an engineer does that isn’t somehow connected to the act of communicating” (Faculty 3), and another says that solving communication problems is “always present in the working life of engineers” (Faculty 2). Yet, as one faculty member notes, it’s often hard for engineering students to learn “that communication’s not something separate, it’s not something that happens kind of after the engineering is done or separate” (Faculty 4). Our design programs aim at teaching students to communicate “all through a design process,” orally, interpersonally, graphically, and in writing. They have to address many audiences--supervisors, clients, vendors, and teammates—and learn how to make persuasive arguments. The programs aim to demonstrate that better communication leads to better design. Sometimes the design challenge is less about creative problem-solving and more about “here’s Photoshop, here’s Illustrator, here’s how to visually communicate your

ideas, . . . [a] skill that's gonna be applicable for whatever they go into whether it's marketing or finance or . . . consulting (Faculty 4). Finally, teaching communication is related to "professional, business-like communication"--not just writing reports or giving effective presentations but learning "how to talk to people, whether it's [through] email" or something else, how to communicate a message in a way that people want to respond to (Faculty 1).

Alumni survey participants were asked to rate their presentation skills, business communication skills, and collaboration skills on a scale of 1-5 before and after being involved in our interdisciplinary design programs and on average noted the following:

- o Their presentation skills improved from 2.87 to 4.15 (mean improvement of 1.28)
- o Their business communication skills improved from 2.62 to 3.87 (mean improvement of 1.25)
- o Their team collaboration skills improved from 3.31 to 4.41 (mean improvement of 1.10)

Thus, alumni believe their presentation skills improved the most. They also valued learning how to present information visually and in a "limited space," which they did in their design portfolio course, a required course in the certificate program. One interviewee said, "Now I'm in business school and running startups and it's like you can't discount that . . . it's really important to communicate very precisely" (Terrence). He also noted that the "lack of skills" in communication "causes you not to have a lot of shared ideas on a team, and . . . limits a lot of thinking and innovative activities that can happen." One participant noted that being involved with design was particularly useful to talk about in job interviews:

[Having had design experience] gives you an opportunity to talk about different skills from communicating with clients to presenting an idea to actually building a prototype whereas I don't think I could elaborate on my material science thesis very much because it just it escapes the audience's attention almost immediately; [in contrast] the whole design project . . . has to do with user empathy so . . . it's a really easy thing to talk about and . . . the breadth of things that you do in the process . . . exhibits your skill sets, so . . . it makes good talk for a job interview. (Terrence)

The one interviewee who said he did not learn much about communication or team collaboration offered this explanation: the division of labor on his team allowed him to simply focus on the engineering work:

I left that to all the non-engineers who didn't know how to design or build anything. . . I handled the stuff that I knew and could do better than them, so I designed it, built it, did all of the actual engineering work and left the presentations and reports and stuff to them. (Jerome)

Conversely, an alumna who achieved the design certificate and worked in DFA valued the fact that she worked with a diverse team as an undergrad:

[In design] I had to work with people who were . . . used to being in charge and it was a helpful learning experience. You learn how to follow and what role you best play. . . . I learned the importance of having emotional intelligence to read people when you're working together and how best to work together in a given group. If the first time you do all this is in a job, your undergrad has really done a disservice to you. (Samantha)

- *Developing team collaboration and team management skills*

As the emphasis on communication shows, the intended benefits from these programs often overlap. Good communication is an essential aspect of successful team management and collaboration, but a good team experience goes far beyond whether students can leverage their talents and successfully complete their work. As one faculty member explains,

The [design] process itself . . . changes the way that they operate and . . . see the world because they're starting to see other points of view in a very focused and . . . intense [way] Going through that with people who are not . . . exactly like you . . . helps mold you into somebody that is able to work well with others in intense situations” (Faculty 2).

At the same time, working with people from other disciplines opens the solution space: instead of following the usual solution path from their discipline, “going to the next step and going to the next step and then going to the next step,” a design program that emphasizes interdisciplinarity shows students that “somebody from another discipline might take a completely different approach” (Faculty 2). Juniors and seniors “from the other side of the campus,” who are not engineering students, often credit the design certificate courses with affording them their first academic team experience (Faculty 1).

On average, survey participants showed a preference for working in groups with diverse skills and perspectives (M=4.13 on a scale of 1-5) to working with a group in which everyone has similar skills and perspectives (M=3.28 on a scale of 1-5). When asked to rate their preference for how they would want to work if they had a difficult project, from 0-6 with 0 being “as an individual,” 3 being “no preference,” and 6 being “on a team,” participants were significantly more likely to say “no preference” or “team” over “individual,” and in fact no participants answered 0/“individual” (M=5.18). When asked whether his preferences for working alone versus on a team changed as a result of being involved with design at Northwestern, one alumni interview respondent said, “Definitely. I find myself being a much bigger team player and really appreciating the skills that my other teammates bring to the team and trying to use them effectively”; he continued to explain,

I was very much a loner through high school. . . ; usually my MO was just “I’ll do all

of these pieces and you guys just worry about these parts and we'll throw them together at the end and that'll be good . . . ,” but working through the design program at Northwestern taught me the values of simultaneous and synchronous collaboration and being in the room with people brainstorming and trying to solve problems together instead of separately and coming together at the end. (Caleb)

Students associated the teamwork experience with how they benefited from interacting with people from other fields. On average they said that being involved with design at Northwestern increased their appreciation for working in a team of people with diverse perspectives (M=4.15 on a scale of 1-5) as well as making them more comfortable working with people from other disciplines (M=4.05 on a scale of 1-5). One contrasted this experience in design to his experience in his major:

The design certificate really was almost the opposite [of my major] where it was the first time I was actually working on [an] . . . interdisciplinary team because you know how it is with engineering: you're just confined within this small class- material science class and have the same class with the same students for 2 years, and so it was the first time- it just broadened my scope quite a bit and I enjoyed it a lot, [and]. . . I think that's why it was so formative for me . . . it was the chance to meet new people from other schools . . (Terrence)

But this respondent also said that the value of teamwork is “context driven”:

At Northwestern I would have no problem relying on my team just because I understood that the caliber of the people on my team I could trust right away... but in the real world . . . I can't do as much of that. [Instead], I kind of have to trust my own ability to get things done At NU where I trusted my team, we definitely worked a lot more effectively. (Terrence)

Currently in business school, Terrence commented that he often has to take the leadership role, and he notes that people tend to stick together, preferring to work with like-minded people, rather than working out of their comfort zone:

A big part of what we're trying to do [is] . . . get the engineers on campus to work with the architecture students and they don't organically work together; we kind of have to place them into teams and see if that works or not, . . . [but] it's definitely better to have a diverse group of people . . .

- *Expanding one's engineering knowledge, while gaining hands-on prototyping experience*
As one faculty members explains, “The way to understand an engineering problem isn't just through your eyes but through your hands. . . you can't neglect the relationship between your hands and your brain” (Faculty 3). He notes that machine shop experience, from the freshman year, is a “good thing” and a “big benefit.” Another faculty member bemoans the

fact that “so many students in engineering have to wait until like their senior capstone to get hands-on experience and it’s all just like theory and numbers leading up to that, but design at Northwestern is very applied and I think that’s pretty critical” (Faculty 4).

All of the alumni interviewed commented on the opportunity to go to the shop instead of sitting at a desk all day. One credited the shop experience with helping his teams recognize the iterative nature of design because they would realize when they tried to build something, and it didn’t work, that they needed to redesign.

Interdisciplinary design experience and the enhancement of community

Faculty and alumni see the “usefulness” of design thinking and design process experience for undergraduates in any school and pursuing any major. For the most part, alumni also felt that being involved with design could be beneficial for anyone. Thirty-three alumni strongly agreed that on average they would recommend being involved in the design certificate program to anyone interested in design (M=4.74); they were less certain but still generally in agreement that they would recommend being involved in the design certificate program to undergraduates of any major (M=3.82), also agreeing that the involvement and certificate enhance the value of any major (3.79). One explains,

The process is something that I think is hugely important to any human being and that it’s a set of skills which will come in handy no matter what profession you go into and having worked in theater, film, engineering, design, and education, it’s definitely a process that is flexible and adaptable for any of those settings. And so definitely anyone can benefit from that creative process, that process of failure, that process of prototyping and refinement and collecting feedback and really valuing the customer; . . . those are all skills that are applicable to anything.” (Caleb)

However, one interviewee disagreed, saying that he didn’t believe the design program benefits “random [arts and sciences]” students who won’t ever do “real design,” won’t touch a CAD program, and are just participating to pad their resumes. (Jerome)

Does this mean, however, that cross-disciplinary design experiences help students feel connected to a larger Northwestern University community? And if it does, can we say that involvement in a design project is the factor that creates community, or would the students benefit equally from working together in any small group? Faculty say that our university, like others, has very “thick silos” and that, unfortunately, the higher in their professions that the faculty go, the smaller and more “scattered around the planet” their communities become (Faculty 3). However, since most of our design courses are team-taught, and mentors reflect many disciplines, from academia and industry, our interdisciplinary programs help build community at the faculty level. One faculty member says, “I already know so many more both individuals as well as communities because of my participation with Segal. The institute just draws different kinds of people together and also tends to build communities with those people so I think it’s sort of inherent in design and the teaching of design that you tend to make more and more and more connections” (Faculty 2).

Extrapolating from this experience, he and others conclude that it's an advantage to the undergraduates to "pass through and walk among . . . these barriers," getting used to working with people with different perspectives.

According to the former associate director of our Design for America group, "students come from all different backgrounds [and] all different majors"; she explains,

We have a ton from [the school of education] and anthropology and . . . all walks of life They organize parties together and they have social events I think Design for America at [our school] has probably grown to about 70 students annually, and part of the description [is], "Hey you gotta make this fun" [because] no one's gonna want to be a part of it cause it's all extra-curricular so unless it's fun no one's gonna want to be there The studio leads make an effort to . . . become friends with each other.

The director of the design certificate program hopes that in "the long-term" being on interdisciplinary design teams gives students from different schools a broader perspective, but asks herself, "Do I think it actually makes the school more connected?" She answers, "Not yet. I think it's just such a small number of students and they come together for just that project. . . . The schools themselves aren't involved."

Alumni, when asked in the survey to what extent being involved in the interdisciplinary design programs made them feel more connected to community at Northwestern, gave a wide range of responses ($M=3.18$ on a scale of 1-5). Participants were also fairly undecided about whether being involved with these programs led them to see less of a divide among the various schools on campus ($M=2.63$) or more of a divide ($M=2.62$). These responses suggest that students do not perceive their interdisciplinary design experiences as a source of connection to "One Northwestern," which our central administration would very much like to see.

However, alumni commented in interviews that their design programs fostered small, limited communities. Caleb, for instance, said in his interview:

I think it helps build limited community across campus but certainly collaborative exercises of that nature like Dance Marathon [a major student philanthropic event] do. Or I know there were a few engineers who helped out in the scene shop for all the student theater programs. That sort of collaboration definitely drives community across schools." (Caleb)

Our previous research on community at Northwestern suggested that our students are satisfied with the sense of community they derive from belonging to smaller social aggregates on campus, such as a fraternity or sorority, a club sports team, or their academic major. Thus, it might make sense that the design programs provide another venue for students to work together as another small community on a large campus or to reach out to make connections with faculty and people in industry. Study participants did say that on average being involved with design at

Northwestern made them feel a greater sense of connection to non-student members of the community, such as faculty and business partners (M=3.89).

Terrance describes a case in which diversity could exist on a team without creating community:

I was taking classes with most of my friends and I think the program wasn't that big yet so I didn't really feel I was connected to the campus in its entirety. I think that had to do with myself as well, I wasn't really extroverted so I kind of [hung out] with the people that were in the classes, and I don't think that's a horrible thing. It just wasn't one of the things that that class was able to do for me. Maybe it was the nature of the teams in which you kind of get stuck with the same 5 people [. . .] I was on a project [. . .] building a Formula One car with a few others [. . .] across campus. I don't know if that's still around, but I think most of my teammates were engineers at the end of the day, because I think in the team, the team formation phase was really important. I think all engineers kind of assembled together and so you had, although there was diversity in the room, I think we just got stuck working with engineers. And then you're kind of just stuck with the same people through the entire course, so maybe that's why I didn't feel the diversity just because in my team I wasn't really a part of that. I think you have to push people to kind of go outside. Cause I think people's comfort zones are to meet and work with people that are very similar to them, even when if you have a room of very diverse people [. . .] I'm leading the design club at [another university] right now, and a big part of what we're trying to do there is exactly this. (Terrence)

And Jerome suggests that interdisciplinary work might actually harm a feeling of connection across disciplines: "There wasn't really any community aspect," he says; " It made me probably not as connected because it made me not like all the non-engineering folks trying to get the design certificate" (Jerome).

Discussion

We were pleased to see from this research that faculty and students agree that the interdisciplinary design programs are meeting their primary purpose - to train students to be effective problem-solvers in the workplace. Students gain valuable experience working in multidisciplinary teams and learn to communicate effectively in a variety of complex contexts. Thus, the elective and extracurricular interdisciplinary design programs that enhance the required design experiences in engineering also contribute to fulfilling the design "hallmark" laid out in Northwestern's Strategic Plan—to support design education because it is essential to "explore new knowledge, invent new forms of creative expression, and find new solutions to some of the most pressing issues facing society." It is also clear from the research that alumni value an undergraduate design experience that emphasizes design thinking and doing.

However, we began this project with another broad question about community at colleges and universities: Do interdisciplinary design programs foster diverse yet inclusive campus communities? Alumni indeed showed a strong appreciation for working in teams of diverse

perspectives and developing comfort to work with people from other disciplines, and faculty believe that this appreciation is related to the fact that the students experience this interdisciplinarity as undergraduates. To quote one faculty member, “The undergraduates [are] . . . our best shot at being interdisciplinary and maybe the only truly interdisciplinary people on this campus” (Faculty 3). Moreover, since faculty believe that their own sense of community is enhanced by these cross-school opportunities for them, it is possible that their greater sense of community trickles down to students, thus helping to break down silos.

Yet, while the diversity of the interdisciplinary design programs has increased, if, by diversity, we mean embracing students from a variety of schools and majors, the effects on the nature of university community remain unclear. More non-engineering students are pursuing the design certificate each year, but, as discussed earlier, the increase is modest. The most common majors among the certificate students are still engineering majors -- Mechanical, Biomedical, and Industrial Engineering -- although students from Psychology and Economics (both in the college of arts and sciences) have also been participating. Thus, there is some disciplinary variety and cross-school participation. Additionally, the male to female ratio has decreased over the years so that now the proportions are nearly equivalent.

Unfortunately, our findings suggest that the value of the interdisciplinary collaborative process can be lost for many reasons, from having students self-select into design teams that are not interdisciplinary at all to having interdisciplinary teams simply divide up the work by each individual’s strongest skills, thereby avoiding deep interdisciplinary interaction and learning. We are continually assessing and revising the programs to address these issues. Moreover, while faculty believe that discomfort is sometimes a necessary step in building community, because students have to learn how to engage across differences and appreciate disparate points of view, some students flee discomfort or see it as a failure of community. During an interview we conducted with Morton Schapiro, Northwestern University’s President, Schapiro noted that some communities develop from comfort--for instance, students may affiliate with a group through shared cultural or religious background--while other communities require “uncomfortable” learning. But students have to be willing to tolerate some discomfort in community-building, just as they do in design process.

As Schapiro also noted in his interview, “Northwestern has always been a community of communities,” and this thought echoes the satisfaction that many of our undergraduates voiced in our previous research on community²². Thus it may be that the interdisciplinary design experiences help students develop new kinds of diverse but small communities that benefit them, rather than contributing to a broad community that reflects the university as a whole. Judging from previous research, such an outcome could be considered a success. Although some campus administrators see their mission as reaching across campus to build community intentionally among disparate groups, most students in the previous study, who define “community” as a place where they feel comfortable and supported, are satisfied with the idea of belonging to several small university communities. Indeed, they see small communities as a necessity for their

success and well-being at Northwestern (p. 16) ²². As a matter of fact, one student described the idea of a broad “university community” as a paradox and questioned its feasibility:

All in all, there are a lot of different types of people at Northwestern University. As a result, it is hard to unite us all as one big community because we have so many different interests. Therefore, we create distinct, smaller communities within the larger Northwestern community so that we can find people with whom we belong . . . (Nadia, p. 11) ²².

This partial disjunction between the way that students, faculty, and administrators define community recalls the fact that the term “community” has many definitions and that promoting “community” can foster different, even sometimes contradictory, benefits. Putnam lauds the virtues of community because it promotes social capital and civic engagement, but he admits that tightly bonded groups of people do not always support positive values. Bellah et al. ²³, in their classic study *Habits of the Heart: Individualism and Commitment in American Life*, find community valuable insofar as “a group of people who are socially interdependent” share practices that contribute to the common good (p. 333). Lave and Wenger ¹¹ value communities of practice because people work collaboratively in them to develop, deepen, share and extend their knowledge. In the context of a university, community is desirable to the extent that it promotes education, encourages civic responsibility, inspires creative problem-solving, and prepares students for professional success and lifelong learning. Thus, whether current students feel that there is one large community to which they belong or many opportunities to be a part of smaller, productive, inspiring communities may be irrelevant. Perhaps identification with “one Northwestern University community” is more important to faculty, staff, and alumni.

However, the data from this study have not been broken down by year, or analyzed with a consideration of changes made in the program over the years. This is a limitation of the study since students who pursued the design certificate ten years ago certainly had a very different experience from students engaged in the program in the last year or two. Moreover, the new introductory design course, developed specifically to allow more non-engineering students to pursue the design certificate or take courses in design process, is small (capped at 24 students) and only in its second year. Thus, the issue of diversity or feelings of community influenced by this new course need to be tracked over the next two years, at least. Finally, our surveys and interviews did not explore whether community-formation is enhanced when students work together on a design project or work in small groups on any kind of project. This is a question that deserves more study.

With these thoughts in mind, we see the following as next steps in this project:

- To analyze our data set with attention to the graduation dates of alumni who participated in the design certificate program

- To interview additional students from both the certificate program and Design for America to get a broader understanding of whether/how our design programs create small communities (e.g. communities of practice), what is the role of design in that process, and how those small communities may benefit students in the short- and long-term. We might also interview students from a Design for America chapter at another university.
- Over the next two years, to survey and interview (a) students who complete the certificate program and (b) non-engineering students who take design courses, particularly to explore the effect of the new introductory design course.

Conclusion

While still in process, this research with faculty and alumni points to the success of the two interdisciplinary design programs in terms of introducing students to design process and helping them prepare for the workplace. Thus it provides evidence for the argument that students across the campus should have more opportunities to be engaged in design thinking and to work on interdisciplinary design projects. These opportunities prepare students for the workplace because design promotes problem-solving from diverse perspectives, creativity, team collaboration, communication, and an ability to rebound from failure. Thus, we intend to argue not only for more design courses to be offered across campus but for more non-credit, cross-disciplinary opportunities, such as more maker spaces (perhaps in student residence halls), more one-day workshops, and more seminars that feature collaboration in design across disciplines.

In addition, in a limited way, this study suggests that those students who work on design projects, whether cross-disciplinary or not, gain a stronger sense of community, either among students or with faculty and people from industry. While these communities may be on a smaller scale than some Northwestern University administrators would like, they still seem to foster diversity, build social capital, and enhance student satisfaction. Additional research should be done in this area to explore whether design, which is foundational to understanding diverse points of view, is also useful for promoting civic engagement. For this research, design educators would be wise to work with researchers in other fields, such as higher education, the learning sciences or psychology. It may prove to be that interdisciplinary design education has even broader benefits to offer our universities than has so far been recognized.

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