Empowering Students with Design-Build

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Abstract
In their second semester of architecture school, seventy-seven undergraduate students across five studios worked together to fabricate and construct a 20’x25’ installation with 2300 unique pieces in their school atrium. The project, titled TwoXTwo, represented a curricular realignment to incorporate digital methods, studio-wide collaboration, and full-scale construction into the beginning design sequence. The theme of this paper is student empowered learning in design-build: what it means, how it can create learning opportunities, and how it can go wrong.

Disciplines
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Comments
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Introduction

In their second semester of architecture school, seventy-seven undergraduate students across five studios worked together to fabricate and construct a 20'x25' installation with 2300 unique pieces in their school atrium. The project, titled TwoXTwo, represented a curricular realignment to incorporate digital methods, studio-wide collaboration, and full-scale construction into the beginning design sequence. The theme of this paper is student empowered learning in design-build: what it means, how it can create learning opportunities, and how it can go wrong.

Scholarship of design-build may seem like an oxymoron. It is often tenuously close to storytelling. Lacking strong methods, such as ethnography, it can easily digress into the anecdotal. However, this should not devalue what is shared. Educational research in general has challenges of methodological rigor. Design-build, specifically, is a complex activity, dependent upon institutional policies, facilities and other resources, and the preexisting traditions and student culture of the school. Thus, any findings from research about design-build may not be directly transferrable—at least not without significant adaptation. This is not to say that data about design-build projects cannot be collected and new ideas cannot be learned from the experience, but these are often inseparable from their context. With those caveats in mind, the following is a case study, presented as a candid discussion of a project with a reflection upon its lessons for future efforts.

Empowerment

The notion of empowered student learning is central to a critical understanding of TwoXTwo and its lessons. The term “empowerment” has become overused in education of late, so that its actual meaning has become obscured. Today, many assume that empowerment means students being in charge of the classroom in some form or another. While allowing students greater agency is a dimension of empowerment, there is more to the definition. For the purposes of this paper, empowered refers to student motivated and able to act in their own interests in support of learning. This objective aligns with the commonly-held idea that students must “learn how to learn” as part of their post-secondary education. The hypothesis of empowerment holds that if students are self-motivated, focused, and capable, this should improve the effectiveness of their learning compared to direct instruction. However, to be clear, this does not mean students are in control. Instructors must create the conditions for empowerment to occur and to be sustained. The lessons of TwoXTwo illustrate the difficulties and potentials of student empowered learning as a pedagogical strategy within design-build. This will be the focus of the latter half of the paper.

Before summarizing the project and introducing the assessment methodology, it is necessary to understand more about empowerment. Thomas and Velthouse’s paper on the cognitive elements of empowerment presents a series of conditions under which empowerment is thought to occur. First, work must have impact. It is motivating when one believes that their work matters and makes a difference. Second, the individual doing the work must feel competence: in possession of the necessary skills and knowledge and confident in their capability to perform the task. Third, the task must mean something to the individual intrinsically (i.e. meaningfulness), with respect to one’s values.
and ideals. Internal motivation of this sort is not concerned with completing the task, but about the care and quality of the work involved. Fourth, the individual must have choice: the ability to influence the goals of tasks and choose the methods they use to complete them. Choice is often what many people focus on when they think of empowerment, but the framework followed here demonstrates how the cognitive picture is more complicated. In order to learn well, one must possess the motivation to want to learn (both from external and internal sources) as well as the ability to learn.

**Course and Project Overview**

TwoXTwo was a full-scale design-build project completed in the spring term of 2016. It was a continuous surface — assembled primarily of 2x2 lumber and inspired by SHoP Architects’ Dunescape — that integrated multiple spatial conditions such as inclines, overhangs, ledges, pockets, etc. The uses of these areas were left to the occupants and were intended to promote a more engaged and playful relationship with public space. The project is noteworthy because all of the students in ARCH 202 participated in its development and execution and because it occurred so early in students’ education.

Fig. 2 Rendering of proposed installation.

The course in which the build took place, ARCH 202, is the second semester in our professional architecture program. Five instructors taught a coordinated studio together in five sections of 15-16 students. Our class of seventy-seven students was fifty-nine percent male and forty-one percent female. Overall, the studio was six percent minority. Thirty-four percent of the class were international students, representing eight different countries. At this point in their education, students have limited experience with design (particularly projects on this scale), do not know each other well, and uneven experience with construction. For instance, many students at Iowa State come from a rural background and are comfortable with heavy machinery and carpentry. But the majority of our students had no such experience. TwoXTwo was a half-semester seven-week project, issued at the start of the term.

The primary objective of the project was to understand public space and challenge conventions of program, formal proportions, and privacy. The project began with precedent studies of public spaces, such as the Trevi Fountain and Millennium Park. Students also conducted spatial and ethnographic analyses of public spaces within the site and around campus. The intent of these early studies was to make students aware of the qualities of public space — everything from function to phenomenology.

In response to the precedent analysis and research, students created proposals for a 5’x20’ intervention in the atrium, taking into account the constraints introduced by the earlier precedent: nominal lumber with a strong sectional quality. The class discussed these proposals and voted on the most successful in each of the five studio sections. During a 24-hour charrette, the five proposals were developed into a single 25’x20’ proposal representing the efforts of the entire second year.

The structural system and detailing emerged from a series of intensive workshops. Students created and tested full-scale mockups to understand their performance and determine a construction sequence. Structural consultants visited the studio to evaluate the proposals for safety, elegance, and economy.

Once the design was approved, the students created workflows in Autocad, Rhino, and Grasshopper for converting 3D models into construction drawings and instructions. Moving into the construction phase, messaging apps and realtime spreadsheets
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were used to coordinate construction shifts and track progress. Fabrication and final assembly took less than three weeks.

Outcomes

TwoXTwo was completed on schedule and there were no accidents or significant injuries during the assembly of the project. The installation lasted three weeks and was well-received both within and outside of the school. In terms of its stated objective to reconsider public space in the College, TwoXTwo seems to have been successful. Besides increasing the density of occupation in the atrium, the installation became the site of several “pop-up” activities: a dance recital, art exhibition, a space for lectures, and the occasional party. The installation had an unscheduled extended engagement when a request was made that it be moved to a local botanical garden for use as an outdoor public space. The following summer, over 50,000 visitors experienced and played on the structure. It was recycled into lumber and mulch at the end of the garden season. Later that year, TwoXTwo was recognized by ArchDaily as one of the best student design-build projects of 2016.6

The benefits of this addition to the curriculum appear to have been significant to the students, school, and community. The outcomes of the project were as one would expect from a successful design-build. Over the course of the project, students learned a variety of research, communications, and computing skills, as well as construction and safety skills. They also learned about project management, negotiation, and teamwork.

Design-build was an excellent framework to teach these lessons in an integrated way while demonstrating their relevance to students. For the most part, faculty, staff, and visitors reacted positively to the installation, which further gave students a sense of pride and ownership in the work. TwoXTwo’s success in activating public spaces on campus and bringing exposure to the architecture program has led to sponsorships and a request from the College to retain a full-scale design-build project as an ongoing addition to the second-year studio.

At the same time, as the paper will later show, not all of the students felt they were full participants in the build and not everyone’s experience was completely positive. On a curricular and administrative level, institutionalizing design-build has opened up criticism and discussion about its relationship to the department’s pedagogical values, use of resources, safety and liability, and a host of other concerns. None of these controversies are new to design-build projects7, even when design-build is not a requirement, but they must be addressed, nevertheless. This study, and others like it, is one way to better understand and avoid the issues discovered during the project, before the next iteration of the studio.
Assessment Methodology

Assessment of TwoXTwo took many forms and was designed not only to determine performance but also to help everyone involved learn more from the experience. As this was the first time ARCH 202 attempted a full-studio build, the instructors sought to measure the impact of the project and identify issues for future projects. Towards this end, students completed surveys and submitted peer assessments and written statements reflecting upon how they worked together, what they learned, and the extent to which they challenged themselves to grow as designers. Instructors recorded personal observations and collected the student evaluations required by the University.

Discussion

Several decisions were made early on to enable such a large and inexperienced group of students to work together a single project. First, the introduction of a precedent project seemed to be effective, as it presented a pre-determined material (wood) with established structural details and a demonstration that the concept would indeed work. This provided the students with a set of constraints and helped to limit the workload during the design phase. Second, the typology of the lofted section, borrowed from the precedent, allowed the students to design both “locally” on designs for smaller pieces and “globally” when those pieces were brought together in series. This had the effect of giving ownership to studio sections as well as the studio as a whole. Third, combining the five studio sections together as a collective studio for the purposes of one large project had the effect of equalizing the distribution of skills, knowledge, and talents among students. If a student was a skilled carpenter, for example, she added to the project and helped her peers learn and work collectively, rather than to the benefit of her section alone. One would also hope that coming together as a collective studio improved the culture of second year, but this remains to be seen.

The overall student response to the project tended to be positive, but among the negative and critical student responses, several themes emerged. There was some resentment because not all students thought they were involved in the design process. Early in the project, students worked in teams of three to develop 5’x20’ concepts, five of which were selected by voting in studio sections. The voting process was prefaced by group discussions about the advantages and disadvantages of the different submissions. In the author’s section the chosen design was a hybrid of two group’s designs. Nevertheless, some students rejected the constraints of the precedent and felt that their authorship was thwarted by the authority of the instructors and the will of their peers. On one hand, this happens regularly in the profession. Not everyone’s ideas can be used; there is seldom a sense of single-authorship. However, on the other hand, the students’ responses cannot be dismissed as a lack of maturity. Indeed, they raise a valid and important question about the role of both the precedent and the composite design in the project. With these established constraints and the constraints of the studio itself (mostly, the need to stay on schedule), could the design-build studio effectively allow such a challenge? Are students only empowered if they agree with the group? If they feel rejected, where can they find motivation to contribute in other ways?

Another issue was the fairness of how student labor was distributed and applied throughout the project. The instructors coordinated regularly with the students through all-studio meetings and presentations, but it soon became clear that some kind of delegation would be necessary to handle immediate issues outside of class time. Student leaders were needed to do things such as correct documentation drawings, keep track of tools, schedule construction crews, etc. Two students, a male and a female, were made project “forepersons,” who would help coordinate between the various groups and the instructors. These students were recognized as responsible individuals and had leadership qualities which seemed to be appreciated by most of their peers. The other students were encouraged to volunteer for task groups and to select leaders within these groups. This was accomplished with the expectation that students would be able to choose activities where they felt an interest or proficiency, rather than by arbitrary assignment. If there were any significant imbalances, the instructors stepped in to correct them, but a large part of the students’ organization was voluntary.

Fig. 5 Group of students performing quality check. Photo by author.
What did these groups look like and how did they form? One early example is instructive. Before the build phase could begin, assembly of the 20’x25’ master model from the five proposals occurred digitally. The instructors created a version and distributed the file to the students. A group of students convened on their own and stayed up all night to make corrections to the model, which were later accepted by the instructors as improvements. This group, comprised of some of the most skilled digital modelers in the class, was almost entirely male and Caucasian. In similar ways, working groups tended to become led by non-international students who asserted themselves at specific tasks. This had the effect of making the diversity of nationalities in group leadership lower than it should have been, given that international students comprised nearly a third of the studio.

Gender representation among group leaders was nearly equal, however. (It is unclear whether this choice was conscious on the part of the students, or circumstance.) Within the smaller groups, students self-selected with a better mix of genders and nationalities, often with their friends. Very few of the students changed jobs during the project, which was unexpected. As the project moved forward, the instructors planned to have students rotate in and out of various jobs in order to experience the full measure of the build. However, once they understood their tasks, most students wanted to continue in the same role. All students contributed to the final assembly, particularly as documentation and fabrication tasks ended.

At this point, the issue of empowerment can be reintroduced. The second-year students were allowed to self-select their tasks and to self-appoint for leadership – in effect, to determine how they would work and (ideally) learn. The students could have been assigned to these positions by the instructors, to ensure an equal balance of gender, race, and nationality, in the hope that those students would learn and grow from the experience regardless of their initial comfort and interest. This is potentially more fair and equitable, but, would it affect their level of engagement if students were not allowed more choice? To be sure, the pedagogy does not need to be so binary as described, but the two sides of task assignment, as presented, raise the question of whether such choices about teamwork are made by instructors because they are better for the build or better for students’ education. As will be seen, these may not be mutually-supportive goals.

Design-build can be a valuable educational experience, but it may not be so for everyone. This is the main problem facing the faculty’s decision to make it a required part of the curriculum. Even at its best, design-build has aspects that can be boring, dangerous, and even exploitative to students. A student design project might fail, but with a public build (particularly one for a client) failure is, effectively, not an option. This can place enormous pressure on everyone involved, which can result in students working overtime while performing tasks that range from uncomfortable to sheer drudgery. It is fair to ask whether this is ethical – to say nothing of educational.

This fear of failure or “failure to fail” can result in problems within the social dynamic of the studio, when students or groups of students are perceived as undermining or failing to contribute to the build. This contributes to clique mentalities, bullying, and other forms of peer pressure, subtle and unsubtle. The instructors saw this happen many times during the course of the build and acted to intervene. One could argue that empowered learning is expected of design-build studios. Projects are complex and developments constantly occur outside of regular classroom hours. Students are in a position to solve problems and contribute new ideas on-site. Some degree of autonomy is useful and self-motivation is encouraged. Difficulties occur when this autonomy interacts poorly with the autonomy of other students and especially with those students who are thought (or think, themselves) to have authority – such as the group leaders. Indeed, this is where the majority of the conflicts occurred.

**Empowerment and Lessons Learned**

Reflecting on the observations and assessment information gathered in terms of the cognitive framework for empowerment provides some insight into the positive and negative outcomes of the TwoXTwo project. Why were some students empowered and others not?
The impact of the project was perhaps the most successful dimension, in terms of empowered learning. It did not take long for students to register the significance of producing a full-scale build in a prominent location within their College that would be experienced by their peers. Their precedent research included an analysis of public spaces on campus, which helped students to appreciate opportunities for intervention and the difference this would make in the space. This aspect of the build seemed to have importance for most students.

Meaningfulness

The project was clearly meaningful to a small group of students (about 25% of the class), who took on many of the leadership positions in the groups. These students worked the most extra hours and nights of anyone in the studio in order to solve problems and ensure that the build was completed on schedule. This group reported a sense of pride in their accomplishment and recognized a connection to the work and their professional studies. Further down the spectrum, most students (about 65%) appeared to feel no strong alignment or dis-alignment with the values or ideals of design and construction. They approached it as an obligation, like shift-work, putting forth an earnest effort as they felt required to do. The meaning of the project to them was primarily as schoolwork. This is not to say that the students did not enjoy themselves or learn, but their motivations were not as strong as the first group. A smaller group (10%) seemed to question the value of the enterprise, which they felt was a distraction to their focus on learning design. The piecemeal nature of some of the work disagreed with their expectation of independence. They were not as interested in construction and did not see opportunities for themselves as the process moved forward.

Competence

One of the most celebrated benefits of design-build projects is the opportunity for students to learn about documentation and construction in a “real” setting. All ARCH 202 students had training in CAD, but not in creating measured construction drawings. Although, their existing skills seemed to be sufficient enough for them to learn on the job and to work together as a diverse group. This contrasted with the competence dimension of empowerment for the fabrication and assembly groups. While all students were required to undergo wood shop and safety training prior to the build, many students appeared to be less comfortable with their construction skills. (This could also be due to the dangers of construction versus computer work.) Self-selection contributed to unequal group distributions, as a majority of female students elected not undertake a representative share of the fabrication and assembly tasks – in spite of instructor encouragement otherwise. Reflecting on the studio, more time should have been spent ensuring that all students felt competence and confidence in this area, so they might have chosen to participate in greater numbers.

Choice

The most critical dimension of empowered learning during the project was choice. In many ways, a lack of oversight led to some serious problems, particularly: the perpetuation of inequalities and missed opportunities to develop learning and leadership. Was allowing students to self-select their groups a mistake? The scale of the project and size of the studio appeared to require a decomposition of tasks and a need to delegate oversight of some processes. The organization of the students, who created their own procedures, assembly line, quality checks, etc. was impressive both to the instructors and to outside observers. Groups of students, unprompted, created their own documentary videos, presentations, and other publications to support the project.

The ambition of the students when given more freedom dramatically multiplied the learning outcomes of the studio beyond the expectations of the instructors. At the same time, this was not true for all of the students. The organization of the studio and that same freedom created conditions for unequal student participation, where some students were not able to contribute as they liked and felt left out of the build.

Conclusion

Is student empowered learning a useful framework for design-build pedagogy? For this post-mortem case study of TwoXTwo, the concept of empowerment provided some insights into why certain groups of students fully engaged and others did not. To
better understand the application of the framework, one could conduct other studies of design-build studios to determine the dimensions of impact, meaningfulness, competence, and choice and their influence on project and student outcomes.

A lingering question from this case study is the relationship between empowered individuals and empowered learning in groups. How can a required design-build studio for a large group accommodate students’ varying needs for motivation? And how can studios balance personal choice and equity when the stakes for builds are often so high?

Fig. 8 TwoXTwo opening. Photo by author.

Ultimately, is a required design-build project at this scope and scale a wise choice for beginning design students? Or are smaller projects with fewer students a better means of achieving empowered learning while learning about design and construction?

Empowered learning is an active area of educational and cognitive scholarship. This paper explored one particular model of empowerment, but motivation and learning are complex subjects and there is work to be done to develop a more critical interpretation of empowerment as it relates to beginning design. As of this writing, a new design-build project in ARCH 202 is in the final stages of planning. The author is in the process of applying ideas of student empowered learning to this latest iteration and expects to follow up with a future publication on any findings.

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Notes