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Work In Progress - Building Empathy without Community Partners

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Project-based learning is core to many first-year engineering, engineering design, and engineering capstone courses. Ideally, students in courses that use project-based learning work on real-world projects that are relevant to their communities with a sponsor or outside partner who helps to guide the work and assess deliverables. By working with a community partner or client, students practice incorporating outside perspectives and empathy into their designs. Realistically, a variety of constraints including time, location, class size, and workload prevent faculty from developing community partnerships/clients for all their student projects.

This paper will discuss ways to use tools like personas in combination with secondary research to mimic many of the benefits associated with community partnerships. We provide suggestions for partnerships with campus units, discuss the impact of these tools in one civil engineering course, and explore areas for future research. Examples of defining and exploring community partners in these courses will be presented.

Introduction

Project-based learning is core to many first-year engineering, engineering design, and engineering capstone courses and research has shown that students gain additional benefits when projects involve working directly with an external client or sponsor [1]. Student projects that include working with an external or sponsor have been shown to increase enthusiasm [2], [3], [4] for technical projects as well to improve student communication skills [5]. In addition, working with a third-party pushes students to think creatively and empathetically about meeting customer requirements – something that may be unfamiliar for students more used to applying their technical knowledge to well-defined problems [3], [6], [7].

Despite the recognized value of external project sponsors, instructors face various constraints when trying to implement these projects in their courses. Time is often highlighted as a barrier to implementation [4] with the work involved in identifying project sponsors, maintaining relationships, and managing instruction [8] described as “exhausting to faculty” [3] particularly those who teach large classes [9] or are already overburdened. Design tools, including personas, offer an alternative that aims to mimic some of the advantages of external clients while minimizing the faculty burden.

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What is a Persona in Engineering Design?

Personas are fictional, "hypothetical [user] archetypes" [10] that are constructed by synthesizing data about possible users to create a detailed composite. In addition to providing basic demographic information, personas also serve to bring data to life by providing narrative details around characteristics including history, values, motivations, likes, and dislikes [11]. Developing the detailed picture required for personas encourages creators to think in depth about the populations and stakeholders they're representing and can help to bring forward information that might otherwise be hidden [7].
While originally developed in the context of software engineering, the use of personas has been adopted by designers more broadly. Engineering educators, especially, but not exclusively those in computer science and computer engineering, have also begun to integrate personas into their courses as a means of building empathy and strengthening emotional design skills [12], [13], [14], [15], [16].

Professionally developed personas are heavily researched and draw on significant amounts of data pulled from a wide range of sources, but evidence suggests that even simplified personas can provide some of the same benefits as full sketches [12] while better integrating into the time constraints of the semester-long student capstone course. Regardless of length, the use of personas should ideally "give the information that is needed to overcome egocentrically biased knowledge in design" [14].

Reports of the use of personas in engineering education include both examples where students interact with personas developed by professionals or faculty [14] and those where students build their own personas [12], [13], [16] as part of an engineering design assignment. In both cases, personas were most successful when integrated throughout students' design processes by serving as a reference point that student returned to repeatedly when making design decisions [7], [16].

Persona use in engineering design education, whether developed by outside authors or students themselves, is still relatively understudied, particularly in Civil Engineering, but initial results from other engineering disciplines indicate that while personas might not, on their own, be adequate to foster empathy among IT students [14], persona use can bolster students' empathetic thinking [13] and as a result, deepen their understanding [17] and improve the quality of their overall designs.

Course and Assignment Description

The Civil Engineering capstone course is large-enrollment (70+ students) class scheduled for 3 credit hours over one and a half semesters and is required for all Civil Engineering undergraduates in their final year. When a new instructor took over the course in 2022, it became apparent that time constraints for both student participants and the faculty instructor prevented the adoption of in-depth projects with deep client involvement as a core element of the class. Instead, the course instructor would need to think creatively about how to integrate some of the

benefits of client projects – including empathetic design – into the course, given considerable constraints.
Conversations between the course instructor and engineering librarian lead to the development of a persona assignment in the Spring of 2023. The persona assignment has since been used twice across two academic years in the Civil Engineering capstone design course where the capstone experience focuses on the design and documentation of a complex construction project.

Students in Civil Engineering experience this design component by concurrently enrolling in the Capstone course and 1 of 4 technical design courses as shown in Figure 1. Students complete an open-ended, technical design in their elected design course allowing them to select a discipline within Civil Engineering on which to focus their capstone experience. In addition, it allows students to benefit from faculty technical expertise without those faculty having direct involvement in the capstone course. As a result of this structure (Figure 1), CVE 5001, a 1-credit Fall semester course, and CVE 5002, a 2-credit Spring semester course can focus on the non-technical components of engineering design including empathy and emotional design skills.

The concept of a stakeholder is first introduced in CVE 5001 with a stakeholder identification activity that draws upon templates developed by Hylton and France [18]. Students are placed into teams that reflect a range of Civil Engineering disciplinary course experience and together use the stakeholder identification assignment to begin describing stakeholders and their wants, needs and pains. Student teams then focus on one or two of their identified stakeholders in CVE 5002. They augment their original stakeholder profiles with additional research to create more detailed personas. Teams then propose a design for a Value and Impact Change (VIC). In this VIC, students create preliminary design changes for a project that was the focus of their 4 technical design courses. Whatever design change is proposed in the VIC must add value and impact to the identified stakeholder from their persona assignment.

The persona assignment requires each student team to focus on one or two identified stakeholders. Students then locate both primary and secondary sources of data that describe their stakeholder. To support students' research, a librarian joins the class to discuss finding and using appropriate data and resources. Students must find or collect data, perform some type of analysis of that data, and draw a conclusion – much as they would when following a standard scientific process. Through conducting research, analysis, and developing detailed personas, students develop empathy for stakeholders.

After developing a more nuanced understanding of their stakeholder, student teams work to define value in the context of their civil engineering design. Next the teams present the results of their stakeholder assessments in a VIC pitch presentation that describes the design stakeholders, the analysis the teams conducted, and how the VIC will create maximum impact for the project's stakeholder(s).

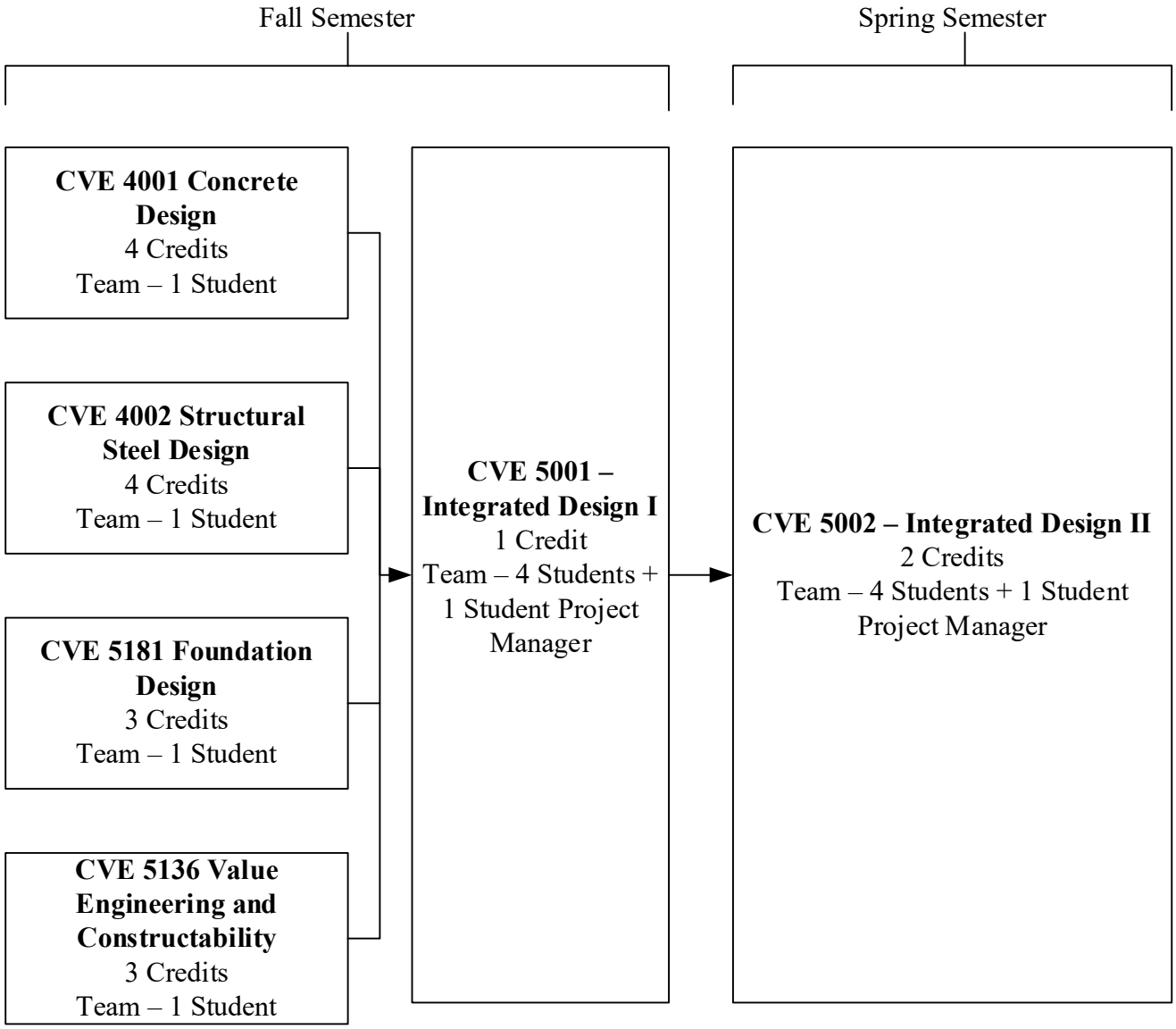

Figure 1 – Capstone Design Course Sequence

Preliminary Assignment Feedback & Reflections

During the two years where the persona and VIC assignments have been integrated into the Civil Engineering capstone course, the students conducted their design work in the context of two different construction projects, both of which were completed, or nearly completed, prior to the academic year in which they were assigned. In the first year, the shared Civil Engineering design project was a multi-use, combined academic and industry research building on an urban university campus. During the second year, the Civil Engineering design project was a new academic building on an urban campus where the class was held. Using projects with completed design components helped to overcome time and resource limitations and allow for successful integration in a large enrollment course with limited instructor resources.

During the first academic year when students worked on the multi-use building, the instructor felt they generally had difficulty completing data analysis and detailed stakeholder profiles. In addition, students found data analysis challenging even when the data was provided with faculty or librarian support. For example, students identified residents of the community surrounding the proposed location for the multi-use building as important stakeholders, but they struggled to provide adequate data or analysis to fully describe the residents' demographics, cultural characteristics, or daily lives and goals. While the hope was that the stakeholder analysis and persona assignments would allow students to build empathy into their designs, the initial implementation fell short of these goals for many of the student groups.

After the challenges of the first year, changes were made to the stakeholder assignments to provide additional scaffolding. One notable change in the second iteration of the course was how students presented their stakeholder analysis. In the first year, students were assigned stakeholder 'canvases' from Hylton and France [18]. While these predesigned canvases provided students with helpful guidance, the overall feedback was that they restricted creative thought too much. In the second year, students were provided the predesigned canvases to use as a guide, but they were required to create their own unique canvases. This allowed students to be more creative instead of trying to fit their research into an existing format.

While changes to the stakeholder assignments lead to improvements in the second year, the difference between the first- and second-year construction projects seem to have made the biggest impact on overall student success. In the second year, the project was the newly constructed academic building where the course was held. Almost all of the student teams selected 'students' as a primary stakeholder. At first this troubled the authors as a goal was for students to build empathy for stakeholders unlike themselves in their engineering designs. Since the student designers were also stakeholders for this project, it was unclear how they would approach the stakeholder assignments. Happily, students appear to have collected and analyzed more quality data compared to the first academic year. More than half of student teams created and implemented surveys and collected primary data in the second year as compared to no student teams surveying residents in the first year. It seems likely that students felt a greater level of comfort reaching out to stakeholders in similar circumstances and in a location they know well. That said, data gathering was not limited to students. Teams also collected data from staff and faculty indicating that they overcame some dissimilarities in position and developed empathy for those in different roles. In the end, while allowing students to study 'students' as a stakeholder initially seemed counterproductive to our goal of their developing empathy for people unlike themselves, it resulted in increased efforts to better understand the other identified stakeholders.

Future Work & Implications

The first two years of this course demonstrate the value of integrating personas into Civil Engineering capstone design projects as well as the benefits of librarian-instructor collaboration around research-based assignments like persona development. While students seemed to respond

positively to the persona development assignment, additional research is needed to better understand how this work impacts the way they approach their designs as well as the quality of the final projects.

The authors plan to create rubrics around stakeholder and persona development for future iterations of the course. These rubrics will be used to better assess how students incorporate empathy into their engineering designs and the quality of the information sources that students integrated into their personas and other stakeholder activities. In addition, future course delivery will also include a greater emphasis on the VIC as opposed to the technical design component which will be completed solely in the technical design course. Finally, the authors look forward to continuing to participate in the research around stakeholder empathy development in Civil Engineering design.

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