DESIGN THINKING AND COLLEGE READINESS
CAN DESIGN PROCESS HELP PREPARE FIRST-GENERATION STUDENTS FOR COLLEGE?

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1. INTRODUCTION

Poster printed by College Prep Program participant.

A critical priority for higher education today is increasing college readiness for low-income, first-generation, and underrepresented minority high school students. College readiness is defined as a student's preparedness to enroll and succeed at a post-secondary level. Academically, this translates to the ability to complete entry level course work and be proficient enough to consider moving to the next level of course work in a designated subject area (Conley, 2007). It includes components such as understanding the norms of academic culture, the ability to integrate learning from multiple disciplines, and the interpersonal skills that enable collaboration. First-generation students face particular challenges in accessing and succeeding at selective higher education institutions. These challenges can include lower educational expectations from teachers, lack of familiarity with the college admissions process, and difficulty transitioning from high school to college (Engle, Bermeo, & O'Brien, 2006). Research into college readiness and access shows that interventions that influence both academic and social skills can impact the success of first-generation students (Conley, 2007; McKay & Estrella, 2008; Engle, Bermeo, & O'Brien, 2006).

In 2014, Washington University in St. Louis launched a Science, Technology, Engineering, and Math (STEM)-focused program known as the College Prep Program (CPP) for high-achieving, first-generation high school students to improve college readiness. The program introduced a design thinking course,

Design Thinking: An Approach to Problem Solving, to engage students on real-world problems through human-centered research, synthesis, making, visualization, and collaboration. Focused on a challenge particularly relevant to students entering college, the course has four distinct goals: 1) Teach students processes of making and visualization; 2) Provide students a critical problem-solving process specific to addressing human-centered challenges; 3) Build skills in collaboration; and 4) Help students become better at communicating. This paper will explore how the introduction of design thinking into CPP supports the college readiness needs of first-generation students. It seeks to lay the foundation for what will be a multi-year exploration of the relevance of design thinking and core principals of design process to college readiness and success for first-generation students.

2. BACKGROUND

2.1 COLLEGE READINESS FOR FIRST-GENERATION STUDENTS

First-generation college students have unique needs when it comes to preparing for academic and social success in college. In a study conducted by the Pell Institute for the Study of Opportunity in Higher Education, first-generation students identified college transition priorities, including higher aspirations for college, the ability to navigate the college admissions process, and help with the initial transition from high school to college (Engle, Bermeo, & O'Brien, 2006). Academic and social integration are significant factors for retention of first generation of students. Specifically, first-generation students are likely to be more successful if they can connect their classroom academics to the real world. Additionally, the formal and informal relationships with faculty, staff, and peers that students have within the educational environment are key to first-generation student's "persistence and success in college" (McKay & Estrella, 2008). These relationships are crucial to academic and social integration in the college environment.

2.2 SOCIAL-EMOTIONAL LEARNING INTEGRATED WITH ACADEMIC LEARNING

Academic and social-emotional learning are also key to integration into the college environment. "Social and emotional learning (SEL) is the process through which children and adults acquire and effectively apply the knowledge, attitudes, and skills necessary to understand and manage emotions, set and achieve positive goals, feel and show empathy for others, establish and maintain positive relationships, and make responsible decisions" (CASEL, 2015). There are five cognitive, affective, and behavioral competencies that are at the foundation of SEL. These are self-awareness, self-management, social awareness, relationship skills, and responsible decision making. A meta-analysis of 231 studies of SEL in schools demonstrated that students receiving quality SEL educations had better academic performance, improved attitudes and behaviors, fewer negative behaviors, and reduced emotion distress (CASEL, 2015).

Success in college is enhanced for students who possess interpersonal and social skills that enable them to interact with a diverse cross-section of academics and peers (Conley, 2007). In addition, faculty and staff at research universities who work with undergraduate students identified critical habits of mind for advanced studies: "critical thinking, analytical thinking, and problem solving; an inquisitive nature and interest in taking advantage of what a research university has to offer; the willingness to accept critical

feedback and to adjust based on such feedback; openness to possible failures from time to time; and the ability and desire to cope with frustrating and ambiguous learning tasks" (Conley, 2003). As discussed in section 2.4 below, these habits of mind can be developed through learning and practicing the design thinking process.

2.3 INTEGRAL COMPONENTS OF STEM LEARNING

STEM education has become a cornerstone of education, K-16. Many STEM academic organizations[1] have agreed that problem-solving, cooperative learning, and subject integration are integral components of the STEM learning process (Mahoney, 2010). These components are core to the design thinking process (as described below). For example, design thinking emphasizes subject integration as research and prototyping tools, thus allowing multidisciplinary, interdisciplinary, and transdisciplinary approaches to learning in one lesson (Drake & Burns, 2004).

2.4 DEFINING DESIGN THINKING

Design thinking is a term, widely used in business and education today, that describes a process to solve problems of any scale. For example, problems might include improving global water purification, increasing the efficiency of a dental office by redesigning its waiting room, or designing a video game curriculum for an afterschool program. Design thinking begins by actively observing people and understanding their current and anticipated needs. Once a particular challenge is defined and primary and secondary research is synthesized, additional steps include "prototyping, designing, and refinement" (Brown, 2008); this cycle of steps is iterative, as prototypes move toward more ideal solutions. Design thinking work benefits from people from multiple disciplines working together.

The fundamentals of design thinking include understanding and empathizing with a primary user, utilizing abductive reasoning, cooperatively working with a variety of disciplines, and completing a series of iterative loops of prototyping. In more detail, these steps are:
- **Understanding and empathizing with a primary user** is achieved through a variety of methodologies, including immersion, interview, observation, and co-creation.
- **Abductive reasoning** is a logical way of considering inference or "best guess" leaps, which create something ultimately new out of the known information (Kolko, 2011).
- **Cooperatively working with multiple disciplines** creates an integrative experience of understanding, communication, and action (Buchanan, 1992).
- **Iterative cycles,** including prototyping and increasingly higher fidelity research and design development inform a final product.

In a review of recent literature on design thinking (Razzouk & Shute, 2012), a framework of competencies for design thinking is proposed, highlighting some of the same habits of mind and competencies identified for student success in college. While there are no clear performance-based assessments for design thinking skills specifically, there is an opportunity to identify how design thinking education may contribute to the competencies necessary for student success.

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[1] including but not limited to the National Council of Teachers of Mathematics (NCTM), the American Association for the Advancement of Science (AAAS), the National Science Foundation (NSF), the National Research Council (NRC), and the International Technology Education Association (ITEA).

3. INTEGRATING DESIGN THINKING INTO A COLLEGE READINESS PROGRAM

Design Thinking faculty reviewing prototypes with students prior to final presentation.

3.1 COLLEGE PREP PROGRAM OVERVIEW

The *Design Thinking* course, part of the second of the three years of CPP, is specifically designed to address the challenges outlined above for first-generation students. CPP participants spend several weeks on campus for multiple summers, participating in programming that emphasizes STEM, reading and literacy, and leadership.

This program is designed to support talented high school students from the region in succeeding at the college of their choice. Participants live on campus for two weeks during the summer after their freshman year of high school, and three weeks during the summers after their sophomore and junior years. The program design is based on research about the needs of first-generation students, as discussed above. Participants in CPP take classes for college credit, draft a college essay, and learn about the college application process. They get first-hand experience living on campus, taking classes, and building faculty relationships that will help prepare them for their future.

3.2 DESIGN THINKING COURSE OVERVIEW

During their second summer in the program, CPP students are enrolled in the 1-credit course *Design Thinking: An approach to problem solving*, which seeks to achieve four distinct goals, as discussed above: 1) Teach students processes of making and visualization; 2) Provide students a critical problem-solving process specific to addressing human-centered challenges; 3) Build skills in collaboration; and 4) Help students become better at communicating.

The course is designed to engage small teams of 4-5 students in a real challenge on-campus, working closely with a college-age teaching assistant. Through a combination of lectures, activities, readings, and coaching from teaching assistants, teams are guided through each phase of the human-centered design process, providing them exposure to research, synthesis, concept generation, prototyping, user testing and evaluation.

3.3 EXPERIENTIAL PROJECT

The subject for each experiential project is selected according to three factors: the program's ability to provide the CPP students direct access to their audience in order to conduct user-centered research, a deep connection between the subject and life on campus, and the relevance for the subject to generate artifact-based solutions. In 2015, the topic was "College Students and Eating", and the 2016 topic is "Recycling on Campus." The project requires a set of direct users, as opposed to experts or those who deliver services, for the students' primary research. The topic should reinforce the mission of CPP by exposing students to a new depth about some aspect of life in college. Finally, the solutions should lean towards tangible (products) solutions, as opposed to services and systems, as this forces students to physically manifest their ideas.

3.4 COURSE STRUCTURE

In week 1 of the course, students are introduced to the concept of design thinking: a problem solving method grounded in empathy that encourages non-linear creativity. They quickly start primary research, using observation, interview, and immersion in context with users. Each research methodology is isolated so students understand the particular application of these methods. They are additionally assigned secondary research as homework, bringing in news articles and statistics that relate to the project topic.

Before processing any of their data points, students are exposed to the fundamentals of visualization through a two-hour workshop, where they use digital and non-digital tools to practice mapping, flowcharting, and drawing structures. It is important to note that these preliminary skills are intended to give them a baseline to visualize their own ideas, communicate to team members, and process what they are learning from research. They may prove valuable later in the process when they prototype solutions, but the role of visualization in discovering the problem and brainstorming cannot be overstated. Visualization skills are essential to the synthesis process, in which students learn affinity mapping, and work with their team to organize their findings, organically identifying significant insights that lead to design inspiration. They also develop personas based on their user research. By the end of week 1, they have identified key insights and opportunities for design.

In week 2, solutions begin to take shape. Teams mold their insights into How Might We (HMW) questions, highly structured prompts that identify the user, context, and opportunity to be addressed. These HMW questions are used for brainstorming, which reinforces collaboration and non-linear thinking. By encouraging wild ideas, students push their concepts to the limit. The teams then select 3-4 concepts to prototype using low-fidelity tools: paper, pipe cleaner, foam core, buttons, and more. Students are visited by users who give feedback on the prototypes, which students interpret and apply to at least one iteration of their concept before a final presentation.

Week 3 is dedicated to crafting a story and making a case for the developed concept. A guest lecturer, an expert in persuasive presentations and advertising, presents compelling ways to tell the story of a product and a process. Teams collaborate to finalize their prototypes and develop robust stories. They are also exposed to other facets of making and fabrication, including using the letterpress to print their own signs, and touring studios and fabrication labs for both art and architecture. The program concludes with polished final presentations to guest critics and parents.

4. OUTCOMES

The first cohort completed *Design Thinking* in June 2015. They reported that it was among their favorite experiences of the College Prep Program. Through a weekly process of self-evaluation, students reported on their own use of visualization, collaboration, presentation, problem solving, observation, making, and concept generation. Students consistently demonstrated high levels of participation.

Beyond self-evaluation, the work product demonstrated a high level of creativity and commitment. Sample ideas developed from prototypes included drones for food delivery, underground tunnel systems, and snack delivery on Segways. Many teams successfully self-organized, delegating tasks into smaller pairs in an effort to utilize the strengths and interests of their peers. For example, over the weekend prior to the final presentations, one team sent two members home to work on the presentation, while two others worked on refined prototypes.

Project deliverables required students to integrate different disciplinary ideas, merging highly technical skills with social and emotional skills. Students negotiated balancing relationships with their peers with their own goals. One of the mantras for prototyping was "strong ideas, loosely held." Students were encouraged to advocate for their ideas, and to listen openly to feedback from both teammates and users. This required a high level of self-awareness and self-management. Students reminded each other to take a step back to respond to the needs of the user at the core.

4.1 STEM COMPLEMENT

The course is structured to complement STEM workshops and college readiness experiences that the students also take on during the three-week program. As an example, readings provided throughout the program were selected for linguistic difficulty and variety, and serve as a complement to reading and writing comprehension workshops. Additionally, training around brainstorming as a tool is organized so that in the third week of the program when the students prototype in an engineering lab, they use the same creative, collaborative process to solve a highly technical problem. In their third summer of the program students will use design thinking to design and implement a mini-makerspace, allowing them to further explore three-dimensional, hands-on prototyping.

5. CONCLUSION AND FUTURE ITERATION
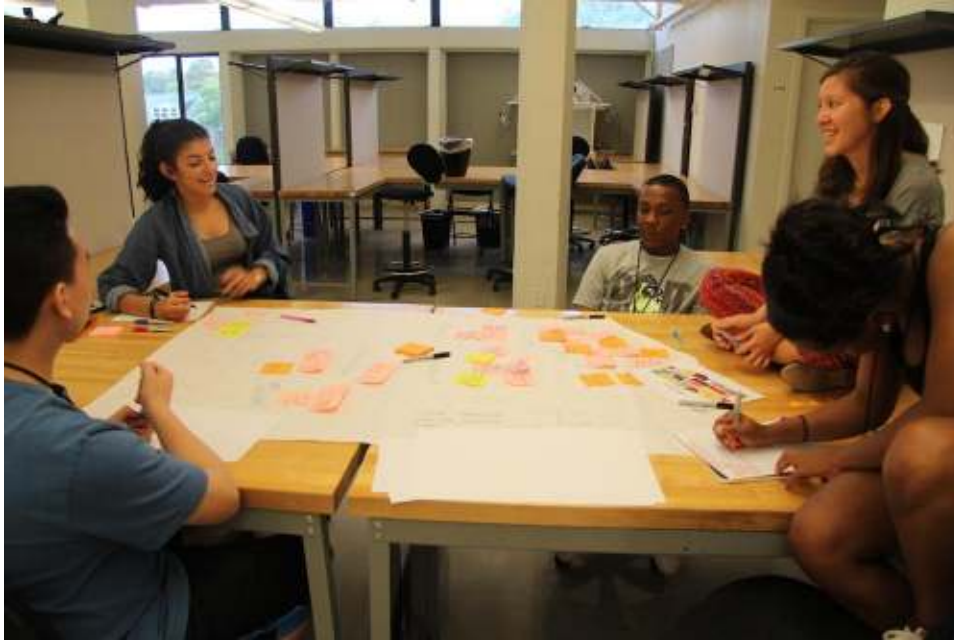
College Prep Program participants working with a teaching assistant on synthesis.

We believe that design thinking can have a transformative effect on first-generation college students' college readiness in the context of CPP. This is a long-term proposition, and we are at the early stages of developing and implementing methods to study this possibility. We are specifically interested in how the course 1) Teaches students processes of making; 2) Provides students a critical problem-solving process specific to addressing human-centered challenges; 3) Builds skills in collaboration; and 4) Helps students become better at communicating. Furthermore, we hope to investigate how the attainment of these four goals helps students to become more ready to enter college. We will study this through both qualitative and quantitative measures, including student evaluations, program leader evaluations of student accomplishment, and program-level data about student preparedness.

In the second year of *Design Thinking*, scheduled for summer 2016, we will conduct further iteration on the structure and content of the course. Each team will be assigned a single, dedicated teaching assistant for the duration of the course (in 2015, teaching assistants split their time between two teams). Not only will this provide students more directed instruction about the design thinking process and coaching about making physical prototypes, but it will increase mentorship and coaching time, in order to improve social and emotional learning.

A next step has been to develop metrics to evaluate success at the intersection of academic and social-emotional learning for first-generation students. This year, the program will introduce individual pre- and post-knowledge reflections to be completed by each student and evaluations of individual student progress to be conducted by teaching assistants each week. These evaluations will make more precise what students are learning. Over time, we hope to also evaluate how that learning impacts their performance in other disciplinary areas in STEM. If we can understand more precisely how making, human-centered problem-solving, and collaboration can impact learning across disciplines and improve college readiness, we will be able to recommend an appropriate role for design thinking curricula across a wide range of high school and college preparatory applications.

REFERENCES

Brown, Tim (2008) *Design Thinking.* Harvard Business Review: p84-92: Print.

Buchanan, Richard. (1992). Wicked problems in design thinking. Design Issues, 8, 5-21.

Collaborative for Academic, Social, and Emotional Learning (2015). CASEL guide: Effective Social and Emotional Learning Programs: Middle and High School Edition. Chicago, IL: Author.

Conley, David T., (2003) "Understanding University Success: A report from Standards for Success A project of the Association of American Universities and The Pew Charitable Trusts" Eugene, OR: Educational Policy Improvement Center.

Conley, David T., (2007) "Redefining College Readiness" Eugene, OR: Center for Educational Policy Research.

"Deep Dive: IDEO's Shopping Cart" (2009) episode on *ABC's Nightline*: www.youtube.com/watch?v=M66ZU2PCIcM.'

Drake, Susan & Burns, Rebecca (2004) "Meeting Standards Through Integrated Curriculum" Association for Supervision and Curriculum Development.

Engle, Jennifer, Bermeo, Aldolfo, & O'Brien, Colleen (2006) "Straight from the Source: What Works for First-Generation College Students" The Pell Institute for the Study of Opportunity in Higher Education.

Kolko, J. (2011) "Exposing the Magic of Design." Oxford University Press. Print.

Lundell, D. B., Higbee, J. L., Hipp, S., & Copeland, R. E. (2004). Building bridges for access and success from high school to college: Proceedings of the metropolitan higher education consortium's developmental education initiative. Minneapolis, MN: Center for Research on Developmental Education and Urban Literacy, University of Minnesota.

Mahoney, M. P. (2010). Students' Attitudes toward STEM: Development of an Instrument for High School STEM-Based Programs. Journal Of Technology Studies, 36(1), 24-34.

Mangan, Katherine. "The Challenge of the First-Generation Student." The Chronicle of Higher Education. 18 May 2015. Web. 18 Mar. 2016.

McKay, Valerie & Estrella, Jeremy (2008) "First-Generation Student Success: The Role of Faculty Interaction in Service Learning Courses" Communication Education Vol. 57, No. 3: pp. 356-372.

Razzouk, Rim & Shute, Valerie (2012) "What Is Design Thinking and Why Is It Important?" Review of Educational Research. Vol. 82, No. 3, pp. 330–348.