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STUDENTS AS RESEARCHERS, COLLABORATORS, & END-USERS: INFORMING CAMPUS DESIGN

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Students in undergraduate design programs often lack opportunity to conduct original research and apply their findings to project solutions. Consequently, they struggle with identifying and framing a design problem, understanding the importance of research-based design, and how to appropriately apply research findings to the needs and desires of project stakeholders. In interior design, this unawareness can lead to design solutions that appeal to the eye, but lack defensible rationale and often do not solve the design problem, or meet user needs. Exposure to research methods and collaborations with practitioners may change how students approach design problems by fostering an empathetic understanding of the human experience.

This design case describes a project design at two universities where 72 sophomore and junior students collaborated with furniture manufacturer Herman Miller, Inc. to generate original research before applying their findings to the redesign of informal learning spaces in their campus libraries. Constructivist Learning and Backward Instructional Design, guided the design of the project. The result of this engagement, exposed students to research methods and research integration strategies, who outwardly demonstrated more confidence in making decisions during the design process. While the long-term implications from this type of engagement are not yet evident, encouraging students to ground their design ideas on evidence they have gathered, and their analysis of it, may not only shape their future decision making, but potentially lead to more appropriate client solutions and provide students with coveted job opportunities in positions where evidence-based design is highly valued.

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INTRODUCTION

Our students are preparing for future careers that will present many challenges and opportunities. The way they approach tomorrow's problems often hinge on the education they receive today. In this *brave new world,* these young professionals will certainly need to call upon their creative and critical thinking skills in equal measures. Consequently, as educators, we strive to assist our students in becoming keen observers of the human condition, responsive to the needs of others, and ultimately able to recognize the power of their decisions in influencing others' lives. Yet, design students' projects come to fruition on paper or the digital realm, in a somewhat altered reality, and they very rarely have the chance to design spaces that are actually constructed. Subsequently, they lack opportunity to see the long-term impact of their design decisions. Therefore, students often struggle with how to best frame a problem, understand its nuances, and may even misinterpret the needs and desires of their end users. This leads to design solutions that may appeal to the eye, but lack appropriateness for the occupants of the space. We felt that exposure to first-hand evidence-based design (EBD) practices and collaborations with practitioners engaged in design research may change how our students approach design problems by fostering an empathetic understanding of the human experience. With this goal in mind, we set out to create a student experience that would immerse students within an existing setting so that they could experience firsthand how that design influenced the users of the space. In this case, students observed and documented user behaviors, collected multiple viewpoints via personal interviews, and analyzed the strengths

and weaknesses of the design through the lens of multiple user types. Collectively, this evidence was aimed to influence their design approach and inform their design decision-making process.

This Design Case describes identical project assignments at two universities where a collective 72 undergraduate students collaborated with furniture manufacturer Herman Miller, Inc. to generate their own original research, then apply these findings to their design solutions for their campus library. We organized the project into two-phases, with our students first utilizing research techniques of behavioral mapping, personal interviews, and photo ethnography then presenting their research findings. The second phase comprised of their design process work, ending with design presentations to industry and campus partners.

PURPOSE

Many students are initially drawn to design professions to pursue their own creative expression. Consequently, their early design projects may serve to please their own preferences more than respond to the actual needs of the user. This is understandable given their lack of experience in assessing design problems. As educators who also practice design, our experience tells us that we must be aware of the nuances surrounding a design project, or risk providing beautiful solutions to misdiagnosed problems. As a simple example, a school's principal may request design services for a custom built-in cabinet to store classroom equipment. However, when visiting the site, the designer may observe the classroom teacher frequently engaging students in lively activities, prompting them to actively move about the room. With this foreknowledge, the designer may determine that the *real* need is for portable storage solutions. Acting on this observation may not only save the school money, but provide a more responsive environment for students and teachers alike.

The benefits of such informed designs are increasingly noted in popular press and scholarly articles (Irish, 2013; Kaup, Kim, & Dudek, 2013). Yet, following his examination of current architectural and design pedagogies, Salama (2015) characterized these methods as "high advocacy and low inquiry," going on to state that current paradigms typically promote "deductive compartmentalized learning," placing little emphasis on "developing or examining current theories" (p. 315). However, he also identified an emerging trend of "restructuring and reprioritizing" design knowledge components (p. 319). He suggested that such efforts would encourage the development of curricula that more fully integrates research and design. Moreover, recent discourse within interior design education also highlights the necessity for students to develop a "comprehensive understanding of the human experience" (CIDA, 2014, p. 6). In fact, in 2014, the Council for Interior Design Accreditation (CIDA; the accrediting body for North American interior design programs) called designers to: a) hone their problem identification skills, b) employ findings from other disciplines to understand human needs, c) guide their decisions with research methods and findings, and d) communicate complex data and research results verbally and visually. In our roles as educators, we engage in a "design process" of our own as we initiate a journey that invites students to build new design-related knowledge and skills during the education process. To hone their design skills, our students need to understand the importance of thoughtful analysis prior to commencing problem or issue-based design work. We developed this project to foster student interaction with industry researchers, as well as task students with generating and applying research findings to a specific design problem. We feel these skills are critical as decisions made during the design process impact occupants of a space long after the design phase is complete. Collectively, we saw this assignment and the invitation to conduct original research, as a way to reinforce the importance of critical analysis, its significance to the design process, and its potential impact on future occupants of the space.

Situational Context

While healthcare professionals and business leaders have long leveraged empirical information for decision-making, the role of research in interior design stems from a different premise. This is due to a variety of factors including: the nature of design to include intuitive reasoning alongside rational when making decisions, the sometimes subjective nature of how one evaluates a design, and that there are relatively few opportunities to test a design's effectiveness with measurable metrics. Yet, design research has evolved, such that it is now viewed as essential to the design process (Martin & Guerin, 2010).

Today, design firms and furniture manufacturers are seeing value in informed design practices, resulting in more effective design solutions. Firms leveraging research-related practices are often considered leaders in the industry, providing added credibility, justifying increased fees, in turn potentially improving their bottom line. Seeking these benefits, design firms are expanding their services from project programming (determining client needs and desires) to a broader scope of pre-design services which range from strategic analysis, consulting, growth forecasting, and/or change management. Clients are also becoming savvy as to the benefit of informed design decision-making. Often, they seek reasoning behind the designer's key decisions and expect to understand the impact of design in terms of a return on their investment through measurable metrics (Martin, 2009). In this business environment, knowledge is key, and project-specific knowledge reigns supreme. As such, the exposure to research processes influences academic research, practice, and education (See Figure 1), and we feel that emerging designers need to be educated about the benefits of generating

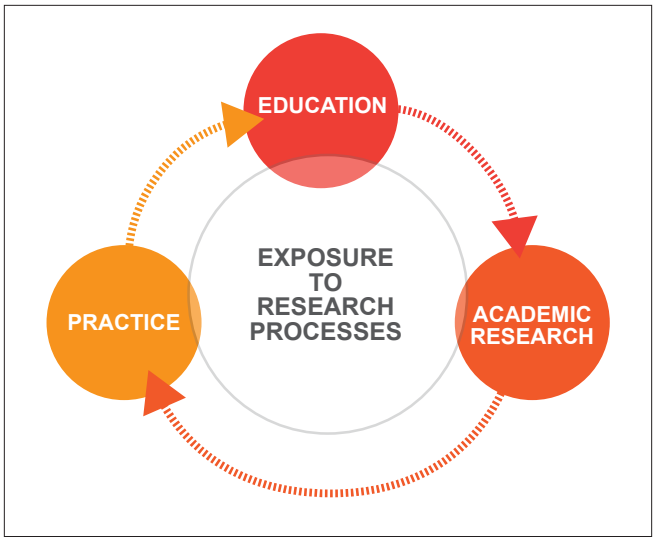

FIGURE 1. The role of research.

project specific knowledge, how research is used in practice, and when to apply findings to their own projects.

Most interior design educators actively seek opportunities for students to collaborate with practitioners and to work within real-world design scenarios. Yet, an interior design curriculum is rigorous and often interpreted as regimented since foundational knowledge is necessary prior to design application and projects grow in complexity as students move through their coursework. During their studies, design students learn a wide range of topics including: building codes, construction techniques, lighting design, communication practices, and material specification. Central to their education is the design studio; of which it has been said to be distinctly suited for problem-solving (Maturana, 2014, p. 32). In these courses, students are required to apply their knowledge to hypothetical design solutions (Ankerson & Pable, 2008), thus they are provided the opportunity to generate new solutions to existing problems. Of all their courses, anecdotal evidence suggests design students are most excited—and nervous--about their studio classes. Yet, they arrive the first day of class without an understanding of the design process or the value of research as a part of the schematic design phase. Within this paradigm it is common for students to try to shortchange or even bypass analytic processes and dive right to the aesthetic components or final design solutions without appropriate exploration. After all, these components often align with their notions of what interior designers do based on popular television shows, and the creativity involved in these tasks are at the forefront of their minds. Therefore, we feel that it is critical that design educators encourage design research early in space planning studios.

Research findings support our premise. When querying student perceptions concerning research, Dickinson, Marsden, and Read (2007) determined that students generally valued design research (and the required analysis), yet were unclear as to who conducts it and the tasks involved to produce it. An examination of design studio pedagogical strategies indicates that students are typically exposed to a very limited range of research-oriented tasks. Generally, in the sophomore year, design students are given a program—a list of client needs (i.e. necessary spaces) and are encouraged to gather information about precedent design projects, and/or seminal research. As students advance through their coursework into the senior year, they may perform a more rigorous precedent study and review of literature, and may have more flexibility in determining programmatic elements (Maturana, 2014). However, in both scenarios students are still using research findings others have published, and are not given the opportunity to generate new knowledge and apply it to their own design projects.

LITERATURE

Industry Engagement in Interior Design

When planning a different studio learning journey, we placed a great deal of emphasis on the need for original research and the research process, with the goal of providing an opportunity for students to see firsthand the benefits of utilizing research during their design process. However, experience suggests that students often place less value on the words of their instructors and more on respected industry practitioners. These industry voices often provide credibility to an educator's message. Hence our collaboration with a well-known, research-based industry partner: Herman Miller, Inc.

We are not the first design educators hoping to capitalize on practice-based collaborations. There are several noteworthy examples where interior design students have collaborated with contract furniture manufacturers (Steelcase Educational Solutions, 2014; Ankerson, n.d.). Yet, these differ from our scenario. First, we were working with relatively inexperienced students, who were early in their studio sequence. While several furniture manufacturers have collaborated with students in various capacities, these are often conducted with senior level or graduate students. Moreover, these engagements do not typically involve students in data collection and analysis. Typical collaborations have focused on idea generation, where practitioners would critique student design solutions. In contrast, our industry collaborators were very interested in the research findings of the students; desiring the young design student perspective. Herman Miller wanted to gain information on how students were using spaces as well as improvising and modifying their informal work areas. They also desired feedback on students' ideal work environments. Their goal was to transfer those findings to better designs for learning environments as well as future workplace design. The rationale was that today's millennial students will

soon be in the workplace of tomorrow, so gaining a better understanding of their preferences was key.

There are some generally accepted benefits to student-industry engagements including: networking opportunities for students, exposure to workplace practices, and increased accountability. Yet, we knew great care needed to be taken during collaborations as these can generate additional pressure on students and create confusion or potential miscommunication (especially if the students perceive there may be a design position or coveted reward offered at the conclusion of the project). Additionally, all parties need to be educated as to the expectations for each (Huber & Pable, 2015). For example, a task that may take a practitioner one hour to complete may take a student several days, simply because they are still learning the process. Therefore, the project parameters needed to be reasonable within a given timeline. Despite these potential issues, we determined that with proper management, the benefits of this opportunity would outweigh any potential negative consequences.

Literature from educational psychology served to both support our goals and inform our project's design. First, we felt that principles of Constructivist Learning (Piaget, 1977; von Glaserfield, 1988) would help us to create the culture of learning and exploration that we were seeking. While Backward Design's emphasis on learning goals (Wiggins & McTighe, 2005), would help us to maintain our focus on our objectives as we navigated the sometimes unpredictable constraints of a real-world project, and finally given that our aim was creating nimble, life-long learners, who are fluent in addressing the needs of others, we felt that the categories of Significant Learning (Fink, 2003), would help us to fully capitalize on the industry partnership on behalf of our students.

Constructivist Learning

While constructivist learning principles are hardly new to interior design education, active implementation of these strategies can often be an afterthought. Constructivists posit that knowledge is a product of interactions and experiences (von Glaserfield, 1988). In that context, learning is a search for meaning, and knowledge is constructed by the learners.

Following this paradigm, our goal was to provide opportunities for students to analyze facts and come to their own understanding (Baumgartner, 2001).

Lebow (1995) outlined key constructivist values, several of which came to the forefront in this project design:

- **ACTIVE ENGAGEMENT OF LEARNERS,**
  It would be important to actively engage our learners during both research and design phases.
- **FOSTERING COLLABORATION AND A COMMUNITY OF LEARNERS** (Brown, Collins, & Duguid, 1989),
  Our students would conduct research and generate design solutions in teams.
- **PLURALISM AND THE BELIEF THAT NO SINGLE VIEW IS "RIGHT,"**
  In this scenario, our students would potentially need to navigate findings that conflict with their existing ideas and beliefs.
- **ACKNOWLEDGING MULTIPLE PERSPECTIVES,**
  Our students would have the opportunity to hear from multiple stakeholders and would need to determine how best to evaluate their opinions.

While these principles were useful in laying the ground work for the project's design, we followed the Backward Design process for the actual design itself.

Backward Design

Wiggins & McTighe (2005) coined the term *Backward Design* (p.13) to describe a process that inverts conventional instructional design. During this process, instructional designers first determine situational factors and desired learning outcomes, then decide which assessment and learning activities would most likely produce the desired outcomes (see Figure 2).

Our situation factors are summarized in Table 1. Going into the design we knew that our respective classrooms offered both similarities and differences. While there was a similar number of learners at each institution, and both cohorts were early in their studio course sequence; they differed in that University A students had one previous semester long studio course. Additionally, while both projects focused on informal learning spaces, University A focused on one large space, whereas University B students focused on multiple, spaces, both large and small. The differences in project locations stemmed from the available opportunities, but apart

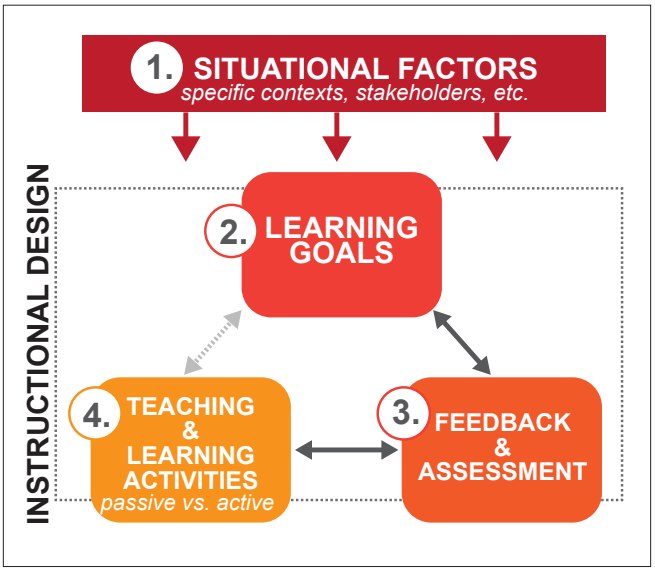

FIGURE 2. Backward Design Process.

CHARACTERISTICS	UNIVERSITY A FALL 2014	UNIVERSITY B SPRING 2015
LEARNER		
Number of learners	38	34
Level	Junior 2nd of five studios	Sophomore 1st of four studios
Frequency of meeting	2.5 hours, 2 times a week	3 hours, 2 times a week
SUBJECT		
Scope of work	1st floor (group study area) (Approx. 16,000 sf) 1st floor café area (2,200 sf)	1st floor coffee shop "The Grind", (2,208 sf) "The Cube", third floor study area (3,013 sf) The "Collaboratory" (7,287 sf) 3rd floor (34,409 sf)
EDUCATORS	3 educators, 2 Ph.D., 1 M.S.	1 educator 1 Ph.D., 1 GTA
EXTERNAL PARTY	Industry team Library staff	Industry team (regional and national), Dean and Associate Dean of Library, Director of Student Center

TABLE 1. Situational factors of the design case.

from orientating the students to different library spaces, they had little influence on the project's implementation.

Learning Goals

Proposed by acclaimed instructional consultant D. Fink (2003), the Taxonomy of Significant Learning (pp. 32-36) calls for a long-range, learning centered paradigm. In this model, educators acknowledge they cannot teach all of the necessary content, so they identify the most important topics, and then promote multiple ways of learning about them. We felt this premise would be appropriate for us, given that this was our first time offering a real-world project with an industry partner to students so early in their design education. Moreover, Fink posited that when students engage in multiple paths to learning they are more likely to have *significant learning experiences* and be more inclined to continue their learning even after the coursework is complete. This was in line with our goals. Fink's Taxonomy of Significant Learning, includes categories of: understanding and remembering foundational knowledge; applying knowledge; integrating knowledge by connecting ideas, people, and realms of life; learning about one's self and others; developing new feelings, interests and values; and finally, learning how to learn, with goals of fostering self-directed learners (2003). Fink did not perceive the model as hierarchical as in Bloom's seminal Model (1956), but instead understood it as interactive, where each kind of learning relates to the other (see Figure 3). Using this model, we derived the following goals for our project:

Foundational Knowledge

We aimed to build students' foundational knowledge in both the research and design phases of the project. During the research phase, our students would be exposed to the methods involved in the research process, which included specific processes and language conventions related to conducting original qualitative research. We determined that we would need to provide our students with strategies and techniques to document the users' experience in the spaces, so that they could synthesize this information into knowledge that they could then respond to within their designs *(Application)*. We intentionally instructed students to stay away from precedent studies and existing library research, so that their findings would not be influenced by the works of others. Once their research was presented, they were able to read and reflect on the work of others, synthesizing it with what they had learned. We felt that it would be interesting for them to determine if their findings supported or refuted the current body of knowledge *(Integration)*. Later, in the design phase, space planning best practices, and code evaluation, as well as knowledge about appropriate furniture and finish selection, was emphasized.

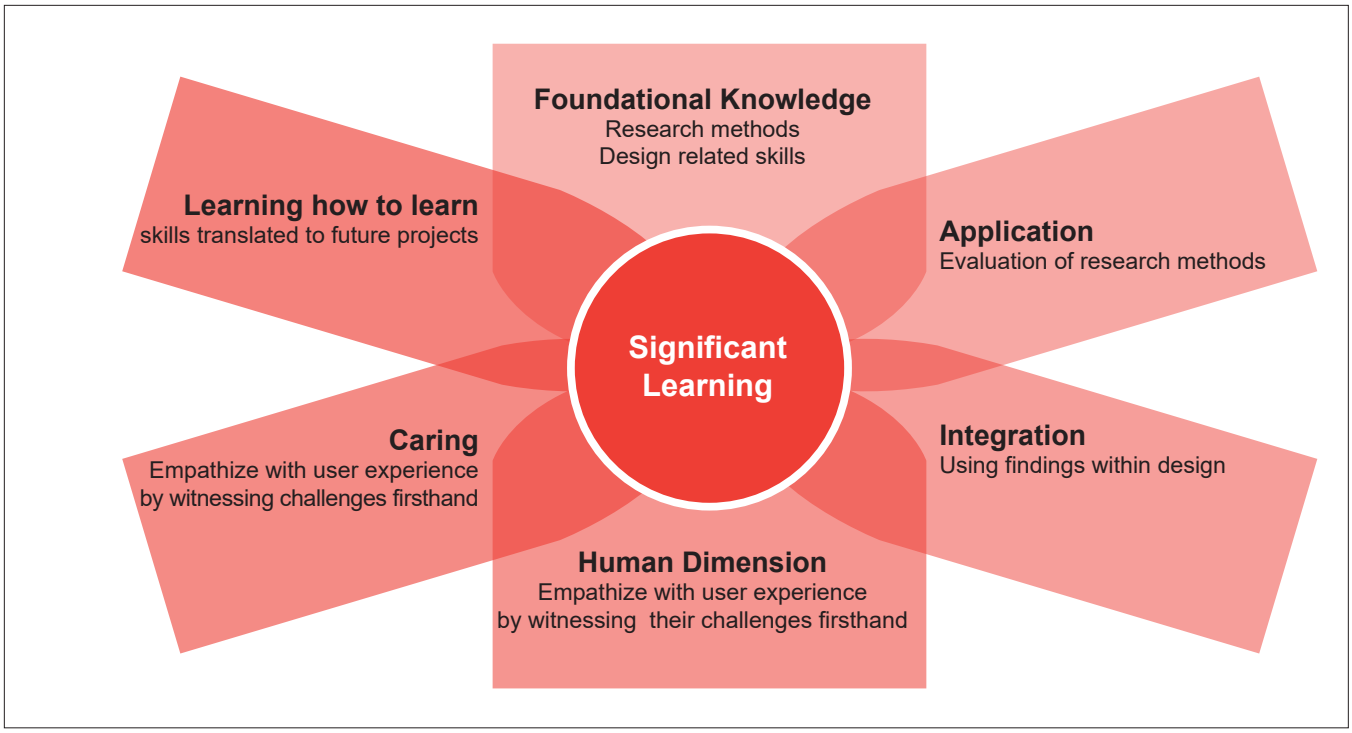

FIGURE 3. Learning goals on Significant Learning Taxonomy (adapted from Fink, 2003).

Application

During the project, our students needed to frequently call upon their skills, as well as creative, critical, and practical thinking to evaluate research findings with a critical eye toward uncovering patterns and themes. Our students would also need to determine which of their findings were important, and how best to communicate this information to the Herman Miller representatives.

Integration

After arriving at key themes, our students used their cognate abilities to redesign the spaces, with the goal of resolving the problems they uncovered during their research. This tasked them with connecting their findings to the development of relevant design solutions. To aid in this we frequently prompted them to discuss how their solutions were responding to the goals they had set.

Human Dimensions

Fink outlines the human dimension as addressing the "important relationships and interactions we all have with ourselves and with others" (p 44). Consequently, this category takes on multiple forms including: knowledge "about self," "learning from others" (p. 44), and developing a "broader concept of others" (p. 46). To incorporate these tenets, our students had to approach the project with knowledge of their own preferences, yet come to understand how they could learn from others—both their teammates and those they were researching. Students were asked to relate their decisions to the experience users would have in the newly designed space, thus building their empathetic understanding. To aid in this, we ensured that research would be conducted in an environment in which students were already comfortable and one in which they could easily identify with its users and their needs.

Caring

Our goal was for the students to empathize with users in the space by witnessing their use of spaces firsthand. It was thought that by designing for their peers the students may be more apt to acknowledge the needs of others as opposed to a user group with which they may have far less in common.

Learning how to learn

We hoped that by having the freedom and ability to identify design issues for themselves, our students would be better equipped to conduct similar onsite research in future projects. Thus, they would *learn how to learn* and would be better prepared to tackle future projects. We also hoped that the students' autonomy would help them connect and communicate with building users so that they could better meet their needs.

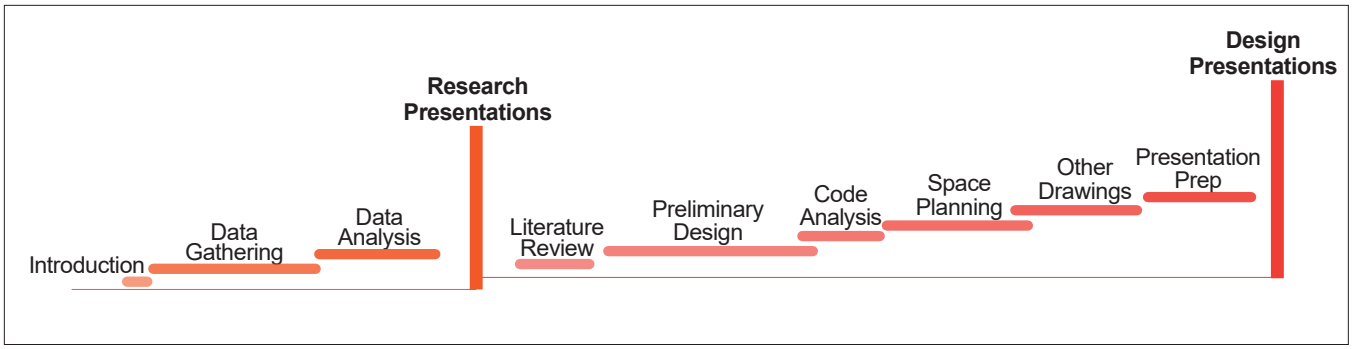

FIGURE 4. Project timeline.

PROJECT IMPLEMENTATION

The students at University A (Florida State University) undertook the project during the fall semester of their junior year. University B (Colorado State University) students completed the project during the spring semester of their sophomore year. See Figure 4 for respective project timelines.

PHASE I (ORIGINAL RESEARCH)

One third of the project duration was spent conducting original research and analysis of findings.

Research Question + Design Problem

To introduce the research component of the project, we proposed a research question that was somewhat open-ended, granting students flexibility in gathering data they felt was important to utilize. Students were asked to investigate "How does the design of non-classroom, work or study environments on a university campus influence (support or hinder) students' work?" The goal of this question was for our students to identify elements in the space that either supported or undermined how other students worked within the given spaces. Again, the general nature of this question allowed students to explore many facets of the spaces that impacted the student users. We were curious to see what they identified as notable.

Seeking more firsthand knowledge, Herman Miller, Inc. was interested in having design students gather data regarding learning places outside of the classroom. To do so, the design students were invited to explore the "modes of work" that college students' use in informal learning spaces such as campus libraries. Campus libraries were selected as a design problem as they are a traditional and common building on campuses today, having both symbolic and functional importance. It is often within the library walls where learning outside classroom takes place. Moreover, a review of literature indicates that libraries have had to evolve to remain relevant in meeting the needs of today's learners (Waxman, Clemons, Banning, & McKelfresh, 2007). As such, we challenged our students to reimagine and redesign specific areas of their campus library to accommodate the ever-changing needs of college students.

Project Stakeholders

Project stakeholders included the students (performing in both researcher and designer roles), industry researchers interested in modes of work, library staff interested in improving the library spaces, library users, student center staff and the instructors/project designers. Projects were completed in teams, which provided an opportunity to build collaboration skills, which is such an essential tool in the architecture and design industries. At University A, rather than let students self-select their own teams, we opted to form teams based on several criteria, which were determined from a questionnaire eliciting previous experience and self-assessments regarding temperament and general interests. The goal was to make the teams diverse and have students work with those they had not previously worked with before. In University B, teams of two were self-selected based on previous co-learning experiences where they had knowledge of how others worked. At both universities, each member evaluated the work efforts of their teammates to underscore teammate accountability. We factored these evaluations into their final individual scores.

Learning Tasks

Research Gathering (Phase I) began with students being introduced to the project objectives and campus clients as well as the "research lead" from their industry partner, Herman Miller. Students then participated in a site visit to the campus library. The following class period, we introduced the students to ethnographic research, relevant theories and concepts, as well as methods of gathering data. For many, this was their first opportunity to conduct original research as a college student. We also shared new terminology and research-orientated language. Since this phase tasked students with new and seemingly unfamiliar tasks, we made sure to answer questions and share relevant examples before assigning the research component tasks. These included three hours of on-site observations per student, photo ethnography, and behavioral mapping. University A students

FIGURE 4. Example of student coding.

also conducted a minimum of two interviews per team. University B students were required to conduct 6-12 interviews per team. Interview questions were those approved by an Institutional Review Board at each university. Some students elected to conduct additional observations in other campus libraries, and/or opted to interview additional students or library staff in order to gain broader understanding. As faculty, we had to ensure that students followed the research protocol approved by each University's Institutional Review Board and ensure the students had received training on how to do so. Following completion of these activities, we reviewed techniques for qualitative coding with the students and the student groups coded their data for emergent themes (see Figure 5). At times the students struggled to uncover the underlining themes from their observations. Working in teams allowed them to discuss findings and share points that enhanced critical analysis. We also visited with the student groups to help them determine the design implications and meanings that could be uncovered from their data. Their subsequent themes became the driving force behind their research presentation, the first phase of the presentation process, which included key findings and the design implications that would inform the project.

Student Outcomes

At the conclusion of the research stage of the project, we let the students choose how to organize and present their research findings to their instructors and to industry representatives. Generally, these were presented either relative to emergent themes (see Figure 6, right) or through the presentation of multiple themes organized by their location in the space (see Figure 6, left, & Figure 7). Common themes included: collaboration, privacy (visual and acoustical), preferred learning spaces based on task, occupant behavior and comfort, or environmental characteristics (i.e., lighting, acoustics, traffic flow). Their themes also highlighted specific problems they witnessed including: lack of signage, way finding, storage, inflexibility of furniture arrangements, and the occupants' inability to find help when needed. Some student groups incorporated additional information including topics such as the history of the space itself, humanizing stories provided by interviewees, or some descriptive

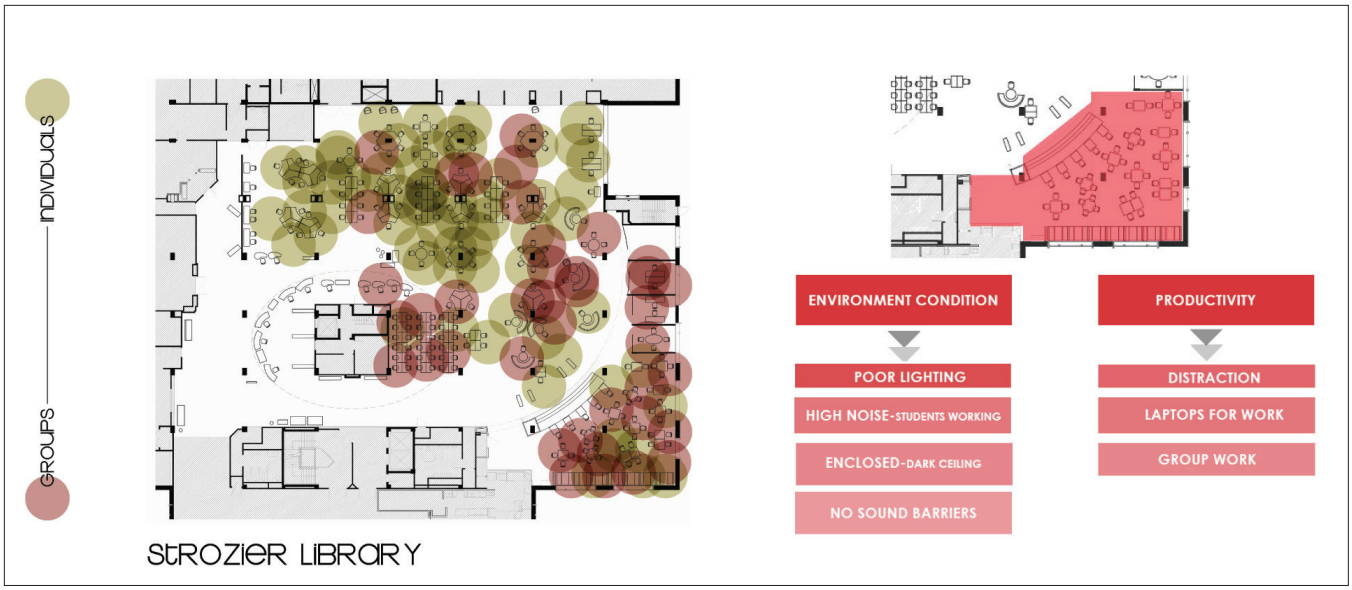

FIGURE 6. Example of University A research presentation slides.

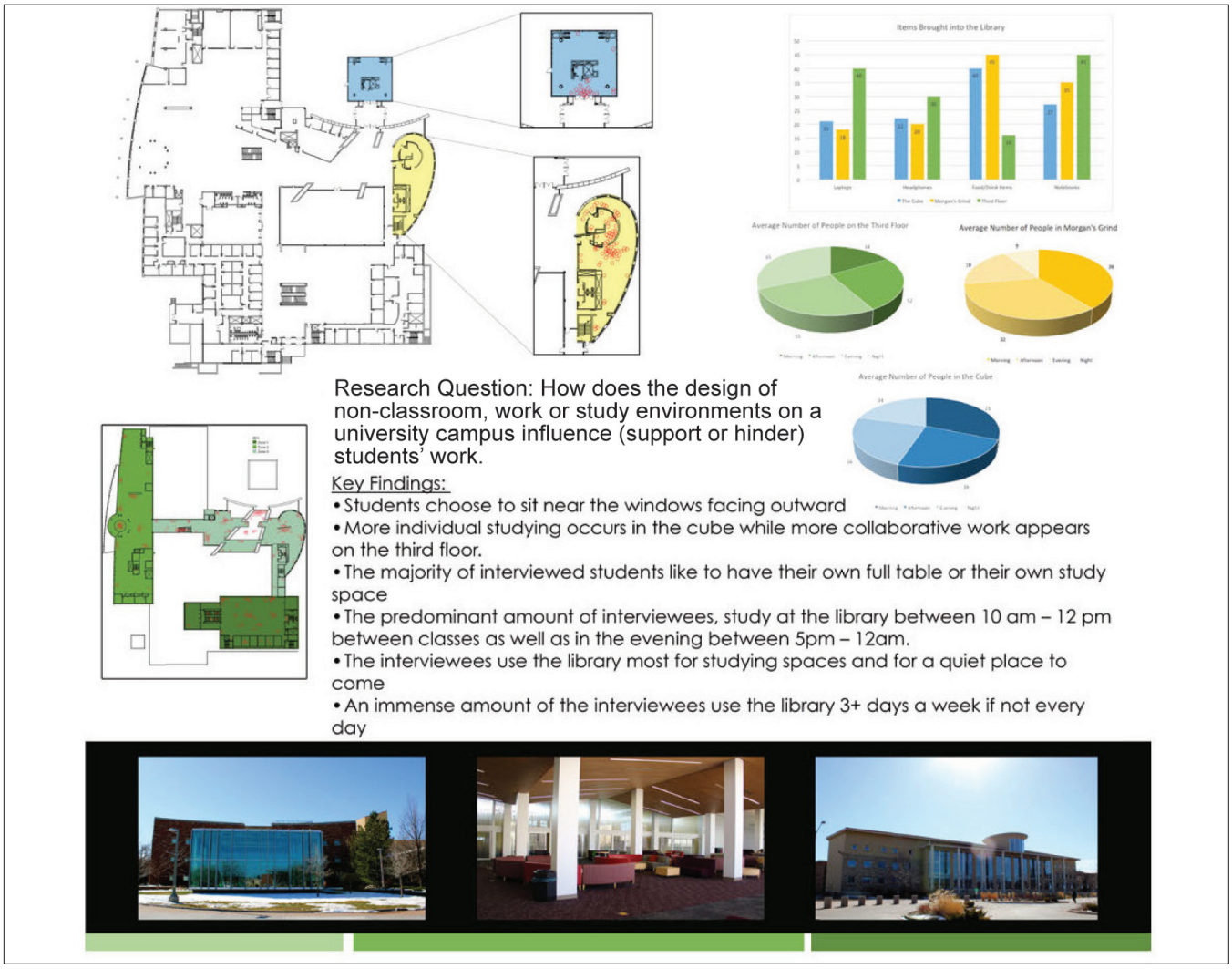

FIGURE 7. Example of University B research presentation slides.

statistics. We were surprised by how excited many of the student were at the prospect of graphically delivering their information, many opting to develop icons, charts, or image overlays to present their findings (see Figures 6 & 7).

While we could have opted to have one final presentation after design work was complete, we chose instead to have presentations focused exclusively on the research component. These were made to fellow students, faculty, Herman Miller researchers and staff, and library administrators. They explained their findings and what that meant to the design of the space. We were surprised by the number of questions the Herman Miller representatives asked our students about the perceptions and behaviors of other students. We also were surprised at how articulate they were with their responses. Since the students had personally gathered the research, we felt this helped them to elaborate on what they learned and identify its relevance to the project. The Herman Miller researcher noted that she was impressed with their insights and expressed appreciation for what she had learned from their presentations.

At University B, students evidenced more comfort with the research process than they did with the Phase II design process. This was to be expected given this was the first space planning studio for the sophomore students. At University A, the design process was ostensibly more familiar to students as they had completed one studio class already, yet students were seemingly more comfortable with the research presentation. For us, as faculty, this was one of the biggest surprises of the project.

We also noticed some distinctions in how students answered the questions posed by Herman Miller's designers and researchers. Students were forthcoming, elaborative in their responses, and able to provide evidence to support their assertions without prompting.

Students seemed to adapt well to the research component of the project. It was helpful that the students were very familiar with these spaces on campus and could easily blend in as participant observers. In addition, they were comfortable talking with peers about their use of the space making this early voyage into research much more comfortable for them.

PHASE II

Following research and analysis, the students moved into the design component of the project. To begin, students at both universities conducted a brief review of literature and evaluated precedent design projects. We asked them to evaluation the new literature and precedent design projects based upon their own findings, assessing what supported or refuted their earlier findings.

To further their understanding of the environmental context surrounding the project, we then asked student groups to write problem and concept statements as well as client and user profiles. It was only after the conclusion of these activities did they begin preliminary design work.

To begin design work, each student team produced adjacency matrixes (i.e. charts indicating relationships and proposed proximities between spaces) and bubble diagrams (i.e. visual exercises testing the required adjacencies by placing "bubbles" to indicate space). Once we approved their general direction via adjacencies, students began space planning using Herman Miller products. We gave instruction on the techniques of working with industry library symbols and criteria on how to select durable products for high occupancy spaces. Students also engaged in designing millwork, custom furniture, lighting schemes, and selecting sample furniture and finishes.

At both of our universities, we typically require students to do pre-design research before any studio project. However, this research generally involves reading the findings of other's studies. When we taught this class in previous semesters, without the integration of the original research component, the use of preexisting research seemed forced and unnatural. Students had to be reminded to reference the research. However, in this semester, with the original research component added, the use of research seemed more natural and integrated, and students incorporated it without our prompting. More importantly, their use of research was almost effortless—a natural result of their efforts in data gathering—and it was clear they utilized it at a higher and more intuitive level than when they try to use the research of others alone.

Design deliverables

To communicate their design ideas, we required certain deliverables, yet we let each student team determine the layout of their presentation boards, by selecting fonts, colors, and other graphic characteristics to best reinforce their design solutions (see Figures 8 & 9). Additionally, we asked each student group to generate binders for both the research and the design component. These binders provided a repository for process work, written statements, and detailed furniture and finish specification.

During the design component, we asked students to produce a series of drawings and images that would communicate their design ideas. These included: conceptual images, key process diagrams or sketches, floor plans, elevations, perspectives, ceiling plans, sketches. and details of their original furniture design (for University A) as well as images of their furniture and finish selections (see Figures 8 & 9).

FIGURE 8. Example of design solution from University A.

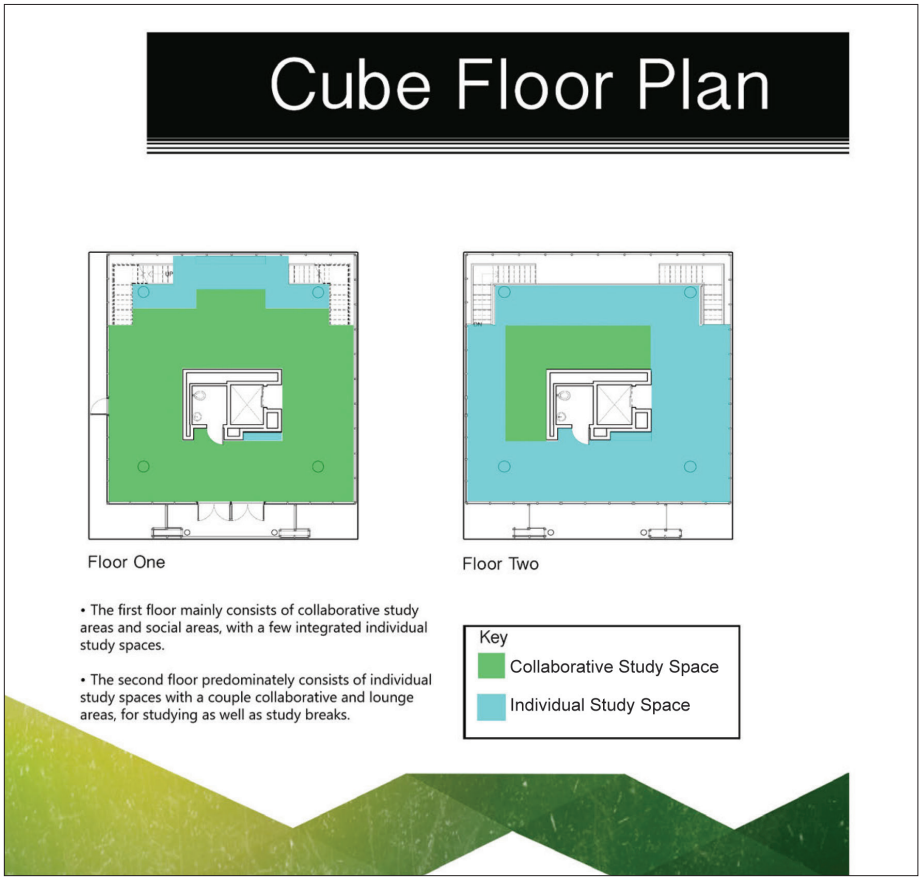

FIGURE 9. Example of design solution from University B.

Feedback

Faculty/practitioner feedback is so important in a studio environment. During Phase I, the original research phase, and in Phase II, the design solution phase, we provided formative feedback via a series of benchmarks that were designed to help the students' progress through the projects. Student groups then presented their research and designs in separate presentations to industry leaders, library representatives, faculty, and peers. Following these sessions, project stakeholders (i.e. client, industry partners, and ourselves) had the opportunity to provide summative feedback. Although students are accustomed to hearing faculty feedback, we noted that students highly valued the feedback from the industry representative and the "clients" from the library.

We also gave feedback to the students via accolades given to teams having either the best research presentations or the best design presentations. We felt it was

CONCERN	REALITY
Students too young to conduct meaningful research.	Students had no trouble conducting research.
Students would not understand how to apply their research design.	Students seamlessly and naturally included it with little prompting.
Would we be able to offer something meaningful to our collaborator?	Students provided them with a fresh approach to library and "hang out" space design.
Would the faculty workload increase?	It did, but it was worth it.

FIGURE10. Instructor concerns vs. reality.

important to provide awards to teams with commendable work after each phase, thus reinforcing the importance of the research and design components equally. Teams that were awarded in the research component were not always the ones awarded during the design component.

ANALYSIS OF EFFECTIVENESS OF THE SOLUTION

At the onset of the project we had concerns surrounding student outcomes, negotiating expectations, and our own workload. Yet, many of these were negated as students worked through the respective phases (see Figure 10).

There were many positive outcomes to the project. We noted that industry engagement seemed to increase student motivation and added validity surrounding the application of research in the design process. This was evidenced in our students' level of preparedness prior to presentations to Herman Miller, as well as their level of nervousness. The students seemed to enjoy the fact that they were generating new knowledge and not relying solely on knowledge produced by others. The university library showed support for the student researchers and expressed an interest in their findings, thus elevating the students' opinions of the value of their research. Having a separate presentation for the research component also highlighted its significance. Typically, research is presented with the final project as a small part of the presentation. In this project, research was front and center in importance and emphasis. When presenting the research information, the students were professional, and generally confident. They were able to package their research findings in appropriate but unique ways and accurately use language associated with qualitative research. While our students were relatively unfamiliar with some of the research methods, they seemed to be more confident in this phase of the project. We thought this may be related to three elements. First, they reported their own findings and knew the stories that shaped their collected data. When questions were posed during critique, they could elaborate on their findings with a certain degree of conviction. Second, the students' confidence may have been related to their exposure to the scientific method and the focus on STEM (Science, Technology, Engineering, and Math) education in secondary education. Or third, their confidence might have stemmed from the relatively more concrete (and less subjective) nature of producing research findings.

The success of the research portion of the project was clear to us. However, when moving to the design phase of the project, more students were likely to struggle. Although some produced successful designs that met user needs, others could not. We attributed this to their limited experience in space planning studios. This is where we really pushed the design process of using adjacencies, bubble flows, and multiple iterations on tracing paper to create the preliminary idea and develop the design into a client-based, rather than personal preference based, solution. Only when the space plan was working were students allowed to input it into the computer. Our experiences from classes in the past told us that once students begin space planning on the computer, they see the design as too final, or too precious, and are less likely to make necessary modifications.

Student Learning

As a result of the project, our students were exposed to valuable skills in terms of the research process, specific qualitative research methods, as well as effective ways to present research findings depicting what they observed. They gained exposure to the value of research in the design process, established a new language, and developed newfound skills in interpreting data and identifying potential bias. We feel, these skills are important in fostering critical thinking, thus reducing the propensity to take unsubstantiated statements at face-value. Additionally, the students were able to learn how research findings may be leveraged in the design process to make more informed design decisions.

We also feel that student learning was enhanced during the process of designing as well. With a more intimate knowledge of the data informing the design, the quality of the conversations between teammates and faculty shifted. Students seemed more confident when defending preferred design choices, details, and use of design principles and

elements (e.g. light, space allocation). Rather than making choices because they "liked it," decisions were made based on collected data and identified themes.

The public nature of the research design document as well as our collaborators and the library's enthusiastic interest in the findings likely sent both explicit and implicit messages about the importance of design research. These factors potentially reduced the perception that research is *dry* and that conducting research tasks held them back from pursing more creative tasks. Although this research was at a basic undergraduate level, it provided an introduction to the process and allowed students to gain confidence in using their own research, along with other precedent, to inform design solutions.

Stakeholder Feedback

The decision to have the student projects focus on a campus space provided opportunities for additional engagement. In addition to our industry collaborators, the students shared their research outcomes with library staff, including the dean and associate dean of libraries, the director of the student center (University A only), and Herman Miller representatives nationally, regionally, and locally. Libraries are constantly in a state of analyzing student needs, including the spaces that serve students. Library staff was able to hear from student designers who had interviewed and observed fellow students and developed design recommendations they could use in the future.

The design solutions were clearly impacted by the student research. During design presentations, our students frequently referred to their findings, and this seemingly added confidence to their design decision making. Their design solutions were defensible due to research conducted. Some students even opted to place user quotes or key findings uncovered during the research phase on their design presentation boards. We have taught these studio classes many times, during which precedent studies and the research of others is always evaluated. Yet, we noted that during this project students used their own generated research in ways they never had done with research generated by others. The research had become part of their own body of design knowledge, easily accessible and applicable.

Our Challenges

We were concerned that the structure of the project might be more involved and time-consuming for us. In fact, it was. Faculty at each university needed to submit a research protocol to its institutional Review board before the project could begin. Since we were at different universities, we communicated with each other regularly to create the structure of the project. We developed and shared lectures to help students learn to conduct and code qualitative data. At each institution, we also coordinated with library staff as well as the research lead from Herman Miller. Both the research presentations and the design presentations had to be scheduled, and guest critics had to be brought in from the library and from Herman Miller. Consequently, while the project was more work, the value to the students was clear, and we all agreed the extra effort was worthwhile since the students were exposed to new skills and industry partners as well as more engaged throughout the project. We often felt that we were also learning new aspects about the client's space and the student behaviors within, as well as seeing the respective environments through the eyes of a younger generation. As such, we felt the project was more informative and enjoyable for us to facilitate.

Our Students' Challenges

There were a number of challenges experienced by the students at University B. Since these students were sophomores, they had rarely worked in a design team. Therefore, they not only were "feeling their way" through the new research and design process, they also were learning how to navigate team communication issues, mismatched student schedules (work and classes), and differing opinions and interpretations of data.

We noted another set of challenges in the design phase of the project. The sophomore students at University B were still exploring their design aesthetic, how to communicate it to a client, and the nuances of a design process. This learning was set within a strict timeframe imposed by a semester block of classes and a deep awareness that the design solution would be presented to high-level campus administrators and their industry partner.

The collaboration and original research components produced some negative consequences. This high-level collaboration likely increased the pressure on the students for a strong performance. Moreover, some students had not yet given this type of formal presentation. As a result, one of their first design presentations was to industry leaders. Additionally, as with any team project, personalities and varying work ethics can cause tension or conflict within the teams.

Improvements

Had the project to be conducted again the following changes improve the learning experience:

1. Introducing a research spokesperson

Having an outside guest speaker, at University A, early in the process to talk about research have highlighted the significance of research. University B invited an ethnographer to visit a class as a guest speaker. This increased student motivation while lessoning their desire to short change the research process.

2. Competition format

While the students were certainly motived by the competition, this may have also reduced inter-team sharing of information and resources. Yet, University B perceived that the competitive nature of this project had more advantages than disadvantages as it served as an additional motivating factor.

3. Evaluators

Some industry representatives were more knowledgeable in research, while others were more knowledgeable in design or in sales. Faculty need to ensure that the competition judges have an appropriate background and skillset to serve as judges on the various project components.

4. Implementation of design

Because this was a student project, it exists only on paper or digitally. While this design project did not allow for the actual implementation (i.e., construction) of the design, it may be beneficial to seek ways to do this in the future.

REFLECTIONS

University A

Overall, we were pleased with not only the quality of work produced, but also by the processes provided to the students. The students were motivated knowing that an industry partner was interested in their research findings. The student presentations to Herman Miller representatives allowed them to receive feedback from practitioners and grounded their decisions in real-world expectations. The students seemed to feel empowered by having created their own knowledge and enjoyed offering it to others.

Conversations in the studio, and explanations given by our students during presentations highlighted how their research findings were woven into their design decision making in a way that precedent studies alone have not done in the past. It was exciting to see the students empowered by their informed design process.

> *"I was pleased by the students' ability to synthesize this research and turn it into useful information that informed their designs."—instructor*

The project was deemed so successful that it was implemented in a subsequent semester. Moreover, the inquiry-based learning format will remain in the course curricula and adapted for future projects that will focus on other spaces. It will remain in the curriculum regardless if there is an industry partner interested in participating.

Anecdotal comments offered by this group of students in the semesters following the project have been insightful. Some indicated that the workload of the research component itself led them to integrate their research findings. In essence, since they had put so much work into their research and analysis, students felt it would be a "waste" to not use it during design. Additionally, several of our graduate students who participated in the project as undergraduate students have commented that the project influenced their decision to attend graduate school as they developed an appreciation for design research as a result of this project.

University B

> *"It was an incredible journey for both students and me"—instructor.*

The biggest surprise was observing that students were more confident with research and the presentation of their findings rather than the design process. Responses were stronger because they knew their data. Students enjoyed the first-hand experience of gathering data and interpreting it—particularly because it was a familiar campus learning space and they had interviewed peers. Students appreciated the feedback from the industry leaders during presentations as well as industry's interest in student perceptions regarding informal learning spaces. University A's experience with both the process and industry partners set our class up for success. The result? Student work was stronger than previous years that had incorporated a hypothetical client problem. The industry members and campus leaders were very impressed—particularly due to the articulate responses and the depth of design at the sophomore level. The students felt their work was recognized and appreciated. As one outcome, a student competition to re-design parts of the library was discussed and initiated.

CONCLUSION

Our college students benefited when they became aware of the potential consequences (both positive and negative) of their decisions. This is certainly true in design. Designers need to have the right information to solve a problem with a creative solution that meets the needs of the users. As design educators, we are preparing our students for an uncertain world, and their ability to generate knowledge and apply that information in meaningful and actionable ways is growing in importance. We felt that having our students ground their ideas to their own critical observation and analysis will likely shape their future decisions and potentially improve the lives of those who will someday inhabit their designs.

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REFERENCES

Ankerson, K.S. (n.d.) *Collaborations.* Retrieved on August 26, 2015 from http://apdesign.k-state.edu/iapd/academics/collaborations.html

Ankerson, K.S. & Pable, J. (2008). *Interior Design: Practical strategies for teaching and learning*. New York, NY: Fairchild Books, Inc.

Baumgartner, L. M. (2001). An update on transformational learning theory. In S. B. Merriam (Ed.), The new update on adult learning theory (pp. 15-24). *New Directions for Adult and Continuing Education, No. 89*. San Francisco, CA: Jossey-Bass.

Bloom, B. S., Engelhard, M. D., Furst, E. J., Hill, W. H., & Krathwohl, D. R. (1956). *Taxonomy of educational objectives. The classification of educational goals. Handbook I: Cognitive domain.* New York, NY: David McKay Company.

Brown, J.S, Collins, A., & Duguid, P. (1989). Situated cognition and the culture of learning. E*ducational Researcher, 18*(1), 32-42. https://doi.org/10.3102/0013189X018001032

CIDA. (2014). *Future Vision Report*. Retrieved March 26, 2015, from http://accredit-id.org/wp content/uploads/2014/10/FV_012315.pdf.

Dickinson, J. I, Marsden, J. P., & Read, M. (2007). Empirical design research: Student definitions, perceptions, and values. *Journal of Interior Design, 32*(2), 1-12. https://doi.org/10.1111/j.1939-1668.2006.tb00309.x

Fink, D.L. (2003). *Creating significant learning experiences: An integrated approach to designing college courses.* San Francisco, CA: Jossey-Bass.

Huber, A., & Pable, J. (2015). When worlds collide: Student perceptions of environmental context during an immersive work experience. *Selected papers from the International Conference on Teaching and Learning,* Jacksonville, FL. Retrieved from http://www.teachlearn.org/26%20ICCTL.pdf

Irish, J. (2013) Ty gywn: Documenting the design of a special school in Wales. *International Journal of Designs for Learning*, *4*(2), 41-44. https://doi.org/10.14434/ijdl.v4i2.3661

Kaup, M., Kim, H. C., & Dudek, M. (2013). Planning to learn: The role of interior design in educational settings. *International Journal of Designs for Learning 4*(2), 41-44. https://doi.org/10.14434/ijdl.v4i2.3658

Lebow, D. (1995). *Constructivist values for instructional design: A case study of a graduate-level learning environment* (Unpublished Doctoral Dissertation). Retrieved from http://digitool.fcla.edu

Martin, C.S. (2009). The challenge of integrating evidence-based design. *Health Environments Research and Design Journal, 2*(3), 29-50. https://doi.org/10.1177/193758670900200303

Martin, C. & Guerin, D. (2010). *The state of the interior design profession*. New York, NY: Fairchild Books, Inc.

Maturana, B. (2014). Where is the 'problem' in design studio: Purpose and significance of the design tasks. *International Journal of Architectural Research, 8*(3), 32-44. http://dx.doi.org/10.26687/archnet-ijar.v8i3.466

Piaget, J. (1977). *The development of thought: Equilibration of cognitive structures.* (Trans A. Rosin). New York, NY: Viking Press.

Salama, A.M. (2010). Delivering theory courses in architecture: Inquiry-based, active, and experiential learning integrated. *International Journal of Architectural Research, 4*(2-3), 278-295.

Salama, A.M. (2015). *Spatial design education*. Ashgate: Surrey, England.

Steelcase Educational Solutions. (2014). *Going beyond campus lecture halls.* Retrieved from http://www.steelcase.com/content/uploads/2014/12/SES-U-of-Florida-case-study.pdf

von Glasersfeld, E. (1988). The reluctance to change a way of thinking. *The Irish Journal of Psychology, 9*(1), 83-90. https://doi.org/10.1080/03033910.1988.10557706

Waxman, L., Clemons, S., Banning, J., & McKelfresh, D. (2007). The library as place: Providing students with opportunities for socialization, relaxation, and restoration. *New Library World,* 108(9/10), 424-434. https://doi.org/10.1108/03074800710823953

Wiggins, G., & McTighe, J. (2005). *Understanding by design.* (2nd ed.). Alexandria, VA: Association for Supervision and Curriculum Development.