Developing Soft Skills with Interdisciplinary Teams in the First Year: Lessons Learned

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Abstract— **The academic structure of most universities dictates that a student work with those of their own program and in conjunction with a program that is tangential to theirs. Interdisciplinary educational experiences that provide students with the opportunity to develop soft skills (such as communication, empathy and problem solving) are considered rare but are much more common in the working environment. As an example, working environments such as Universal Creative are comprised of multiple disciplines (i.e. civil engineer, mechanical engineering, illustration, user experience design, etc.) A function of working in an interdisciplinary team can also be to work on unknown or "wicked problem" that has no defined answer. This presentation will provide an overview of the Jag Challenge, an innovation sprint experience for incoming students to the university. Students work in teams of three as they are provided a challenge space, find specific problems within that space, conduct stakeholder interviews, develop empathy maps, ideate, conduct secondary interviews and then present their final solution. In Fall of 2019 over 210 incoming students participated from eight first year experience course sections. In 2020 over 350 students participated in a virtual or hybrid format of the Jag Challenge. While one section may be comprised of mostly engineering students or business students most sections were interdisciplinary (i.e. a nursing student working with an education student).**

Keywords— innovation; human-centered design; empathy; soft skills, interdisciplinary learning

I. INTRODUCTION

Todays colleges offer defined programs that allow students the opportunity to engage deeply within their discipline. The ideal situation is that professors mimic the working environment of the discipline they will go into. As a college student continues to engage with their program they will face many complex challenges that reflect the industry they are entering both individually and in teams. The disciplines these students enter into may have structures that do not reflect the teams they found in their classes. Within the entertainment industry teams may be more diverse with multiple disciplines engaging in one problem. For example, within the field of themed entertainment, a team of engineers will work closely with concept designers, illustrators and financial executives from diverse backgrounds, cultures and ethnicities to develop a new attraction.

Students leaving their college careers are entering a workforce where they are not guaranteed to obtain a job or internship weeks or even months after graduating. A study conducted by AfterCollege found that 83 percent of students do not land a first job before graduation, or even months afterwards (Rutt, 2014; Johnson & Maness, 2018) There is a reason for this gap in employability of students. According to Spisak (2016), studies show that job/career success is based on 75 percent soft skills and only 25 percent hard skills. With the lack of soft skill development students end up falling behind. It was also found that professionalism, teamwork and interpersonal skills emerged as positive predictors of chances of getting a permanent offer of employment (Dabke, 2015).

Teams must be taught project management and execution within the constraints of a budget and timeline, how to inspire creativity (the creative process), and how to communicate with one other and deal with conflict. Employers are looking for students who can not only practice the skills of a discipline but also embody the soft skills that are needed to excel in the workforce. "Though the importance of soft skills is widely acknowledged, soft skills curricula are either non-existent or underdeveloped in most universities" (Hart Research Associates, 2015). Johnson & Maness (2018) continues this thought by stating that "Hard skills are essential for any career and they are very real. However, an employee's ability to effectively apply these skills in the workplace will depend on their ability to collaborate with other people on projects that further the goals of their organization". Employers want to hire people who can work with people from different disciplines and cultures and who are ready to apply hard skills with other people on complex projects. When starting a new graduate degree in entertainment technology Pausch & Marinelli (2007) visited potential employers. Their research asked multiple questions but primary why they would not hire a student. The unanimous answer was that students could not work effectively in

interdisciplinary teams. University programs were not preparing students to work in these types of teams and students needed to not only work in these teams but be taught how to do so.

Interdisciplinary learning is where individuals from various disciplines must contribute to a shared goal. An individual from one team (such as an engineer) may work with an artist to complete a task or goal. Interdisciplinary teamwork rely on a common understanding and shared knowledge where individuals then work with each other on specific problems towards a solution (Research Development Office, 2020). Richter and Paretti (2009) define interdisciplinary teams as different domains collaborating as they identify, integrate, and value multiple perspectives and to learn from one another in ways that reshape their own understanding and practices. They go on to state that "interdisciplinary learning involve more than simply adding new content from other fields, but also understanding and integrating new values and approaches to problem definition and problem-solving" (Richter and Paretti 2009, 31). This definition aligns with Lattuca's concept of interdisciplinarity in which individuals from a team may continue to act as experts in their own domain but work together to integrate knowledge across those boundaries as they learn from one another (Hixson et. al. 2013).

Accrediting bodies for various disciplines acknowledge the need for interdisciplinary teams. For example, the Accreditation Board for Engineering and Technology, Inc. (ABET, na) requires that students have an experience with interdisciplinary learning. "It is a commonly accepted leadership principle that interdisciplinary teams will be more effective at achieving a desired outcome. Additionally, there are reports from several groups that describe improved outcomes from interdisciplinary design teams" (Blair 2021). Often, within engineering programs interdisciplinary teams are limited to one type of engineer working with another. Within certain fields (such as in entertainment) an engineer may be working closing with much more diverse disciplines such as an engineer working with a sculpture or 3D designer and thus need to experience working within an interdisciplinary team structure.

Currently, programs in higher education with interdisciplinary teams are limited but those that have an interdisciplinary component have seen positive results. Oden, O'Malley, Woods, Kraft (2012) presented results from their current course capstone in design engineering to evaluate the inclusion of interdisciplinary teams. "A wide variety of positive outcomes have emerged from combining our capstone design courses. First, students have been able to successfully tackle design challenges that would be quite difficult to accomplish with students of only one major." They go on to say that presenting problems to an interdisciplinary team allows for a more realistic representation of the design work that students will face in the industry. By positioning this within a class

structure they have been able to incorporate business planning, market assessment and entrepreneurship into the class for all students.

1.1. PEDAGOGICAL UNDERPINNINGS

Constructivism and situated learning can be used to support interdisciplinary learning. Constructivist approaches emphasize the learner's active role in building new knowledge rather than passively receiving information (e.g., Duffy and Cunningham 2004). Situated learning emphasizes that knowledge is dependent on the context in which it exists (e.g., Greeno, Collins, and Resnick 1996). These theories point toward the need to engage learners in authentic activities in which the acquisition of knowledge and the application of that knowledge in "real- world" contexts are intertwined.

Another model to consider is the Spiral Curriculum, proposed by Jerome Bruner in the 1960s. The Spiral Curriculum "shifts education from a model in which content comes first and application second to one in which learners are engaged in authentic ("real-world") applications of knowledge at ever-increasing levels of complexity across a curriculum" (Bruner 1960). Although not stated explicitly, this framework underlies much of the recent curricular developments in engineering education. "For example, it stresses design across the curriculum in which design moves from being solely a capstone experience to one in which learners are 'doing' design consistently across the curriculum even as they continually acquire new knowledge that allows them to design increasingly complex products or processes at more sophisticated levels" (Hixson, Paretti, Lesko, McNair, 2013).

As more programs within the university system are developing interdisciplinary experiences faculty must have a clear understanding of how student teams should function and what should be taught in courses that have these types of experiences. Currently, little research has been conducted to understand how interdisciplinary teams can be taught. While this may be common in some industries there is little done within university classrooms to support the development of these types of skills.

II.   METHODS

Indiana University-Purdue University Indianapolis (IUPUI) has a history of instilling highly engaging practices into the undergraduate experience. These are often categorized as high impact practices according to the work of George Kuh (2008). High impact practices are practices that are proven to be highly engaging and impactful experiences for students that are known to show higher numbers of retention. Examples of high impact practices are first year experiences, e-portfolio, undergraduate research, and project-based learning. The university also has a legacy of providing faculty with overarching learning objectives that give faculty a common

target for classroom and pedagogical development. In 2018, IUPUI restructured these learning objectives into what is now known as the profiles of undergraduate learning. These are common profiles that allow students to become engaged in one of four areas which are community contribution, innovation, communication, and problem-solving. One of the primary high impact practices is first year experiences which comprise a Summer Bridge week before classes begin and a course during the fall semester.

Bridge week is a five-day experience where students are given an opportunity to learn about college life, familiarize them themselves with the University, develop new connections on the campus, familiarize themselves with the surrounding city of Indianapolis, and gain an understanding of what is expected of them when they enter college. To better align the profiles with the first-year programs a new experience was created. With the help of an internal grant Dr. Christian Rogers and Ms. Heather Bowman began the process of creating what is now known as the Jag Challenge experience. This experience provides students the opportunity to engage with five distinct learning objectives.

• Students learn to build empathy for target audiences from different "perspectives"

• Students can articulate a minimum of one strategy for solving a problem

• Students will be able to present idea through various modalities in a public form

• Students learn to leverage the skills and abilities of all team members including cross- disciplinary/cultural contributions

The underlying purpose for choosing each of these objectives was to focus on soft skill development in an interdisciplinary setting of students from across campus.

2.1. RECRUITMENT OF FACULTY

In order to create a common experience for all students participating in the Jag Challenge it was important to identify faculty that were already familiar with human-centered design and were interested in engaging first year students as they went through the process. Thus, faculty were individually asked to join in the Jag Challenge (both in the 2019 and 2020 pilots). In 2019 eight sections (210 students) participated. This was done in a face-to-face format. In 2020 eighteen sections (357 students) participated. Due to the pandemic the Jag Challenge was placed with in the first semester and took place over a 10-week period in a virtual or hybrid format. Some of the sections were made up of students that were focused on specific areas (such as STEM) while others were comprised of multiple disciplines (i.e. nursing and education, creative writing and business).

2.2. PROFESSIONAL DEVELOPMENT FOR FACULTY

While some of the faculty understood human-centered design others did not. Human-centered design is designing based on the philosophy that empowers individuals or

teams to design products or services for those that are experiencing the problem. For the 2019 pilot a training session was conducted to better support students going through the Jag Challenge (and thus engaging in human-centered design). Faculty learned about the processes and mindsets that the students will go through following human-centered design methodology. This training also served as an information session where instructors could ask questions and understand the learning objectives and value of this experience for the students. For the 2020 pilot (due to the pandemic) we were unable to do a common faculty training. An informational video was presented to faculty in leu of a training session.

For supplemental support materials instruction was given to faculty in a PDF guide format (2019). In 2020, the instruction was further refined to include instructional videos and an online module that could be installed in individual course shells (via the Canvas LMS).

C. FORMAT

The Jag Challenge is a multi-step innovation experience done in a sprint format. Students are given limited time to complete specific tasks which is why it is often considered a sprint. For both the 2019 and 2020 pilot students followed a similar format. The steps are as follows:

• Challenge Space – Students are given one of multiple problem spaces. The problem spaces are designed to be highly ambiguous to allow for multiple problems to be found within that space

• Empathy – Students are individually given the task of finding one person who is a stakeholder connected to that problem space. They are given specific instructions on how to interview them (so as not to lead them) and find from their perspective what problems exist in that problem space. Students then meet with their teams to discuss the interviews and pick a problem. For the 2020 pilot students were given the additional task of developing a profile of the person who would experience that very problem utilizing an empathy map (see Figure 1).
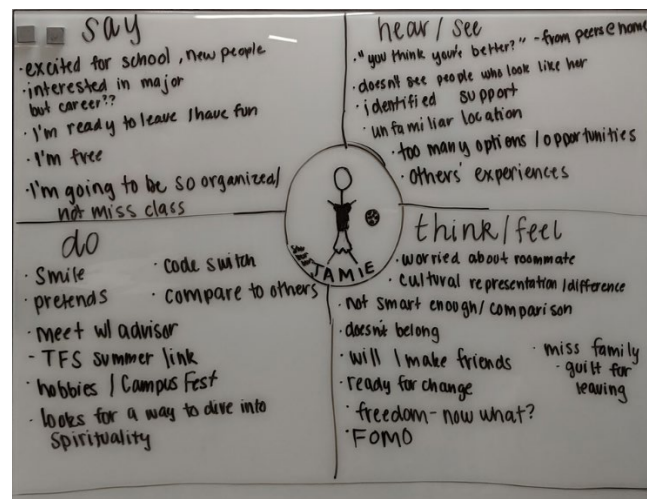

Figure 1. An empathy diagram depicting insights revealed through a student perspective discovery interview.

- Ideation – Students are led through a time activity to develop multiple solutions for this problem. Students generate multiple possibilities before landing on three possible solutions. They are then asked to go back to their original interviewee to obtain feedback on a final solution.

- Prototyping and Presentation – After conducting their second interview student teams come together to develop prototypes and presentations for sharing with their class and a final showcase experience. A prototype could be a working model of their idea (such as a mockup of a mobile app or technology or a physical model). Other students created posters or slide presentations to share.

- Reflection – Students individually reflected on their experience with Jag Challenge. They have to restate the problem space, discuss the results of their interview, present multiple possible solutions and discuss the final solution. They also reflect on their experience in being part of a team structure and their overall experience with Jag Challenge. This was added for the second pilot.

- Final Showcase – Students have to present their final prototype and presentation to their individual class and/or as part of a larger showcase. For the first year all students participated in a final showcase (similar to a science fair) on the last day of bridge week. For the second year the instructor for each section picked the best presentation to move forward to a virtual innovation showcase which took place online via Zoom and broadcast over YouTube Live (see Figure 2 & 3).

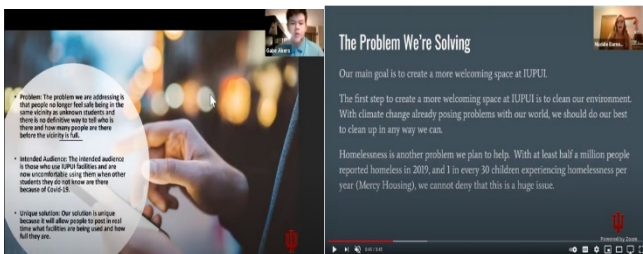*Figure 3 Students presenting at the 2019 Jag Challenge Showcase.*

Figure 2 Students presenting at the 2020 Virtual Jag Challenge Showcase

III. RESULTS

The Jag Challenge is highly experimental. Very few (if any programs) exist like this within the first-year experience and include interdisciplinary teams working together to come up with innovative solutions after identifying their own problems. Many variables must be considered in the development of a high quality program for students. What follows is a discussion on some of the primary steps in the process that present evidence of skill development within interdisciplinary teams.

3.1 IDENTIFYING CHALLENGE SPACE FOR STUDENTS

Students were given one of multiple problem spaces in each of the two pilots. Faculty could choose the problem space for their student teams or allow the teams to choose their own. For the first year pilot the problem spaces were (a) creating a more welcoming space on campus, (b) sustainability, and (c) improving the relationship between IUPUI and the city of Indianapolis.

For the second year of the pilot the sustainability problem space was dropped and two new problem spaces were included. They were (a) creating a safer space at IUPUI, (b) rethinking the university experience online. The purpose for the change in problem spaces was to align with the natural experiences that the students were going through as this was at the height of the pandemic with many of the students experience all of their courses online and face-to-face courses with safety precautions in place. Students within different disciplines often had to come to a decision on the problem space they would engage with which was a challenging experience for them.

3.2 THE FIRST DAY

During the 2019 pilot faculty met with all students who were participating in the Jag Challenge experience. Students were introduced to the Jag Challenge and a presentation was given on what the purpose of the Jag Challenge. The main pitch to the students was that they were now a part of the IUPUI community and as members of that community we needed their help and input to make IUPUI a better place. Students were immediately presented with their first step which was to conduct individual interviews. Students were given instruction to ask open ended questions of their interviewees about the specific problem spaces and to not ask questions about individual problems. This common presentation was not included during the 2020 pilot due to the various formats of each section. Instead, students watched a welcome video which presented the Jag Challenge to them with similar content.

3.3 TEAM DEVELOPMENT

Working with teams from different disciplines came with various challenges. For example, students who were considered exploratory (did not have a defined major) found it a struggle to understand the type of problem spaces they would want to work on. Students who had declared majors wanted to work on problem spaces that were tied closely to their major. Students also struggled

with common team-based projects as some students did not pull their weight. Team members would work to engage less interested individuals but found it difficult. Team selection was often done at random by counting numbers but it was also different from section to section.

3.4 INTERVIEWING AND EMPATHY MAP

One of the greatest struggles for a student was to interview a stakeholder without the inclusion of any bias in the interview. Students were given the task of identifying a person (faculty, student, community member, staff) that was close to the defined problem space and conduct an interview with that person. They needed to ask open-ended questions and bring no actual problem to the conversation. The primary purpose for this interview was to find problems that exist within the problem space and bring those to the table with their fellow teammates. The second primary task was to create an empathy map that helped the students to categorize a person and create a profile for a person who might experience this problem. For some students this was their favorite part of the experience. For others it was highly confusing. It was found that much of this was dependent on how the instructor either taught or augmented the instructor videos that were given to students.

3.5 IDEATION

Ideation was considered by students to be one of the most fun parts of the process. As students came up with ideas they had to share those ideas with their teammates and then add to those ideas to come up with as many as they could. For the 2019 pilot this was done face-to-face with sticky notes. Students were each given a stack of notes and had to write down as many ideas as they could within a timed format. They then moved to a "plussing" phase where students followed a "yes and" model. For example, a student may say that there should be a locking system for all doors at IUPUI and someone else may say "Yes! And we should use our student ID's to open them." The next phase was designed to eliminate some ideas and finalize three ideas to then share with their interviewees for feedback. What was found was that with some sections the instructors ignored the time allotted which did cause some confusion for students. In virtual sections (during the 2020 pilot) students used technology such as Google Jamboard which is a free platform for sharing virtual sticky notes.

3.6 PROTOTYPING/PRESENTATION

Students had to find a way to present their final ideas to their classes and a wider audience. For students in the 2019 pilot, they had the opportunity to utilize physical mediums to prototype such as construction paper, cardboard, markers, and posterboard (see Figure 4). For students in the virtual environment all presentations were slide presentations where students created a pitch

presentation. Students had to consider how they would methodically present the problem space, the problem, the audience that would experience that problem and then why their solution was appropriate for the problem. Each solution varied on the level of innovativeness that was presented. Some solutions were highly innovative but ungrounded practically while other solutions were

Figure 4 Students preparing for their final presentation

practical but not innovative (i.e. more police on campus or to hold classes outside). It was noticed that during the 2020 pilot the students struggled due to the pandemic and the level of innovative ideas dropped significantly.

IV. ASSESSMENT AND CONCLUSIONS

Having conducted two pilots of the Jag Challenge that were different in format (2019 within 5 days and face-to-face and 2020 virtual/hybrid over 10 weeks) much can be learned that is beneficial both to the future of the program and to programs that are feeders for industries that could benefit from interdisciplinary teamwork. While the Jag Challenge included students from various disciplines insights can be drawn for usage within entertainment and engineering programs as well.

4.1. TEAM-BASED COMMUNICATION

As presented by Hart Research Associates (2015), there is a strong need for the development of soft skills. It was noticed during both pilots that students were given opportunities for develop in interpersonal communication skills through team introductions and development. As students engaged with each other from various perspectives each member had to understand how to come to consensus and work with each other. Even as teams were deciding on challenge spaces they would often want to choose a space tied to their discipline rather than be open to others (i.e. nursing students wanting to work on safety instead of considering another option). With varied individuals on each team they had to come to consensus on the challenge space as well as the ideas that were generated. Students also had to learn about each other by participating in various personality tests which helped them better communicate as a team and understand various roles.

Students also had to develop their ability to communicate publicly as they presented during the Jag Challenge Showcase. Students developed multiple ways to share their ideas. Some students created mock-ups of physical spaces. Other students created virtual prototypes (often called low fidelity prototypes) while others created

posters or slide presentations. During the 2019 pilot the showcase consisted of presenting their idea to multiple individuals (including institutional administrators) in a science-fair style format. During the 2020 pilot the top teams from each class presented their innovations publicly in a virtual format (streaming over YouTube).

Students developed through their ability to research various challenge spaces. By conducting interviews and looking at various internet resources students needed to understand how to find specific problems but also understand the context of that problem and then create solutions to solve the needs of the people who experience that problem.

4.2 EMPATHY

As posited by Bruner (1960), the spiral curriculum proposes designing through throughout the course rather than learning and applying later. Students in the Jag Challenge had to continually design and iteratively build on previous insights. It was noted that as the students went from one interview to the next that their designs changed and shifted to accommodate the needs of those who experienced the problem. By conducting these interviews it led to greater empathy as students needed to solve problems from another person's perspective and not just their own. This was noted by commentary in final reflections.

4.3 DEALING WITH AMBIGUITY AND FAILURE

Students are often given an exact problem to solve and specific criteria to solve that problem. As students enter the workforce, they need to recognize they are not going to be given all the criteria to solve the problem or even know what problem exists. It is their responsibility to find stakeholders who understand the challenge space so that they can identify the problems that need to be solved in that space. Within the themed entertainment industry employees may be given specific criteria (a specific storyline or IP) but for many it is on the organizational team to develop the concept. It is also valuable to listen to the needs of the client as the outside perspective or the guest (or the guests of the client).

It was found that students struggled with this ambiguity that was presented through the Jag Challenge curriculum. The underlying fear was that if students did not have constraints given to them that they would ultimately experience failure. Ambiguity and failure have been presented as a common struggle in other studies (Liu and Schonwetter, 2004). Students were not given specific examples for how to find a problem (other than suggested questions for interviews), or examples of solutions within each challenge space.

As students were moving throughout the Jag Challenge experience some developed solution prototypes that weren't exactly what they had initially planned. It was important for them to understand that failure is acceptable and inventible. One such example was a section where multiple teams struggled with developing innovative solutions. The instructor had them meet as teams' multiple times and pushed them to rethink their solutions to come up with something more unique to the proposed problem.

Mourtes (2010) found similar results as students who participated in a re-designed aerospace engineering course focused on problem-solving. Results from that study indicated that coaching, working in teams, and time management provided support for students and increased their confidence which led to a decrease in anxiety. This was found with the Jag Challenge as students went through the process. Students indicated increased confidence in solving problems in a safe environment where ambiguity and failure are accepted.

4.4 PROBLEM-BASED LEARNING

Jag Challenge has presented itself as a way of implementing problem-based learning (PBL) from the beginning of a students college career. Problem-based learning has been posited by the Accrediting Board for Engineering and Technology (ABET) as an approach with excellent potential for developing critical problem-solving skills and soft skills (such as communication and team skills). (Mourtes, 2010).

I. FUTURE WORK

Much can be learned from the Jag Challenge 2019 and 2020 pilot but for future iterations of the Jag Challenge program but also for other innovation experience with interdisciplinary teams.

5.1 TRAINING AND DEVELOPMENT

In order to develop any type of problem-based learning experience where humans are at the center of the solution (i.e. themed entertainment design) faculty need to have a strong understanding of timing and methodology. The 2019 contained eight sections and thus was highly controlled. Nevertheless, one faculty member failed to follow the time restrictions and it caused issues for the students who felt their experience was poor. As the program grew the second year it was noted from the student reflections that a few sections had very thorough documents while others lacked substance. It is recognized that this is an issue of professional development. Like teaching students, instructors need presented materials in multiple modalities as well as exercises to walk them through the process of solving problems from a human perspective. Moving forward, the training will be refined for faculty to include a more hands-on approach to training so that faculty gain a clearer understanding of human-centered design. There also will be a greater emphasis for the faculty on student reflection at the completion of the Jag Challenge.

5.2 ADAPTABILITY

The pandemic played an impact on the 2020 pilot. It was noted there was higher levels of energy from the students within the 2019 pilot when they all met face-to-face for a five-day period instead of meeting either virtually or hybrid in a 10-week format. Students were unable to get together on the first day of the 2020 pilot due to differences in format between the classes and different days those classes were meeting. This was also noted by some of the faculty who participated in the Jag

challenge from the first year to the second year. Nevertheless, the curriculum has proven adaptable and also repeatable through the use of Canvas modules that can be plugged into a course. As curriculum continues to be refined it will be implemented in a common module that can be implemented into multiple courses.

5.3. INTERDISCIPLINARY TEAM-BASED CURRICULUM

Moving forward, the principal researcher of this project will be engaging in an interdisciplinary team-based project where interviews will be conducted with team-members from various organizations (both with innovation and creative forms as well as in the themed entertainment industry) to understand how interdisciplinary teams work together, communicate and solve problems. This research will then be developed into curriculum for use in both the Jag Challenge as well as in the Themed Entertainment curriculum at IUPUI.

5.4 EMPATHY AND HUMAN-CENTERED DESIGN

It is valuable for students to understand how to solve problems from the guest/patron perspective. This is true for students in the themed entertainment disciplines but also in many other fields. It is one thing for a student to come up with a themed land design on their own but if it is something that a guest would not value that it is not valuable putting time into. This is a difficult task for a student (to put themselves in another person's shoes). As students engage with others it is easy for them to include their own bias instead of finding the problems from another perspective. Further curriculum should be developed to look at the patron/guest experience and how these experiences can be used to co-design multiple experiences as well as develop new products and services.

Overall, the Jag Challenge has is considered to be a fun and creative experience for new students that they typically won't find at many universities. While much work needs to be done to further refine the experience it has proven to be a valuable way to begin a student's college career who may come into the institution with very little understanding of human-centered design.

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