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Development of Social Engagement Activities to Increase Student Participation in a Makerspace

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Abstract

Over the past decade, the makerspace movement has transformed engineering education by providing students with open access to equipment and workspaces where they can develop their problem-solving skills, collaborate with other students, and gain confidence in their abilities. However, some literatures suggests that many makerspace environments do not readily support diverse populations, can create tensions between different student groups, and can sometimes feel exclusive and unwelcoming. In addition, non-dominate students often develop negative perceptions of makerspace culture due to gender bias and marginalization. It is essential that academic makerspaces are welcoming and that all students feel a sense of belonging in these spaces, as a greater sense of belonging in students leads to increased persistence and student success, especially for non-dominate student populations.

Funded through the NSF Research Initiation in Engineering Formation (RIEF) program, this project seeks to increase student sense of belonging in undergraduate engineering students through the integration of *social engagement activities* into an academic makerspace. *Social engagement activities*, in this context, are events, projects, discussions, and workshops that have a strong emphasis on supporting the social and emotional development of students. Supporting students' social and emotional development is an essential component to creating culturally competent, well-rounded engineers. Due to the flexible and informal nature of the makerspace environment, it is an ideal place to build and create these social connections between students. The engagement activities were designed to encourage students of all backgrounds, majors, and ability levels to participate in the makerspace as they build connections with their peers. To encourage connection with peers, the engagement activities were supported and directed by major-level students who were hired as *Student Engagement Liaisons* (SELs)."

This paper summarizes the development of the social engagement activities and reports on participation, student engagement, and student perspectives of the activities. Working closely with the project PI, the SELs worked together to design, develop, and conduct five social engagement activities: (1) Halloween DIY Night, (2) Inclusion Discussion, (3) Holiday Crafts, (4) Game Night & Innovative Workspaces, and (5) Spring Craft Night. For each activity, student participation counts were recorded, and post-event evaluations were collected from the SELs. Overall, engagement activities have been successful from the standpoint of student participation and engagement. The paper highlights several lessons learned and plans for future events. The next phase of the project will assess the impact that these activities have on student sense of belonging.

Introduction

Western Washington University (WWU) is a public institution with approximately 15,000 full-time undergraduate students, 160 academic programs, and a vibrant campus community. The Engineering & Design Department (ENGD) offers four undergraduate-only programs: Electrical Engineering (EE), Manufacturing Engineering (MFGE), Plastics & Composites Engineering

(PCE), and Industrial Design (ID). In this department, students first enroll as pre-majors in engineering and design, and then declare a focus in their second year; There are approximately 200 major-level students and 100 pre-major students.

WWU institutional data and department research data show that 1. the percent of women-identified, first-generation, Pell-eligible, and underserved students declines from the pre-majors to the major; 2. there has been a decrease in diversity as the programs have become more competitive; 3. pre-majors, women-identifying, and non-dominate students report a statistically significant lower sense of belonging than their counterparts [1]. In response to these data, the Engineering & Design Department First Year Program (FYP) has recently implemented strategies focused on supporting pre-major students, increasing student sense of belonging, and creating inclusive work environments. These efforts are supported by an NSF-funded project which seeks to increase student sense of belonging in undergraduate engineering students through the integration of social engagement activities into the new departmental academic makerspace.

By providing opportunities for students to participate in non-technical activities within a makerspace environment, this project aims to encourage students to come to the makerspace with the sole purpose of connecting with their peers through participating in workshops and events. This, in turn, will introduce students to the makerspace who may not otherwise choose to and/or may be intimidated by the technical components of the space. The social engagement activities are structured to support students from all backgrounds, prior knowledge levels, and interest areas. In addition, discussion elements focused on supporting the creation of inclusive work cultures have been integrated into some of the chosen activities. This paper details the social engagement activity development process and summarizes the overall design, participation, perceived participant engagement level, successes, challenges, and initial impressions of the effectiveness of the activities.

Academic Makerspaces

In the fall of 2019, the Engineering & Design department opened a makerspace designed specifically to support pre-major students, who often lack access to the lab and project experiences that are so critical to the development of sense of belonging, self-efficacy, and STEM identity. This 1500-square-foot facility provides students with equitable access to equipment, tools, and training and well as opportunities for cross-departmental collaboration.

Makerspaces and maker-centered learning shows promise for broadening participation, promoting innovation, and increasing STEM identity. Research has shown that participating in academic makerspaces is associated with positive changes in students' design, engineering task, and innovation self-efficacies; motivation; expectations of success; interdisciplinary awareness; and belonging [2] [3] [4]. However, research also shows that makerspaces can be intimidating to new users, leading to feelings associated with a lack of belonging, especially for women and other traditionally marginalized students. Both fear of criticism and fear of failure has led to gender imbalances in makerspace use [5]. Furthermore, recent research has shown that many maker-type environments do not readily support diverse populations [6], create tensions between different student groups [7], and can sometimes lead to a work environment that feels exclusive and unwelcoming. Thus, the design of these spaces and events that take place in them must be carefully considered.

Social Engagement in the Makerspace

This project uses the flexible nature of an academic makerspace as the framework to provide students with the opportunity to connect socially in ways that have been shown to increase sense of belonging. This is accomplished by integrating social engagement activities into a university affiliated makerspace. Social engagement activities, in this context, are defined as events, projects, and workshops that have a strong emphasis on supporting the social and emotional development of students. Due to the flexible and informal nature of the makerspace environment, it is an ideal place to build and create social connections between students. To ensure equality of access and to allow for flexibility, the engagement activities are designed to maximize student ability to participate, regardless of prior knowledge or ability level. The engagement activities are designed to increase student sense of belonging with a focus on supporting underserved students, who have an increased risk of personal hardship and academic failure due to the disproportionate negative impact of the pandemic [8].

To encourage connection with peers, the engagement activities are supported and directed by major-level students who are hired as student engagement liaisons (SELs). The engagement activities were designed to encourage students of all backgrounds, majors, and ability levels to participate in the makerspace as they build connections with their peers. In addition, the activities were designed so students can participate with varying levels of commitment. There are two main types of social engagement activities planned for this project: 1. Event Series and 2. Meaningful Projects & Support Tutorials. In this paper, we focus on the former since the project and tutorial aspect are still in the development phase.

Four SEL's work to support this project. Two of the SEL were hired during the 2020-21 academic year and an additional two were hired at the start of the 2021-22 academic year. Together, the four SELs represent 3 of the 4 programs (EECE, MFGE, and ID). Working closely with the project PI, the SELs worked together to design, develop, and conduct the five social engagement activities described in the findings section.

Data Collection

Data collection included recording number of student participants and gathering feedback from the SELs. Students are considered participants if they stay for longer than 10 minutes and engage in at least one activity or conversation. Students who entered the makerspace and left are not counted as participants. At the conclusion of each engagement activity, the SELs were asked to complete a post-event evaluation form where they reflected on the successes and challenges of the events. The contents of the post-event reflection are detailed below in Table 1.

Table 1: Post-Event Reflection Instrument

Number	Question	Response Type
1	What was your impression of the level of engagement of the student participants?	Likert Scale, 1 (Terrible) to 5 (Excellent)
2	From your perspective, was the activity/event successful?	Likert Scale, 1 (Definitely No) to 5 (Definitely Yes)
3	Would you want to host an activity/event like this in the future?	Likert Scale, 1 (Definitely No) to 5 (Definitely Yes)
4	What went well?	Open-Ended

5	What are your suggestions for improvement?	Open-Ended
6	Is there anything else you would like to add?	Open-Ended

Findings

First, we provide an overview of each event and then summarize student engagement and lessons learned. Working closely with the project PI, the SELs worked together to design, develop, and conduct the five social engagement activities: (1) Halloween DIY Night, (2) Inclusion Discussion, (3) Holiday Crafts, (4) Game Night & Innovative Workspaces, and (5) Spring Craft Night Event. Table 2 briefly describes each event and reports how many students participated in each activity.

Table 2: Social Engagement Activities & Participation Counts

Activity	**Description of Event**	**Students**
Halloween DIY Night	For this event, students were invited to the makerspace for a night of spooky fun, crafting, and costume making. The SEL's created stations around the makerspace, each with a different theme and of varying levels of complexity. Stations included décor painting, mask making, headband creation (bunny ears, angel halos, and devil horns), and costume making (which included sewing, gluing, cutting, sticker making, and more).	31
Inclusion Discussion	Students were invited to come and talk to the SELs about the importance of inclusion in relation to the department. Discussion topics prompts included what makes you feel included and welcome when you enter a room? What does an inclusive classroom feel/look like? Why is it important for our classes to be inclusive? How can we (students, staff, faculty) do better when it comes to creating inclusive environments?	8
Holiday Crafts	For this event, the SEL's hosted a 4-hour holiday themed craft night. Again, there were a variety of stations where students could engage in projects of various complexity. Projects included building snow globes, making stickers, creating homemade gifts, and painting decorations.	20
Game Night & Innovative Workspaces	Students were invited to the makerspace to participate in a night of gaming. Games ranged from "simple" (Uno, cards, Jenga) to more complex (One Night, Settlers of Catan, Dominion). Each SEL hosted a game table, and each game table included a "Innovative Workspace" discussion question focused on gathering student input on how we can improve the feel and function of student work and lab spaces in the department. Questions included: What type of environment do you feel the most productive in? What do you like about the spaces in the ET building? How much of your day is spent in the ET building? What are some words you would use to describe the building,	5

	classrooms, labs? What are some minor changes that you would think would improve your experience as a student?	
Spring Craft Night Event	In collaboration with the WWU Makerspace Club, the SEL group hosted a craft night to celebrate spring. This event was similar to the holiday craft night and included project-based activities of varying complexity.	21

Overall, engagement activities have been successful from the standpoint of student participation and engagement. Figure 1 summarizes the average SEL responses to the Likert-style questions described above for each of the social engagement activities.

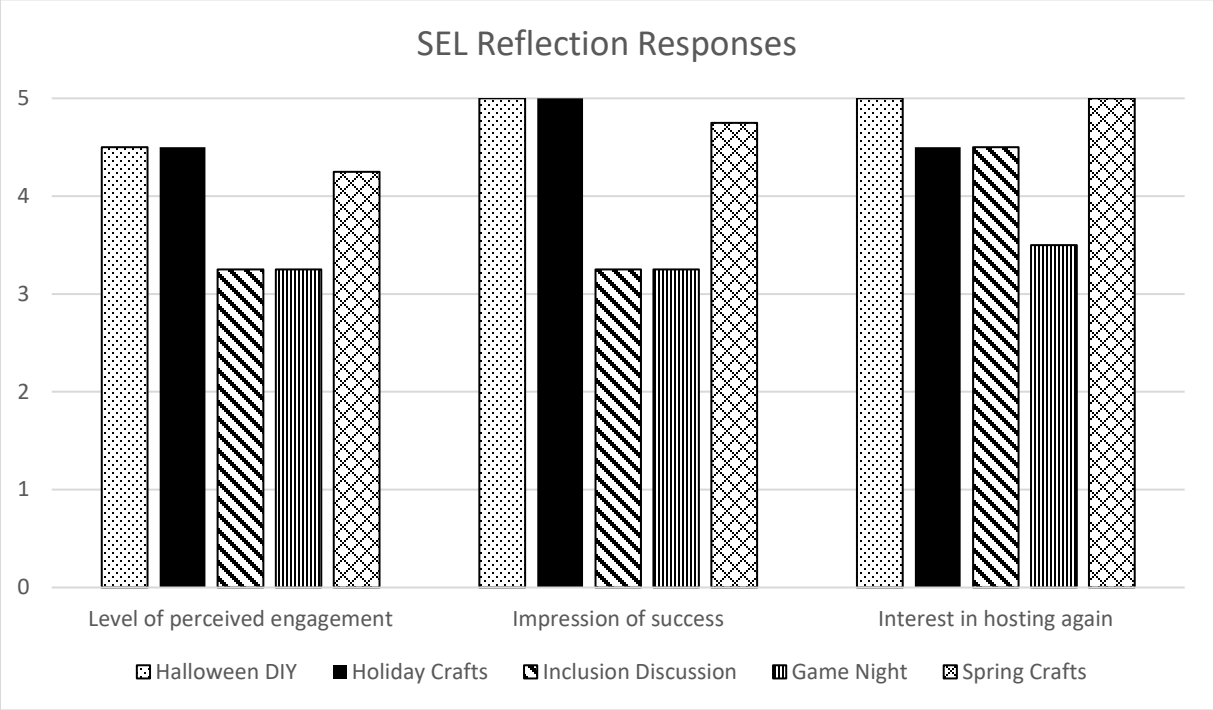

Figure 1: SEL Reflections

All craft-based events (Halloween, Holiday, Spring) were considered successful by the SELs and had a high level of engagement. However, the discussion-based events (Inclusion Discussion and Game Night/Innovative Spaces) were not as highly ranked. It is interesting to note that although the perceived level of engagement and impression of success of the discussion-based events was below average, the SELs are interested in hosting these types of events in the future.

The open-ended questions on the survey instrument provide additional insight into the events. Select comments from the SEL reflections are included in Table 3.

Table 3: Selected SEL Reflections on Social Engagement Activities

Activity	**Comments/Reflections**

Halloween DIY Night	"New people came into the makerspace and got a bit more interested in it. Everyone seemed to be having a good time" "Having a wide variety of possible crafts, as well as staff to encourage projects, allowed for creativity and discovery that may not have come if our resources were more limited."
Inclusion Discussion	"I feel that the presence of the pre-majors allowed for some perspectives that I wouldn't normally have heard or considered from full majors." "Having a list of questions that was geared towards both pre majors and full majors so that we can adequately engage with both groups would have been great, but we will have that for the next discussion." "Some form of activity besides a roundtable discussion might have prompted more input from the group. Examples of this might have been writing ideas on the whiteboard, submitting anonymous papers, working on small group projects, etc."
Holiday Crafts	"Students seem to appreciate these events, so we should keep doing these. It was a nice bonding event. This was a great place for students to connect. There were conversations that started from "You were in that --- class" and people made friends!" "While I love the holiday craft nights, I feel like there are some people who may not feel comfortable coming to the event because of social anxiety."
Game Night & Innovative Workspaces	"The level of engagement from the students that showed up were good. They seemed excited about the event to play games and bring up their point of view for the building improvements." Next time, it'd be good to advertise to avoid the word *discussion* and replace it with more approachable words like *chat"* "Probably could've chosen a better time and advertised a little earlier" "I would be interested to try something like this again, where the discussions are structured to be more natural. Having very few people show up made it difficult for me to really see how well the discussion formant went, however."
Spring Craft Event	"Overall, many people were socializing and working on their projects! It was fun." "The sewing kits brought a lot of attention, and we did the event with the Makerspace club which made it more successful."

	"I think for the next event, we should connect 2 tables together so that more students can sit together. The lone tables can feel isolating"
	"Everyone was engaged with activities. There was more conversation between people than before"

In their comments, the SELs indicated that there were some challenges with the format and structure of the discussion-based events and plan to address those in the future. They noted that these types of events would benefit from more participants and recommended doing more advertising and perhaps referring to them as "chats" rather than discussions. Additionally, SELs felt the events could have been improved with a different structure, such small group discussions rather than a round table. On the other hand, the craft-based events were seen as engaging and encouraged socialization between students. The SELs noted that seating is important and that having large tables encouraged collaboration and conversation.

Discussion: Successes, Challenges, Lessons Learned

Overall, the engagement activities have been successful from the standpoint of student participation numbers and general level of student engagement during the event, especially considering the hesitancy of students to work together in the tenuous post-covid environment. The makerspace, being small, has a capacity of 24 students so attendance was limited. Luckily, no students were turned away due to lack of space but that is something the SEL team needs to be prepared for in the future.

The most important lesson learned is that the design of the event is important. It is critical to offer a variety of activities in which students can participate at varying levels. The most successful events included activities that allowed students to join in simply by sitting down and getting started, such as painting or drawing. Activities that required instruction, speaking to someone, using equipment (3D printers or sewing machines), or explaining gaming instructions, tended to attract students already familiar with specific aspects of the project, game, and/or technology. For example, during the Halloween event, only students who already knew how to sew were using the available sewing machines. In addition, the SEL team noticed that students did not tend to engage in activities that involved learning new things until after they became comfortable in the space.

Another reflection is that it is important for the SEL students to invite students in as they come in the door. Although this seems obvious, there were times when things got busy and students entering the room were not greeted immediately. The SELs reflected that those students who were not greeted would turn to leave or would just stand at the door unsure of what to do. Having a team of dedicated students to run these events was critical to the success to the events. Not only were they responsible for the design and development, but they were also in charge of advertising and promoting the events through channels such as Instagram, discord, and slack.

The main challenge thus far has been navigating the changing dynamics of the makerspace in the context of the pandemic. The first three weeks of the winter quarter at WWU were remote which required the SEL team to postpone some of the activities. In addition, all activities needed to be setup to allow for adequate spacing between students per department protocol which impacted student engagement. The project could be improved by including students in activities remotely.

While this is possible for the discussion related activities, this will be more challenging for the craft and project focused events.

Conclusion & Next Steps

Social engagement activities serve to build community and connection between students which is important to the development of student sense of belonging. The SEL team has been successful in designing and conducting social engagement activities that allow students of varied backgrounds, prior knowledge, and technical aptitude to work together in an academic makerspace. The SEL team has plans to offer addition events over the course of the next two years. Planned event themes include a make-do-build night, stamps & stickers, mediation & self-care. The SEL team is also currently planning a remote event focused on a discussion topic and will evaluate student interest in this format. The next phase of the project will investigate the impact that these activities have on student sense of belonging. All attendees have completed a sense of belonging pre-survey and will be sent a post-survey at the end of the academic year. Data will be analyzed and summarized in a future publication.

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