Engagement in Practice: Performing STEM Outreach During a Pandemic

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Introduction

At Santa Clara University (SCU), STEM Outreach in the Community is a course that satisfies the university's Experiential Learning for Social Justice (ELSJ) requirement. The course has a two-unit lecture component and a one-unit lab. In lecture, students participate in discussions and complete assignments where attention can be brought to national and local economic and educational inequities. Students perform outreach through the lab component of the class. The outreach opportunities are traditionally through four partner sites where SCU students teach engineering lessons to K-12 students. In March 2020, when the pandemic caused shutdowns across the US, like many other schools, SCU and the partner sites transitioned to online learning. At SCU, this resulted in students being distributed across the country. Some partner sites, as non-profits that existed as after-school programs, ceased operations as they were no longer allowed to care for students in-person. Other partner sites transitioned slowly to online but most have been unable to support virtual volunteers. With that, for the entirety of the last four quarters (Spring 2020 through Spring 2021), outreach opportunities have moved to a virtual environment.

Course Logistics and Learning Objectives

The course satisfies SCU's Experiential Learning for Social Justice (ELSJ) requirement. The ELSJ component of SCU's Core Curriculum cultivates social justice, civic life, perspective, and civic engagement. It involves community-based learning with a social justice emphasis. Students are required to (i) engage in 16 hours of community-based learning experiences and (ii) perform critical reflection and evaluation of their experiences. A primary goal of the ELSJ requirement is "to foster a disciplined sensibility toward power and privilege, an understanding of the causes of human suffering, and a sense of personal and civic responsibility for cultural change."

The specific learning objectives of an ELSJ class are as follows:
- Recognize the benefits of life-long responsible citizenship and civic engagement in personal and professional activities (Civic Life);
- Interact appropriately, sensitively, and self-critically with people in the communities in which they work and appreciate the formal and informal knowledge, wisdom, and skills that individuals in these communities possess (Perspective);
- Recognize, analyze, and understand social reality and injustices in contemporary society, including recognizing the relative privilege or marginalization of their own and other groups (Social Justice);
- Make vocational choices in light of both their greatest gifts and the world's greatest needs (Civic Engagement).

The STEM Outreach course was developed (i) to give Engineering students an opportunity to take an Engineering class to satisfy their ELSJ requirement, (ii) to provide meaningful outreach to the community, (iii) to promote STEM to under-served communities close to SCU. In addition to the ELSJ learning objectives, this course was designed with the hope that students would also:

- Develop educational materials and hands-on STEM activities as a service to the community
- Develop project/time management, organizational, and leadership skills.
- Develop effective listening/collaboration skills while working with community partners.
- Recognize and understand ethical responsibilities of engineers.

In the lecture component of the class, students are introduced to concepts that can help them when performing their outreach. Specifically, there is a nine-lecture sequence where the following material is discussed:

Lecture 1: Introductions, Course Logistics, Goal Brainstorm, Meet groups, Lessons: big picture
Lecture 2: Teaching Brainstorm, Growth Mindset, Self-Concept (Math), Lesson plans
Lecture 3: Productive Failure, Common Core/Math Anxiety
Lecture 4: Stereotypes/Stereotype Threat [3]
Lecture 5: Perspectives Workshop (run by outside group)
Lecture 6: Teaching with Constraints
Lecture 7: Continuing Education, Community College
Lecture 8: Income in the US
Lecture 9: Final Reflection

The course is open to all students and approximately 35 enroll each quarter. While many students are from the School of Engineering, the class is also taken by students from the College of Arts and Sciences and the School of Business. Students from the latter are generally Finance or Accounting majors who have expressed that they want to learn more about STEM. While the college, as a whole, has a good gender balance, the STEM Outreach class tends to follow the percentages found within Engineering and has 25-30% females. 41% of SCU's students are white and 28% are underrepresented minorities. The students found in STEM Outreach tend to match these statistics. While SCU has many programs supportive of lower socio-economic students and first-generation college students, only 2.2% are from the lowest 20% quintile. 71% of the student body comes from a family in the upper-most 20% economic quintile.

Preserving Goals Through Transition to Online Outreach

An important consideration of the transition to online outreach was to continue to satisfy the university's goals as stated in the previous section. With the outreach, specifically, the goal was to provide avenues for the required 16 hours of outreach that continued to expose SCU students to experiences that would allow them to communicate with individuals within the community. The ultimate goal is two-way learning where SCU students provide supportive outreach while learning about the societal barriers that make it more challenging for socioeconomically disadvantaged students to succeed academically. In addition, students providing the outreach can benefit from the strategies that are discussed in the course [4].

New Partners

Since transitioning to online, three main partnerships have been leveraged to meaningfully connect SCU students to their community. This section will introduce and explore the details of each relationship. One avenue for outreach came from within as SCU's Ignatian Center was well

connected with local K-12 schools and tutoring was initially provided for individual 5th graders whose families signed up for the opportunity. This was facilitated completely by the staff at the Ignatian Center. The age group was particularly attractive as 4th-6th grade has been determined to be a critical time for outreach [5]. Over the past four quarters, this has resulted in tutoring that has spanned 60 individual tutoring partnerships with students from 2nd to 10th grade. In each case, the SCU students self-schedule two one-hour tutoring sessions per week and are responsible for providing a Zoom link.

Another resource was through a volunteer program that was also created within SCU. The Society of Women Engineers (SWE) chapter had recently created the cleverly named SWE++ program where members of SWE teach programming to local 7th grade girls who had not previously been exposed to computers or the world of programming. This outreach puts female college students in teaching positions in front of their younger counterparts. This works to shift implicit gendered stereotypes that can hinder a pathway to a STEM-related career [6]. SWE++ transitioned to online in Spring 2020 and hosted weekly Zoom sessions. Students from the STEM Outreach class supported these SWE++ lessons by joining the virtual sessions and going into Zoom breakout rooms to work with smaller groups of three to four 7th graders.

A third avenue for outreach came from leveraging the fact that the course's professor also teaches at a local Community College, Mission College. Thus, communication with students at both schools was straight-forward. Students at SCU, equipped to provide tutoring, were connected to an eager body of students at Mission College who wanted tutoring. Tutoring was arranged in Math, Chemistry, Physics, Engineering, and, despite stretching the limits of STEM, Economics and Accounting. As Engstrom and Tinto eloquently stated "Access without support is not opportunity" [7]. This partnership worked to provide that support.

Assessment

Before the STEM Outreach course begins and after the it is complete, students complete a survey that asks a variety of questions that seek to learn more about their perspective on social injustice – both locally and globally. While over 40 questions are asked, data only from the following questions will be focused on here:
1. In your view, how extensive are the social and economic inequities among people in the neighborhoods surrounding SCU?
2. In your view, how unjust do you personally feel the social inequities are in the neighborhoods surrounding SCU?
3. In your view, how would you rank your social and economic status relative to other people in the neighborhoods surrounding SCU?
4. In your view, how extensive are the educational inequities in terms of opportunities to a quality education for all students in the neighborhoods surrounding SCU?
5. In your view, how extensive of a disadvantage is growing up in a low-income family to getting a quality education in the neighborhoods surrounding SCU?
6. How important is it for you to be involved in social justice activities?

Students also submit a final reflection paper where they discuss their time in the course and, specifically, the impact of the outreach that they performed.

Challenges, Successes, and Lessons Learned

Before discussing the successes and lessons learned from the existing online partnerships, it is worth noting some of the hurdles that other groups may encounter if embarking on similar relationships. While many barriers will fade as outreach returns to in-person; other challenges may persist. One challenge that was faced was that some pre-existing partners were simply not prepared to handle the transition to online. With that, they were unable to get their services delivered virtually and this made it impossible for SCU to continue collaborating. Another partner continued working online with some students but explicitly required that background checks be done locally. While this was straight-forward when SCU students were on-campus, this severely limited the students that could participate after most had returned to their permanent homes across the globe. The final challenge, for the few pre-existing partners that have been able to transition to virtual instruction had to do with their ability to integrate outside volunteers. Most teachers and non-profit facilitators were struggling to manage the technology required to connect with their students and were simply not able to handle the additional requirements to facilitate breakout rooms and other mechanisms that would allow SCU students to participate.

Once partnerships with the Ignatian Center, SWE++, and Mission College were established, there were a different set of challenges, but also a great number of successes. The remainder of this section will focus on the outreach that has been performed online since March 2020. With the contacts made for individual tutoring through the Ignatian Center, the biggest challenge has been the retention of the K-12 students. What started as just fifth graders has expanded to students up through high school. Unfortunately, in many cases, students are being signed up for this tutoring by their parents and, in some cases, the students are seemingly unwilling participants. This has caused the SCU students to focus on retention strategies and focus on things other than tutoring. The SCU students appreciate the value of the time spent and have been steadfast in their creativity and drive to make the best of each session. One would think that the older students at Mission College would be more likely to commit to their tutoring sessions, but, unfortunately, many are juggling jobs, family, and other responsibilities that make academics a lower priority. Thus, while the tutoring would be helpful, it takes a back seat to many, more important, obligations. Of course, a final hurdle that everyone across the world has been struggling with is the ability to meaningfully connect with students over an online medium. The SCU students are not trained in education and did an admirable job given their limited time preparing for it. Many created virtual lessons that went beyond just helping their students with homework.

When considering successes, it is worth considering the perspective of both the students receiving the online tutoring and the SCU students who were performing the outreach. Anecdotally, many SCU students spoke extremely fondly of their time in the class. Here are some quotes from SCU students that have been drawn from their final reflection papers:
- "Through working with <my Mission College student>, I was able to find opportunities to be grateful. She juggles childcare, marriage, and learning all in one day. For her to do all of the aforementioned tasks and stay positive and eager to learn is incredible. Even when faced with

the difficult challenge of finding balance between working, supporting her son, and learning, she was thankful for every one of our sessions and time spent furthering her abilities. It caused me to self-reflect and continued to fuel my growth in finding gratitude in everything I do."

- "By sending their daughters to our Saturday sessions <at SWE++>, the girls are being exposed to coding, which is something that is so important since technology is everywhere. By letting them have this experience, these girls are one step ahead since they have learned such a useful skill that many others may not have until many years later."
- "Between <my student> and me, it was evident the differences in social and economic status. My knowledge of these differences grew just by the few short weeks I had with <her>. What more can I learn if I were to do this for a couple of months or a year? I am sure I would learn a lot more and gather a greater awareness of the social justice issues we talked about in this course. When tutoring <my student>, I was re-inspired to continue helping out in my community at home and school."

Despite the challenges described earlier, these inspiring transformations and observations were made possible despite connecting through an online medium.

The author had limited contact with the students on the receiving end of the tutoring at every location except for Mission College; however, the few emails received spoke very highly of the experience. Specifically, one thanked their tutor for helping them understand a particularly challenging topic, while another thanked their tutor for helping them get an A – claiming that it would not have happened without them.

More quantitatively, it is worth considering some of the data from the surveys that SCU students took before and after the course.

	Intro Survey		Exit Survey		Intro->Exit Change	
	Pre-COVID	Post-COVID	Pre-COVID	Post-COVID	Pre-COVID	Post-COVID
Q1	3.22	3.25	3.60	3.93	12%	21%
Q2	3.37	3.17	3.70	3.95	10%	25%
Q3	3.04	3.08	3.50	3.51	15%	14%
Q4	2.88	3.00	3.55	3.76	23%	25%
Q5	3.80	4.33	4.30	4.41	13%	2%
Q6	3.80	3.75	4.05	4.22	7%	13%

Table 1: Results from the survey as described in the Assessment section of this paper. Questions were answered on a scale of 1-5. Average values are shown for each question both prior to (171 students) and after (62 students) the transition to online outreach for both the intro survey (before the class) and the exit survey (after the class). The percent change is also shown.

Table 1 shows the results from the survey taken by 171 students before and 62 students after the course. Students who took the class since Spring 2020, in response to questions 1 and 2, felt more strongly that social and economic inequalities were extensive and unjust than prior STEM Outreach students. This helps justify that the transition to the online partnerships, if anything, strengthened the goals in terms of helping students see this. Students increased equally in terms of ranking their social and economic status relative to others as asked in question 3. Based on question 4, students also increased equally in terms of understanding how extensive educational

inequities are in terms of opportunities to a quality education for all students. question 5 suggests that after the pandemic, prior to taking this course, students more strongly viewed the extent of the disadvantage of growing up in a low-income family with regards to getting a quality education. And, despite the increase being smaller, the extent was still even stronger after the course. Finally, question 6 reveals that students felt more strongly about being involved in social justice work after the course.

In terms of lessons learned, it is important to have the right partnerships and to try to ensure an opportunity for meaningful connection. It is also important to recognize that students will connect with other students – no matter how challenging the medium might be.

Future Work

Looking ahead, the author hopes to analyze the data more exhaustively and compare to terms after the pandemic and after the return to in-person outreach. This initial look is a cursory one and looking more deeply at all questions may reveal even more lessons. Also, the focus initially is on the impact of the outreach experience on the SCU students; a more purposeful approach to the research aspect of this course could result in concrete information on the level of support provided to the underrepresented students that were worked with.

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