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## **An Engineering/Computer Science Project with Community Service Focus**

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### **Abstract**

This conference paper/submission informs about a S-STEM (Scholarships in STEM or S-STEM) project awarded to the University of New Mexico (UNM) School of Engineering (SOE). The project is focused on providing scholarships to students with merit who also demonstrate financial need. This particular project was focused on professional development activities as well as community service projects. The community service was attained by the scholars through taking credit hours or through undertaking paid internships. Although the project is in its first two years, it has had many successful community engagement/community service projects. This paper/submission focuses on surveys and other data from the scholars' participation in this project. The data shows that the project is headed in the right direction in terms of achieving its original stated goals.

### **Literature Review**

Although there are not a lot of journal papers on the topics of Service Learning/Community Engagement (SL/CE), there are many conference papers, especially published in ASEE conferences, that address these topics. For example, Koh (2020), developed a “Community Engaged Design” course as a senior design capstone in a small liberal arts college. Students were able to address pedestrian safety in their community by coming up with a prototype for a system which detected and warned drivers of the presence of bicyclists. Jordan (2014) took their service learning all the way to Haiti by working with the locals there to establish a solar project that can offer sustainability for them. Schneider (2017) presented a paper that discussed several research and capstone projects aimed at improving efficiency and reducing operational costs at a local food

bank. Then they extended that to interdisciplinary collaborations centered on the use of sustainable urban agriculture as a means to increase access to fresh produce within the emergency food network. Frey & Atwood (2013) used a Strength of Materials course to engage students in a local middle school in hands-on activities related to concepts like buoyancy, electricity, strength of materials, and mechanics. Jordan-Bloch & Cohen (2018) used service learning to motivate girls into STEM education/careers. Che (2018) used students in a computer-aided engineering (CAE) course to construct a CAD model via ANSYS for an old truss bridge. The motivation for this project was for students to help determine the load-carrying capacity (or reverse engineer it) of the bridge for safety purposes going forward. Krishnan & Nilsson (2015) discuss a course titled “Engineering Projects for the Community” at their institution to engage students in community projects. Projects cover a wide variety of engineering majors including civil, mechanical, electrical, bio and computer. This course also emphasizes the need to interact with civic bodies or public organizations which is a new soft skill set for the students involved. Nagel et al. (2019) discuss in their paper design courses at James Madison University intended to help the local community through student engagement in projects benefiting the locals. The paper is particularly focused on second-year course for the design, development, and delivery of human-powered vehicles for individuals with disabilities. The course incorporates experiential, problem-based learning and active learning pedagogies to teach sophomore engineering students engineering design fundamentals. Lu et al. (2018) presented a paper involving their land-grant university and a created course encompassing three majors (distribution logistics, sociology, and technology management) who work together on a distance service-learning project to address food disparities. Canney et al. (2018) presented results from a CAD course (or drafting course) which engaged its students with local community partners through the university’s own Center for Community Engagement. Oakes et al. (2018) presented a long-standing program at their institution that has had a great impact on education and community engagement, as recognized by ASEE, IEEE, NAE, and others. Over 400 projects have been delivered ranging from software that allows agencies to coordinate services and protect privacy, to a constructed wetland that purifies agricultural runoff, to an iPad app that helps children with autism communicate, to a new school in rural Ecuador, or an accessible camp for children with disabilities.

Although there are more older references dealing with SE and CE, it suffices to say that ASEE is in particular interested in these topics and studies that address them. The current study, with its own unique flavors, is one of them.

### **The Initiative**

The University of New Mexico (UNM) is a Hispanic serving institution in which a larger number of students are first generation college students from low socioeconomic backgrounds and face academic, financial and social barriers while pursuing their education at the University. The UNM School of Engineering (SOE) is hosting a National Science Foundation (NSF) sponsored project for Science, Technology, Engineering and Mathematics (STEM) majors (focused on Engineering and Computer Science students). This new initiative is one where the participants are engaged in

service-learning opportunities with the local community addressing their technical needs, while also understanding the root causes of community issues by engaging in dialogues with the community leaders through the UNM Community Engagement Center. (CEC). The participants of the program receive scholarships and/or credits for classes (or paid internships) which not only help with their continued academic learning, but may also increase their ability to work in interdisciplinary teams, increase social skills, communication skills and expand their knowledge of community-engaged processes.

### **The Partners**

The project was initiated and is led by the UNM SOE, with multiple partners, a major one of which is the UNM Community Engagement Center (CEC). CEC serves as a university-based intermediary with communities to achieve community driven results. CEC partners with community-based organizations and leaders who are implementing innovative and impactful strategies towards addressing inequities. The students who engage in community-based projects are often inspired to work alongside community partners as they grow into their careers. CEC strategically chooses partners that are committed to serving through innovative strategies.

### **The Model**

The UNM School of Engineering's initiative has multiple facets. For the purposes of this paper/presentation, we will focus on one aspect: community engagement. SOE's collaboration with CEC began in the spring of 2020. CEC would reach out to the community partners asking them to send their technical needs requests, and then CEC shared it with the UNM SOE. The Engineering Student Success (ESS) Center within SOE, working with the PI (Principal Investigator) helped recruit and match students from all disciplines of engineering, with the chosen technical needs of the community sites. The CEC then sets up the introductory meetings between the S-STEM scholars and the site partners, conduct an orientation for the students and facilitate community engagement experiences for the NSF S-STEM scholars and non-profit organizations. S-STEM scholars were involved in projects that used their engineering technical skills to develop sustainable processes and products that will meet an array of needs, including creating software solutions, providing website assistance, conducting energy audits, or developing energy saving technologies. The CEC staff met with STEM Scholars on a bi-weekly basis for an hour where staff reviewed and discussed various topics such as the continuum of community engagement to service learning, community mapping, community outreach, and asset-based community approach. The CEC staff allocated time to hear about project updates, and issues or concerns that needed to be addressed. The SOE also organized a series of meetings where the S-STEM scholars would share their lessons learned with peers, faculty, researchers and coordinators. SOE also coordinated formal research on the project with researchers (e.g. communication research).

### **The Community-Based Projects**

Students worked with their partner site leaders to design and implement projects. Examples include:

- 1) One group of S-STEM Scholars worked with an organization that provides services and support for refugees and asylum seekers. STEM Scholars helped certain clients learn digital media skills to better outreach for their start-up businesses. STEM Scholars helped them with their website development and taught them to increase their online presence by using social media and other platforms. One of them also worked with refugee farmworkers and helped them with planting, gardening, irrigation and taught them some basic farm equipment maintenance (like fixing a leak in a hydraulic pump), and the importance of using local produce to help the local economy. In the following year, they also helped install a mobile solar trailer for their farm by converting the manure spreader into a mobile solar trailer that they could use for work tasks and community events.



Figure 1: The trailer being converted to support solar panels for future on-the-go charging of equipment. One of the student groups worked on this community project.

- 2) Another group served at a community health clinic that supports immigrants and refugees. The scholars focused their work on assessing areas where the clinic could be more energy efficient. They installed a drip-system that increased the efficiency of a water system that spans the property. Also installing and retrofitting a high efficiency insulation barrier to the windows, doors, and surroundings to help reduce the clinic's energy costs.



Figure 2: Window above the door shows an increase in the internal temperature of the building, signifying better insulation. This is the work of one of the student groups with a community partner.

- 3) A third example is where scholars served a community organization that works on preserving acequias (old water ducts/canals) and works on sustainable solutions to save land and water by using traditional farming methods. The S-STEM scholars worked on mapping acequias that are not functional within the La Pajarito Acequia Madre in the South Valley, in Albuquerque, New Mexico, using geographical information systems (GIS), and drone technology. Three proposed acequias were reported alongside a database of high-resolution photographs, and GIS digital maps.

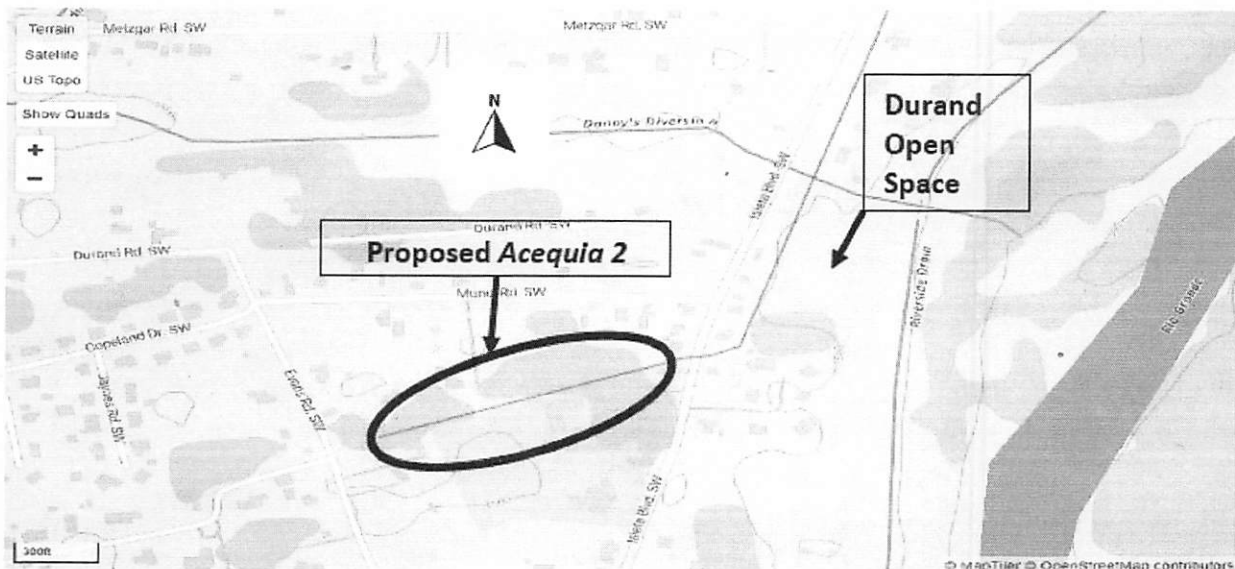
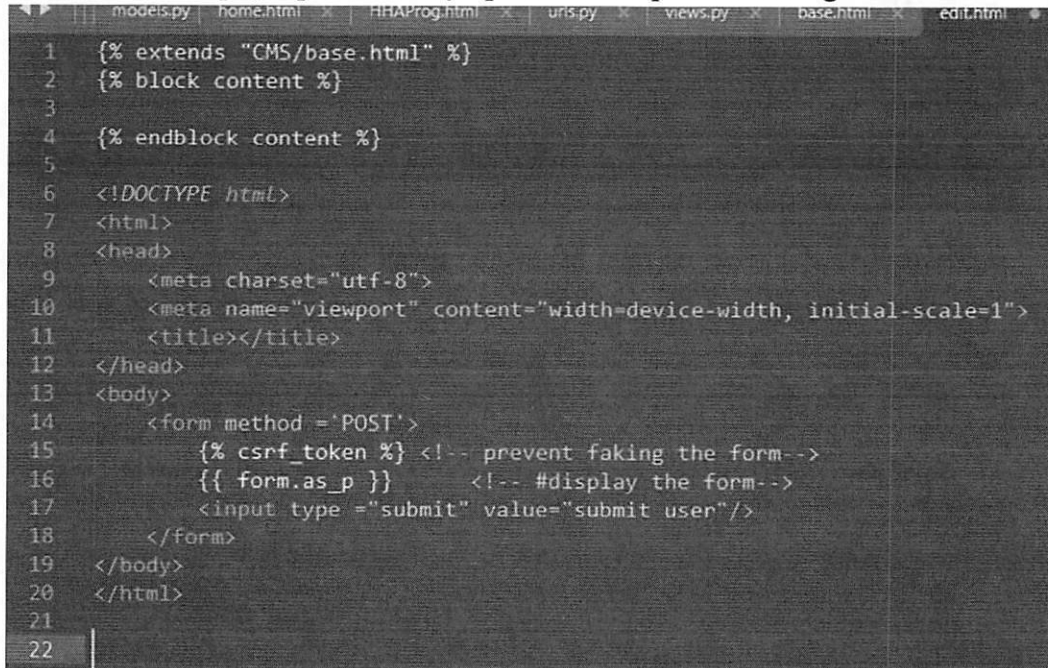


Figure 3: GIS mapping of the area around the acequia performed by the community-engagement project students.

- 4) One other group served at a non-profit whose mission is to transform New Mexico into a thriving community for all its residents, by engaging with Latino immigrant families in educational and career development opportunities that build skills for economic and social justice. The participants worked on creating models for the back-end computer server. They also helped with the data that the organization needs and worked on creating formats to view the data/page queries. They optimized the process through research and coding.



```

1  {% extends "CMS/base.html" %}
2  {% block content %}
3
4  {% endblock content %}
5
6  <!DOCTYPE html>
7  <html>
8  <head>
9      <meta charset="utf-8">
10     <meta name="viewport" content="width=device-width, initial-scale=1">
11     <title></title>
12 </head>
13 <body>
14     <form method = 'POST'>
15         {% csrf_token %} <!-- prevent faking the form-->
16         {{ form.as_p }} <!-- #display the form-->
17         <input type = "submit" value = "submit user"/>
18     </form>
19 </body>
20 </html>
21
22

```

Figure 4: Some of the background programming done by the students in this particular community-engagement project.

## The Outcomes

The UNM SOE and CEC incorporate a qualitative research study that seeks to explore how participants' Service Learning/Community Engagement (SL/CE) experiences influence students' perspectives and understandings toward public welfare and their engagement with engineering majors. In addition, the study seeks to investigate students' reflections on their major: pre- and post-SL/CE. The research methods include collecting data through surveys, one-on-one interviews with the scholars, document analysis of scholar and site leader reflections/reports, and regular check-in meetings.

The initial findings from participants survey responses have indicated mostly positive outcomes. Some of the participants expressed how it increased their affinity for community work and helped them better understand how engineers could serve collective humanity, and empower people. They also talked about how working with the community helped them understand community assets and how the solutions could be found from within the community rather than from outside the



community. Some of them were also able to build a stronger relationship with their community and were grateful to the community leaders who were their mentors.

Though there were positive outcomes, there were also some challenges that the participants and the community members had to overcome. One of the challenges expressed by community leaders and students was finding time to coordinate meetings with all the group members and to get updates. There were also concerns about not knowing the clear expectations as the groups were a combination of students who participated in this for class credits and there were others who were participating as interns.

## **Lessons Learned**

The initiative is in the early stages but there have been some interesting lessons learned already:

- 1) The importance of giving opportunities to students to work collaboratively on interdisciplinary projects: Early on we heard students mention that they enjoyed the interdisciplinary nature of the initiative, which is what they believe happens in the real world. Others expressed their concern at not being focused enough on their specific engineering discipline, which speaks to the nature of how siloed disciplines can become.
- 2) Though initially a handful of students had concerns about not working in their field of engineering, later on they were able to understand and appreciate the importance of work on community-identified needs. Real world problem-solving energized many of them.
- 3) Placing students with the same community partner for more than a semester provided more time for them to complete their projects and build a stronger relationship with their community.
- 4) Continuing with some community partners over time, with different students, had the benefit of stronger long-term partnerships with community sites, which is at the heart of strong community engagement.

Though this interdisciplinary initiative by the SOE is fairly new, we believe that it gives immense opportunities for students to learn and serve the communities that they come from and help create an impact on the lives of many people. We plan to continue our work on this project to reach out to more communities that need a helping hand and to engage more students in our community.

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**KIRAN KATIRA**

Dr. Katira is the Director of the UNM Community Engagement Center (CEC). For the past 25 years she has been organizing with community leaders through CEC, where she nurtures the anti-racist leadership development of local youth around education, health and immigration justice. She is on several governing boards, including Dorn Charter Community School, NM Dream Team and NM Asian Family Center. Kiran is a national trainer in undoing racism, with the People's Institute for Survival and Beyond and has taught university courses on anti-racist education, peace and justice, and critical multicultural education.

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Dr. Khraishi currently serves as a Professor of Mechanical Engineering at the University of New Mexico. His general research interests are in theoretical, computational and experimental solid mechanics and materials science. He has taught classes in Dynamics, Materials Science, Advanced Mechanics of Materials, Elasticity and Numerical Methods. For the last several years he has engaged himself in the scholarship of teaching and learning.