

Kevin Ochoa

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REU Program

STEER Labs

E4USA's Impact On Early Student Engineering

Objectives/ Purpose

The main purpose of this research project was to identify how this collaborative project [e4usa] removes the barrier between existing programs in order to explore scalable and sustainable ways to work together and meet the demand for highly trained engineering professionals.

As well as testing the effectiveness of the program in developing student interests in the engineering field. This can also be helpful in identifying how someone's marginalized identity can affect their career choices and interests. With all this data we used the Social Cognitive Career Theory to explain our data and to support our results and conclusions.

Theoretical Framework

The Theoretical Framework that I and my mentor used was the Social Cognitive Career Theory (SCCT). This theory explains the important influences a person's beliefs, outcome expectations, and personal goals have on their career trajectory. Self-efficacy (personal beliefs) is one key component of the theory and is derived from four different beliefs; these are emotional and mental state, accomplishments observed by others, and being persuaded. The second building block is Outcome Expectation which connects to the Self-Efficacy aspect of SCCT. When a person does something, they expect an outcome (usually something in their favor) and this

pushes them to do it again. The third building block of SCCT is their Personal Goals which can be set by the person for many reasons. The Theory organizes these goals into performance goals and choice goals. These goals help keep them on track and work them toward their objective.

Methods, Techniques, or Modes of Inquiry

Our data consisted of transcribed interviews of high school students being interviewed about how they felt about the e4usa program. These questions also went into detail about what they believed an engineer was and what skills and techniques an engineer needs to do their job successfully. This is where we began the Qualitative Analysis Process with an overview of all the transcripts. This was to familiarize ourselves with the data. Drawing connections to the SCCT allowed me to gain a better visual of the results. I annotated a few selected articles and coded them manually. Themes were found across the different transcripts which ranged from "Contributors to Students Confidence" to "Student Perceptions of Engineers". This was all done using the software "Dedoose" which allowed us to organize our codes and subcodes on one list. Emergent coding gave us the groundwork for our Qualitative Analysis.

Combining the team's codes for the Analysis was a lengthy process and gives you a glimpse of just how the same transcript can be viewed from two different perspectives. With my mentor, we were able to combine our code list together and create a codebook that captures all, if not, most of the ideas that can be used in our research. A second review of the transcripts allowed us to create new codes with a better idea of what we could be looking for.

Data Sources/ Evidence

The codebook showed information can be interpreted as a positive sign of e4usa's success. Many of the codes could be backed up with two or more quotes from students. The students who took part in the program also showed a higher understanding of the engineering design process. For example, one common theme we found was "Knowledge, skills, or perceptions acquired" where students developed skills surrounding Communicating Ideas, Seeing oneself as an Engineer, and the Engineering Design Process. We find that the e4usa helped these students believe they are more aware and comfortable with engineering. The course helps students practice the Engineering Design Process. It was a lengthy process where solutions were thought of and reviewed to solve a problem. This is where students learn the wider aspect of engineering: creating solutions and helping the common people.

Of course, we have the goal of e4usa to break down the barriers minorities face and make engineering more accessible for them. An essential reference to this can be seen in a research article describing the efforts to break down the barriers minorities face when going into engineering. "Changing the perception of engineering and exciting diverse groups of students to pursue engineering requires a diverse group of teachers to teach pre-college engineering classes, beyond the mathematics, physics, and computer science groups" (Dalal and Carberry 8). This brings about another issue that prompts inclusivity and diversity in the education setting. From teachers to counselors, the belief is that breaking down minority barriers in engineering can involve making the classroom more welcoming with teachers from diverse backgrounds. This can encourage students to become more involved in engineering and become more comfortable with the idea of learning these difficult skills.

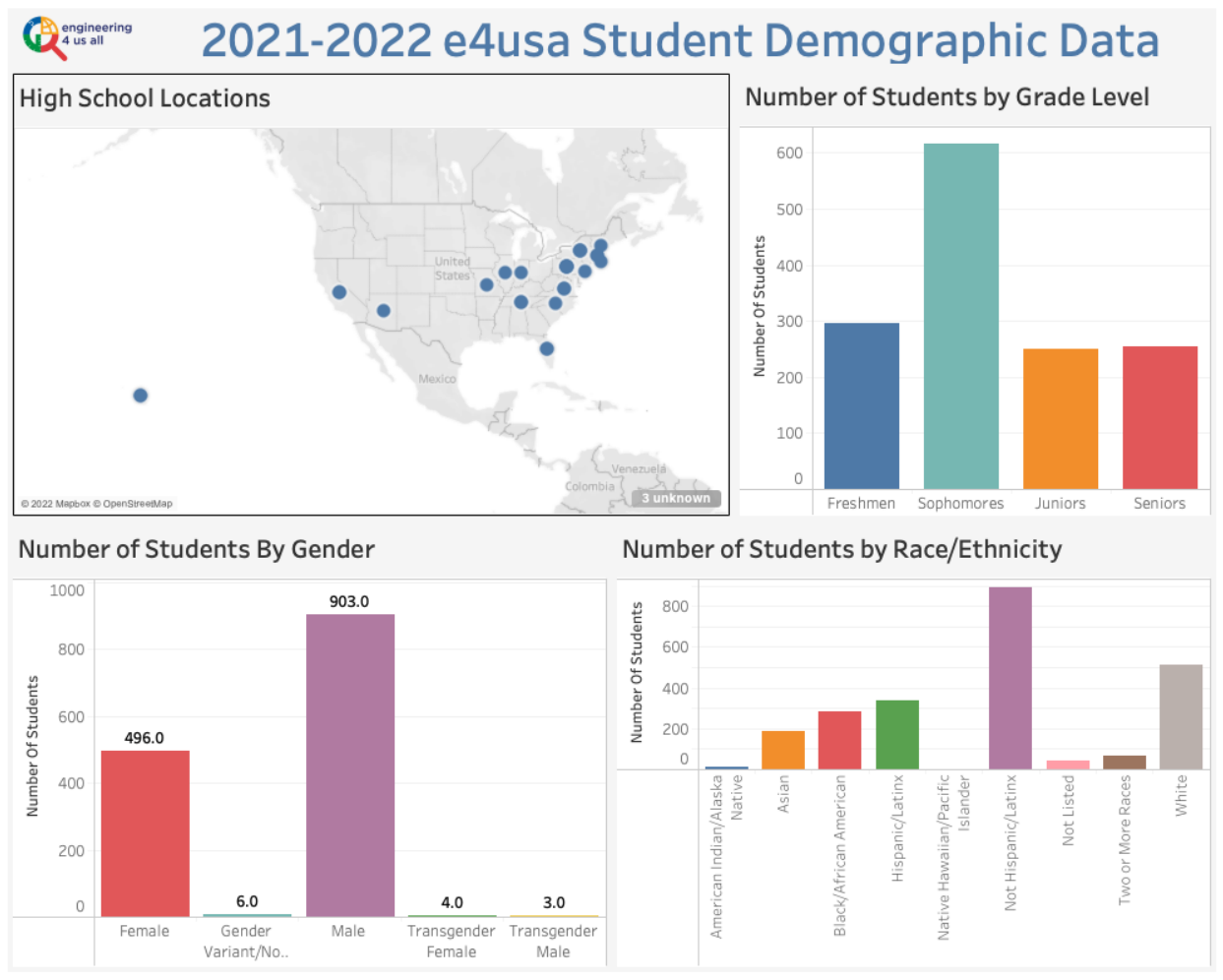
Another data source is from the 2021-2022 Student Demographic Dashboard which was constructed by me through a software called Tableau. The data that was derived from the

program should be an inclusion of all demographics participating in the program. Despite their inclusion, there was not an equal set of students from each demographic. White students were more prevalent in the program, and when looking at the data there are higher numbers of males in the program than females or any other gender. This could be seen as a guide as we include more students from different demographics and ensure that e4usa helps minorities overcome the obstacles when it comes to the engineering field.

Substantiated Conclusion

From our Qualitative Analysis, we can conclude that the e4usa program has successfully prepared its students with the critical knowledge and skills they could need in the engineering field. The e4usa high school program gave students a curriculum that allowed them to gain new insight into what engineering was about. It was effective at allowing students to get an overview of engineering which helped students know whether engineering is a right fit for them.

Tableau Dashboard



Works Cited

Medha Dalal and Adam R. Carberry. "Enabling Factors and Barriers for Adopting Engineering Curricula in High Schools: School, District, and State Administrator Perspectives (Fundamental)". *2021 ASEE Virtual Annual Conference Content Access, Virtual Conference, 2021, July*. ASEE Conferences, 2021. <https://peer.asee.org/37029> Internet. 14 Jul, 2022