Background

Strong research supports the benefits of undergraduate research experiences such as internships in success and retention of students, particularly in underrepresented groups (Lopatto, 2003, 2007, 2009; Laursen et al., 2010, Hernandez, et al., 2013). CUREs are a model that is being recommended to make these experiences available to a greater number of students as well as to students who traditionally would not have either the free time, or cultural capital to make the connections to get internships (Corwin Auchencloss et al 2014). This is a particularly important topic for a community college such as SRJC, which is a two-year Hispanic Serving Institution (HSI) with the following demographics:

- LatinX: 40.29%
- First generation college students: 30.00%

Project

In order to investigate the benefits of CUREs, over a 3 year period, SRJC implemented CUREs in 14 different STEM classes; both for STEM majors and non-majors.

- Agriculture: Soil Science
- Biology- Biology for Non-Majors, Principles of Biology and Fundamentals of Biology (Botany & Ecology)
- Chemistry: Introductory Chemistry and in Organic chemistry
- Computer Science: Computer Video Game Production
- Economics: Introduction to Macroeconomics and Introduction to Microeconomics
- Environmental studies: Introduction to Environmental Science
- Mathematics: Statistics and Linea Algebra
- Microbiology: General Microbiology
- Physics: Electricity and Magnetism

Data was collected on student success, defined as the percentage of students completing the course with a C or better. In addition, at the beginning and end of the semester student in both CURE and comparable Non-CURE courses were given validated instruments that assess a student's risk of dropping out of a scientific career path (Estrada et al, 2011). These questionnaires focus on scientific self-efficacy (confidence), scientific self- identity and endorsement of scientific values. These qualities are important predictors of student persistence in the sciences because they represent a student's integration in the scientific community and motivation to continue as part of that community.

At the end of the semester, CURE students were also given a survey that assessed their intellectual ownership in their project. Project ownership is another quality that is associated with student retention in the sciences (Hanauer & Dolan, 2014)

Results

The results of this project were very encouraging. Strikingly, there was a difference in student success between CURE and Non-CURE courses in some of the targeted populations: first generation college students, LatinX students and female students (Figure 1). The largest difference, and the one that was statistically significant was in 1st generation college students.

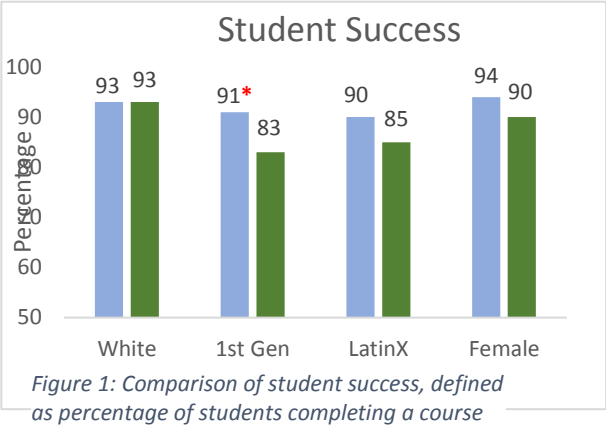

*Figure 1: Comparison of student success, defined as percentage of students completing a course with a "C" or higher, between CURE and non-CURE sections of 14 STEM courses at SRJC between 2017-2019. *p=0.04 for 1st generation students*

The results from the student surveys were more mixed. All of the students, both CURE and Non-CURE showed a statistically significant increase in their scientific self-efficacy (Figure 2, 3 & 4), showing positive effects of taking any STEM class at SRJC.

For CURE students, scientific identity and values alignment showed a statistically significant increase for female students, first generation college students and LatinX students (Figures 2,3 &4). Interestingly, the CURE students started out at a lower score than the Non-CURE students, but because they had a greater gain, ended approximately where the Non-CURE students ended. This pattern was seen for female students' scientific identity and values alignment (Figure 2). While for first generation college students and LatinX students, the Non-CURE students still finished ahead of their CURE cohort (Figure 3 & 4).

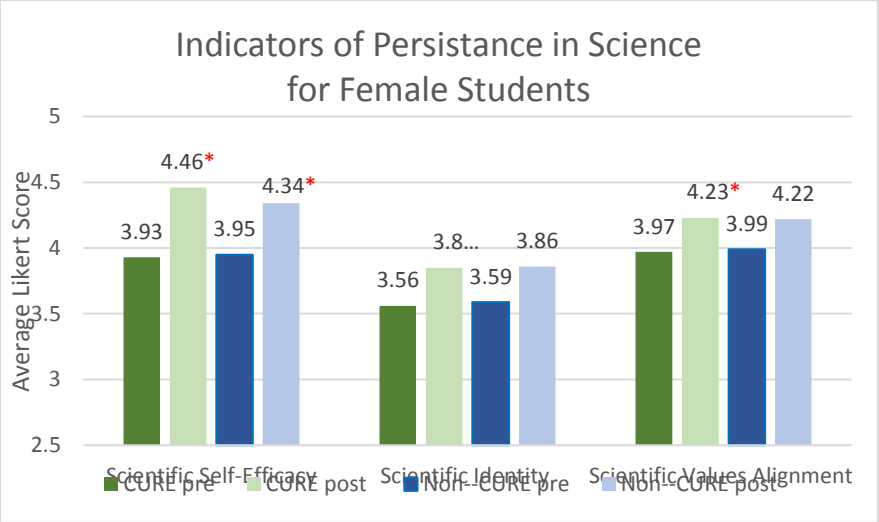

*Figure 2: Female students: Pre-CURE and post-CURE comparison of average Likert score for answers to Scientific Self-Efficacy, Identity and Values Alignment questionnaire (Estrada et al. 2011). * p=0.*

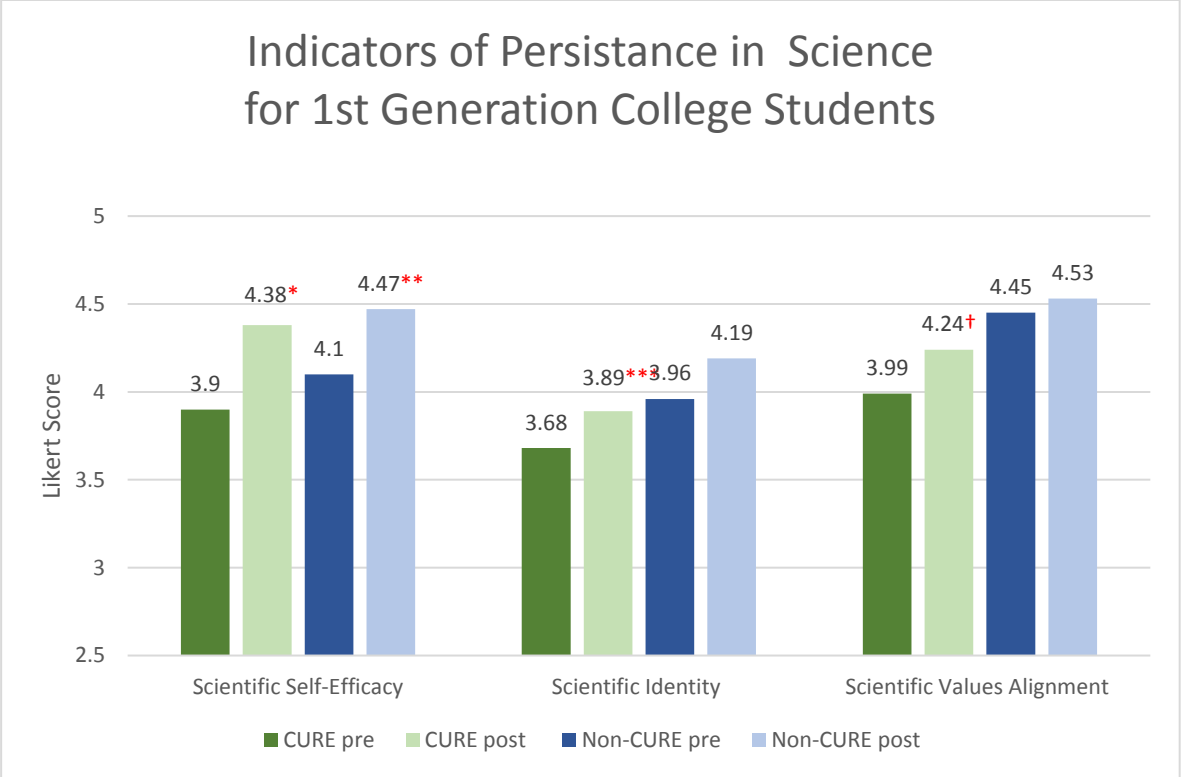

*Figure 3: 1st Generation College Students: Pre-CURE and post-CURE comparison of average Likert score for answers to Scientific Self-Efficacy, Identity and Values Alignment questionnaire (Estrada et al. 2011). * p=.0, ** p= .001, *** p=035, † p=.08*

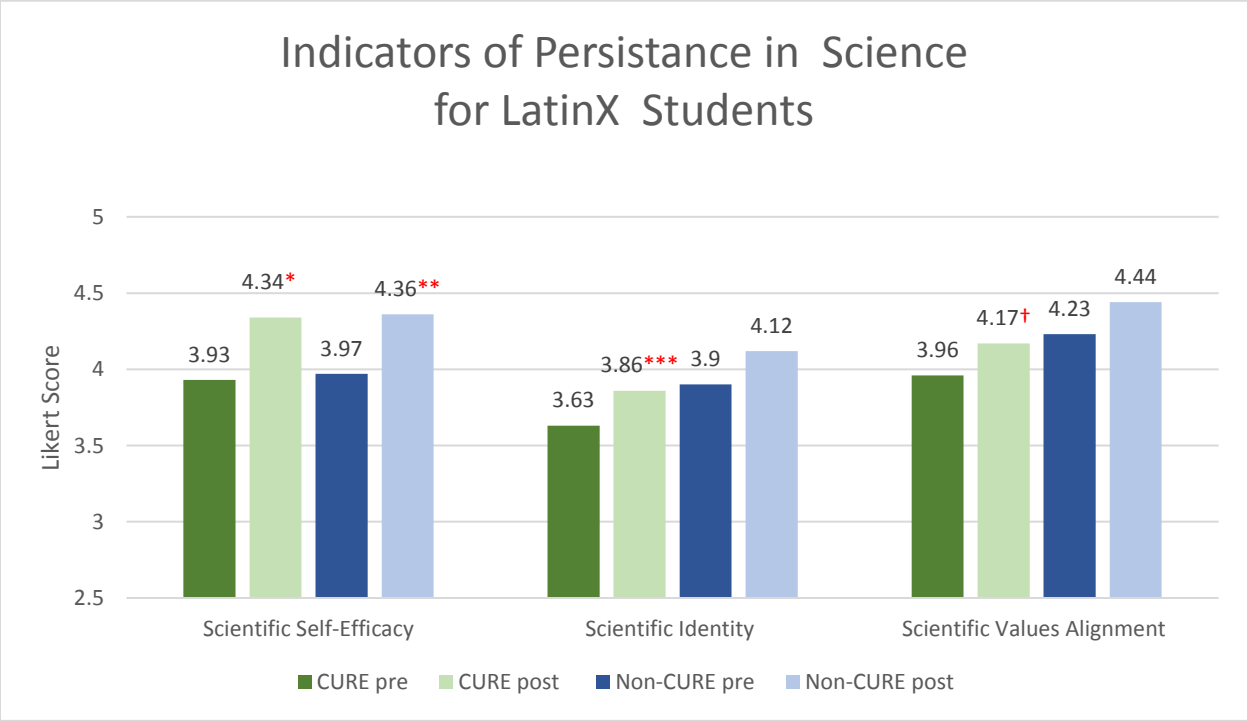

*Figure 4; LatinX Students: Pre-CURE and post-CURE comparison of average Likert score for answers to Scientific Self-Efficacy, Identity and Values Alignment questionnaire (Estrada et al. 2011). * p=.0, ** p= .021, *** p=016, † p=.021*

At the end of the semester, CURE students' surveys showed that female students and 1st generation college students had a statistically significant greater investment in the projects as measured by intellectual ownership (Figure 5).

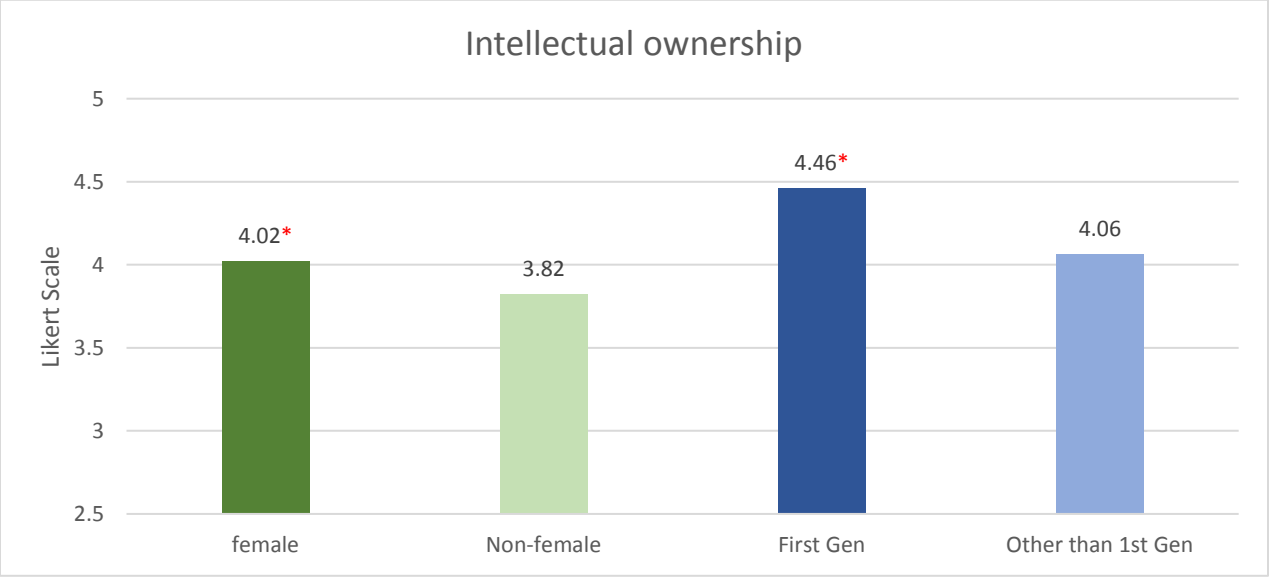

*Figure 5:Female and 1st Generation College Students: Post Cure average Likert score for answers to Intellectual Ownership questionnaire (Hanauer & Dolan, 2014) * p=0, **p=.06.*

Conclusion

Given that SRJC is a community college with a current population of ~19 thousand students and that the a sample size for CURE students was 730 and 236 for Non-CURE students, these results should be seen as exploratory rather than definitive. Nevertheless, these are very encouraging results, as the data indicate some of the most vulnerable members of STEM classes are benefiting from CURE projects. More work needs to be done, such as expanding the Non-CURE comparison group, doing ethnographic research and tracking these students as they continue their academic careers at their transfer institutions.

While the project focused on student success in STEM classes, there is one other striking aspect of this project; the number and diversity of CURE projects that faculty implemented across a wide range of disciplines. Community college faculty have heavy teaching loads as well as college service requirements. This project demonstrated that faculty are eager to get involved in new and exciting ways of integrating science and pedagogical research, The key to faculty involvement was the release time

that allowed them to plan and implement their CURE project. Faculty need time as much as they need money in order to implement much of what we already know are beneficial programs.

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