



Methods for Retention and Promoting Self-Efficacy in Secondary Students in Astronomical Research

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High school teachers participating in the NASA/IPAC Teacher Archive Research Program (NITARP) analyzed recruitment protocols and follow-through patterns of student mentees by evaluating student contribution to the project and results from demographic and perception surveys. What emerged is that astronomical research encourages academic resilience in students, with possible implications for the broader STEM education community.

Encouraging Resilience

Over the course of a calendar year, thirty six-students from eight high schools participated in data-based astronomical research (see our accompanying science poster by Anderson, et al.), facilitated by Caltech and NASA's Jet Propulsion Laboratory as part of the NITARP program. This program tasked students well beyond the standard classroom expectations of a traditional high school physics or astronomy course, requiring them to attain facility with complex, specialized and frankly daunting tools to navigate large amounts of astronomical data and manipulate it, and present results in a poster session at an AAS Winter Meeting.

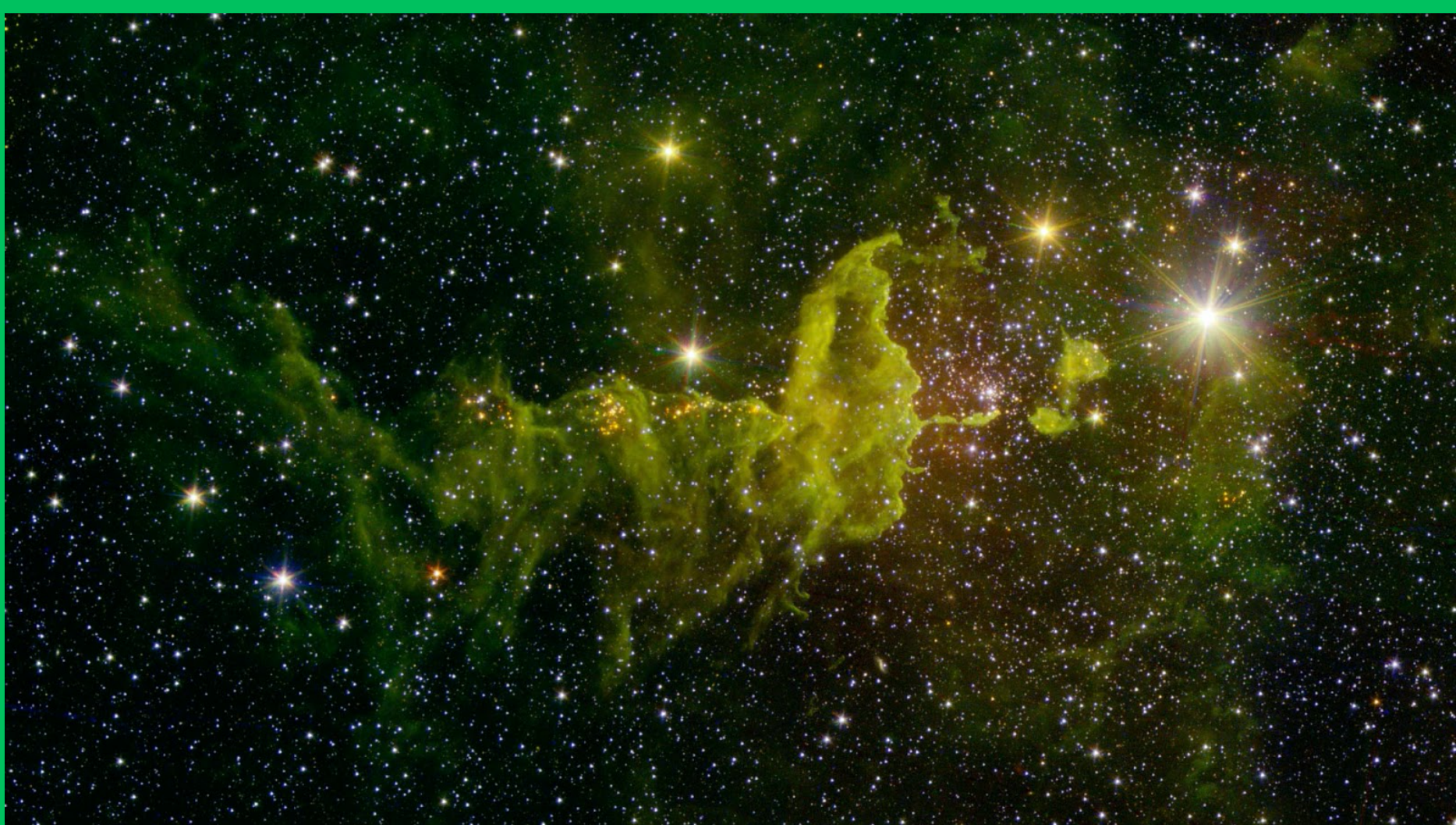


Figure 1. IC 417, the subject of this NITARP research project.

The tasks and commitment demanded by this program demands can be overwhelming for students, causing some of them to drop out mid-year. Yet students who followed through report a sense of exhilaration and achievement. The question becomes, "what keeps students on board?"

To answer this, students and educators were surveyed to assess student recruitment and support throughout the program, and reasons why students left the program. Analyzing the data of seven NITARP participating educators and twenty-four of their students provided a roadmap for promoting student participation and resilience.

Findings

First and foremost, the impact of COVID-19 can certainly not be understated, and, as a result, several students who left the program citing the pandemic were omitted from this study. Instead, the focus centered on academic rigor and environment for supporting students.



Figure 2: NITARP students and educators greet each other for an online work session.

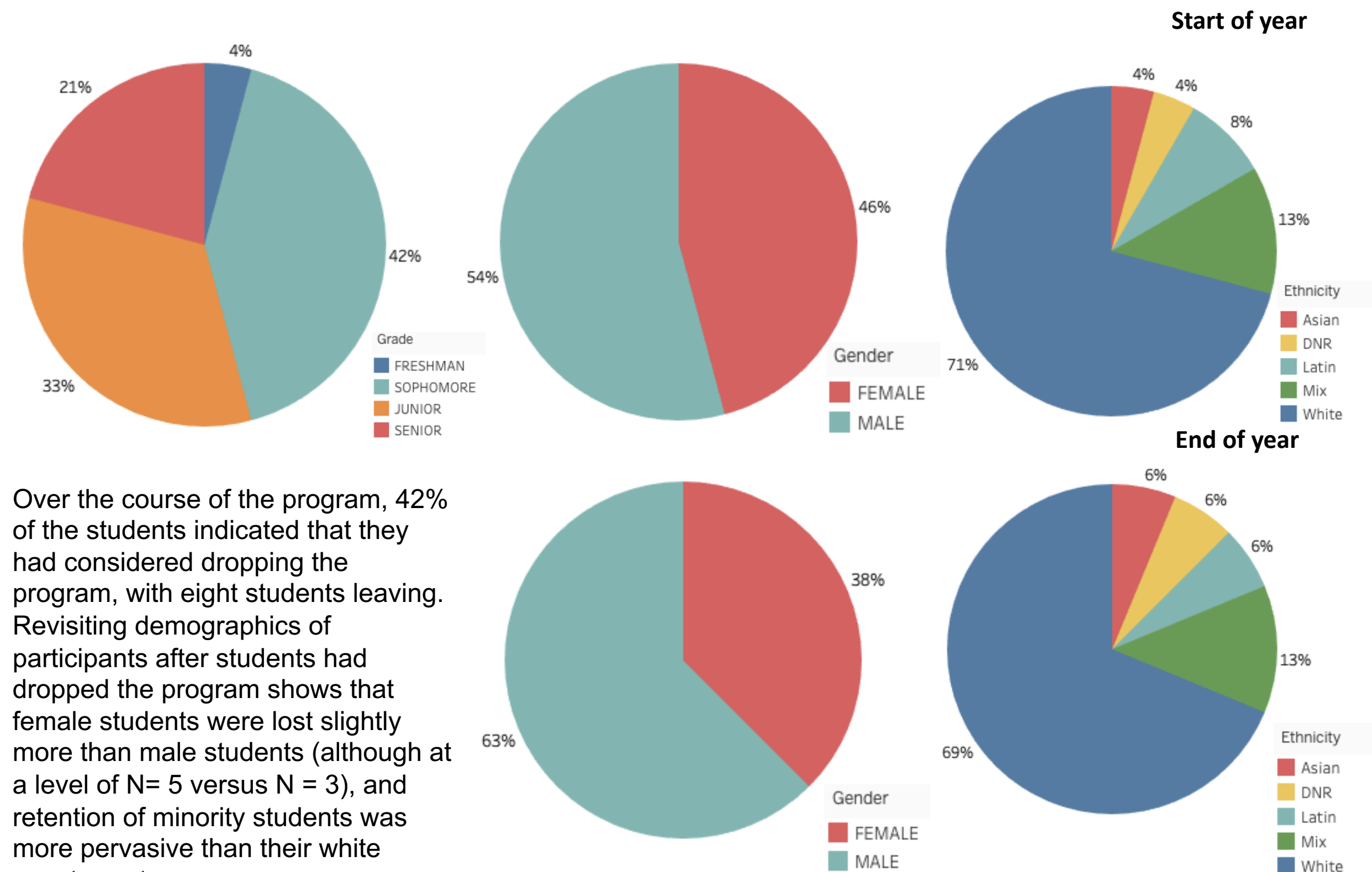
Of the students surveyed, participants showed a roughly even split between male and female students, with a stronger representation of sophomores and juniors. This is likely because high school freshmen may not yet have the academic background, while seniors will graduate half way through the program, which is aligned to a calendar year, not an academic year.

Students primarily identified as white/caucasian, with ~12% additional ethnicity being represented by each minority group. Students were overall very high performing, with few GPAs below an A average, and 73% of students indicating they planned to pursue a degree in STEM in college.

Acknowledgements

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Student Demographics



Over the course of the program, 42% of the students indicated that they had considered dropping the program, with eight students leaving. Revisiting demographics of participants after students had dropped the program shows that female students were lost slightly more than male students (although at a level of N= 5 versus N = 3), and retention of minority students was more pervasive than their white counterparts.

The stayed versus dropped demographics of the students by grade level shows no meaningful trend by years in high school or science courses completed. This suggests, that the workload was not unrealistically demanding for any age group. Students who both stayed or left often indicated that at times the workload felt overwhelming, but at the same time, they felt supported or that the teamwork motivated them to work through frustration or doubt. With student testimony indicating a sense of support and no clear demographic driver, attention turned to the teacher/student environment and expectations.

Educators varied recruitment protocols in terms of having an open call for applications versus selecting the students to participate, and also varied widely in how often they met. Significantly, of the three school groups to have greater than an 80% retention rate, all included a student-driven presentation component. These presentations included a school-wide sharing of the research, attending scientific lectures together (pre-COVID), and even delivering a seminar as part of the NASA Educator Workshop- a monthly event where teachers nationwide join live professional development webinars in order to better teach their own students.

Conclusions



In the case of all participants in the program, educators who challenged students to demonstrate their learning throughout the program by their own design saw no less than an 80% retention of their student participants.

As a conclusion, it is clear that students can be recruited by the exciting opportunity to do research in the NITARP program, but that their resilience to persevere in the program throughout the year is facilitated by their sense of ownership.



Figure 3. The Crescenta Valley High School Team.