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BOARD # 450: S-STEM: Barriers Stakeholders Face in Supporting Low-Income, First-Generation, and/or Rural Graduate Students

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S-STEM: Challenges Stakeholders Face in Supporting Low-Income, First-Generation, and/or Rural Graduate Students

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S-STEM: Challenges Stakeholders Face in Supporting Low-Income, First-Generation, and/or Rural Graduate Students

There is a growing need to train a wide range of students from different backgrounds in engineering disciplines and a growing demand for a skilled workforce with graduate degrees (Pearson et al., 2022; National Academies of Sciences, Engineering, and Medicine, 2019; National Science Foundation, 1996). A team of specialists in engineering and organizational systems worked together on a grant sponsored by the National Science Foundation's (NSF) Scholarships in Science, Technology, Engineering, and Mathematics (S-STEM) program to explore how evidence-based strategies used successfully at the undergraduate level might improve the recruitment, retention, and outcomes of graduate programs. In this study, we interviewed a sample of the stakeholders who support low-income, first-generation, and/or rural graduate engineering students, to gain insight into the barriers they face in their efforts. We used a thematic analysis of transcribed interviews to draw conclusions. We found seven themes describing the facilitators and seven themes describing the barriers that stakeholders face in supporting these students. Our findings have implications for researchers who would investigate and implement future organizational support systems as well as for the leaders who would design and implement an array of interventions as part of an organizational support system.

There is a growing need to graduate a wide range of students from different backgrounds in engineering disciplines and a growing demand for skilled graduates (Pearson et al., 2022; National Academies of Sciences, Engineering, and Medicine, 2019; National Science Foundation, 1996). A team of specialists in engineering and organizational systems worked

together on a grant sponsored by the National Science Foundation (NSF) to explore how evidence-based strategies used successfully at the undergraduate level might improve the recruitment, retention, and outcomes of graduate programs. We launched a multi-year project aimed at replicating an existing support system for undergraduate students and adapting it for graduate students (n=11) in 2021. The recruitment efforts led to the continuation of recruitment and support for an additional 10 and 9 students in Academic Years 2022 and 23, respectively. Overall, of the above-mentioned group, 22 have graduated and are considered alumni of our program.

There is an increasing body of research indicating that well-designed support systems can enhance the GPAs of STEM students, improve retention rates, and boost graduation rates (Chang et al., 2018; Doerschuk et al., 2016; Domingo et al., 2019). However, some prior studies indicated that not all support systems lead to significant improvements in student persistence to the degree (Ballen & Mason, 2017; Banda & Flowers III, 2017), GPA (Ballen & Mason, 2017; Banda & Flowers III, 2017; Gibson et al., 2019), or graduation rates (Ballen & Mason, 2017; Banda & Flowers III, 2017). This suggests that merely establishing a support system does not ensure positive outcomes; the system's design and interventions require careful planning (Pearson et al., 2022).

Further, while the learners and the interventions are key components of this system, we posit that another striking gap exists in the research literature. To date, no empirical research exists relative to the intentional study and mitigation of barriers that stakeholders face in supporting these students. Thus, our evaluation question was, “What are the facilitators and barriers that stakeholders face when implementing program interventions within the university

system (Chyung, 2015; Chyung, 2018) to support low-income, first-generation, and/or rural graduate students?"

Methods

We began this study at the start of the second semester of supporting the enrolled students in the program. Thirteen stakeholder interviews were conducted, representing faculty mentors, advisors, as well as program and college leaders, who support the graduate engineering students enrolled in the scholarship program about the barriers and opportunities they face while engaging with the students. The interviews were recorded, transcribed, and analyzed, by a team of research assistants under the direction of one of the faculty members who is also a co-principal investigator. The research team used a thematic analysis to uncover general themes and aggregate the research study findings. Our methods complied with ethical guidelines, as participation was voluntary, participants were assigned pseudonyms, and identifiable information was removed from interviews.

Findings

In this section, we share common themes and discuss their implications for other stakeholders who support program-level interventions designed to support low-income, first-generation, and/or rural graduate students. We begin with the common facilitators and then share barriers that the participants experience. We conclude by sharing some of the unique experiences shared by stakeholders, relevant to their roles and responsibilities.

Seven themes arose when stakeholders reflected upon the support structures and programs, which they saw as facilitating their work to support low-income, first-generation, and/or rural graduate students. These included the SEnS-GPS program; graduate college and

university resources (e.g., various awards, scholarships, and financial support provided by the graduate college and university); student clubs and organizations for rural populations in engineering; which provide mentorship and information about financial resources and graduate school; undergraduate research opportunities that help retain students in the academic pipeline; learning from past experience advising; mentoring; and helping procure resources like books; software; and equipment; flexible work arrangements (e.g., allowing students to work off-campus and accommodating students' schedules); community building to reduce feelings of isolation and uncertainty.

Likewise, several themes that address the challenges and barriers that stakeholders face in their work to support these low-income, first-generation, and/or rural graduate students arose. These themes included the stakeholders' perceptions of a lack of dedicated department-level programs or resources to support students, mitigate added stress or strain (e.g., cultural barriers to collaboration and integration, isolation and loneliness, degree completion uncertainty), unintended exclusion due to personal situations, effects of the coronavirus pandemic, complicated academic records, lack of actionable support and flexibility from the university, durable skills development. These common themes and findings provide an emerging framework for the facilitators and barriers identified across the transcripts, highlighting the key areas of support and challenges faced by low-income, first-generation, and rural graduate engineering students.

Discussion

The initial analysis of interviews with stakeholders has yielded interesting findings, some of which are likely useful to inform future work at our institution and similar work in other

university contexts. Here, we discuss the insights gained from these interviews, including retention rates, involvement in support system activities, and the stakeholders' satisfaction with the program's support infrastructure aimed at minimizing obstacles.

While our initial set of stakeholder interviews comprised a small sample (n=13), our findings represent an emerging area of evidence not previously presented in the literature. Specifically, while evidence exists of universities providing organizational support and interventions for these students to bridge cultural barriers (Aguirre & Banda, 2019; Covarrubias et al., 2019; Garcia et al., 2020; Wilkins et al., 2022), we have yet to uncover evidence of universities systems creating information loops and incentive systems for stakeholders working in support of students from different backgrounds to receive direct support and an array of interventions to bridge cultural barriers. It is clear the benefits of integrating stakeholders from different backgrounds for representation purposes should be maintained. However, our evidence suggests more support is needed to facilitate widespread, rapid, and sustainable, deep change. Such support could include targeted training programs as well as stronger collaborations between support units within the institution.

Limitations

While our sample size was small, we did interview all of the mentors who supervised graduate student scholarship recipients, the advisor of the recipients, and their mid-level organizational leaders. Thus, these findings represent a variety of unique perspectives in the support system. Another limitation was the timing of this study. While we were able to identify themes associated with facilitators and barriers within the organizational support system for a

variety of stakeholder roles, we would recommend further research to understand how the program and outreach dedicated to these efforts have taken these factors into account. That is to say, more research is needed to understand the ways the systems adapted and the ensuing outcomes of those adaptations. Lastly, while these findings document important insight not previously available in the literature, more research is needed to understand the potential generalizability of the themes previously described. This potential generalizability could be made possible as more evaluative studies are conducted on similar programs.

Conclusion

Based on insights from a prior literature review (Pearson et al., 2022), along with the initial program, the outcomes observed, and the themes uncovered from this study, we provide a summary of aspects that require closer observation and potential adjustments as we prepare for an extension of this grant initiative. These include the previously described facilitators that stakeholders rely upon to support their work and the barriers that we uncovered. Future investigation should consider additional support for stakeholders and ensuing outcomes in additional contexts, to further understand what is needed to increase stakeholders' capacity to better serve low-income, first-generation, and rural students.

Author Contributions

All authors confirm they have contributed to the preparation of this article. Conceptualization, L.A.G.; methodology, L.A.G. and A.F.; software, L.A.G; validation, L.A.G.; formal analysis, L.A.G. investigation, L.A.G.; resources, A.F.; data curation, L.A.G.; writing—original draft preparation, L.A.G.; writing—review and editing, L.A.G., A.F., M.S., and R.dS.;

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