BOARD # 430: Progress of an NSF BCSER Grant: Effective Strategies to Recruit Underserved Students to Engineering Bridge and Success Programs

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Abstract

This project is funded by the National Science Foundation EDU Core Research: Building Capacity in STEM Education Research (ECR: BCSER) program. The BCSER grant is twofold: (1) to build the Principal Investigator's STEM education research skills, and (2) to conduct a research project. The research project of this BCSER award is to systematically study effective strategies to recruit underserved students into engineering bridge and success programs at 4-year institutions in the U.S. The research includes three stages: perspectives on recruitment from program leaders, perspectives from prospective underserved students, and comparison of both viewpoints. This paper reports on the progress made on this BCSER award, including preliminary research results (a case study), accomplishments, and future work of the project.

Background and the Theory of the Research Study

The EDU Core Research: Building Capacity in STEM Education Research (ECR: BCSER) program is administered by the National Science Foundation (NSF) and supports projects that build researchers' capacity to conduct rigorous research in STEM education [1]. This BCSER award belongs to the Individual Investigator Development (IID) track New to STEM Education Research type. It includes both a professional development plan for the PI and a research project.

Engineering bridge and success programs such as summer bridge, math remediation, and engineering scholars' programs have been created at 4-year institutions in the U.S. to support students' college transition, success, and retention in the major. Many bridge and success programs face challenges in recruiting underserved students such as underrepresented minorities (URMs), women, first-generations (first-gen), low socioeconomic status (SES) students, rural students, and more, even though they intend to support those students. Recruitment is critical to reach and convince underserved students to enroll in those programs to broaden participation in engineering. Limited literature focuses on recruitment practices and barriers in those programs [2-3]. Difficulties were reported in identifying effective recruitment strategies. The BCSER PI led an engineering summer bridge program formerly funded by NSF Scholarships in Science Technology Engineering and Math (S-STEM) program and observed the recruitment challenges after federal grant phased out in her own bridge program and other similar ones that lack federal funding. The purpose of this BCSER research project is to systematically study effective recruitment strategies from the viewpoint of both program leaders and their prospective students. The first stage focuses on the perspectives of program leaders. This paper will report the current progress of the award and preliminary results of the first stage of the research project.

The project uses the Diffusion of Innovations (DOI) theory as its framework [4], which posits five stages of the innovation-decision process: knowledge, persuasion, decision, implementation, and confirmation. It also describes variables influencing the adoption rate: perceived attributes of the innovation, type of innovation-decision, communication channels, nature of the social system, extent of change agents' promotion efforts. Engineering bridge and success programs are

seen as innovation as they are new to many prospective underserved students and their families. Different types of communication may be needed at each stage to encourage adoption, i.e., students' enrollment and participation in the program. A report of low student awareness of the summer bridge program [5] indicates challenges even at the knowledge stage, the first stage of the innovation-decision process (previously called the awareness stage in the DOI theory).

Professional Development Activities

To build capacity in STEM education research, the PI took courses in both qualitative and quantitative research methods in education. In addition, the PI worked with subject matter experts (SMEs) to develop and refine a survey instrument and interview protocol for the research study, discussed below. The PI also attended NSF ECR PI meeting, American Society for Engineering Education (ASEE) annual conference, and Society of Women Engineers (SWE) annual conference for training and professional development in STEM education research.

Research Methods

This BCSER research employs an explanatory sequential mixed-method design. A purposeful snowball sampling method was used to obtain participants. A list of 107 engineering summer bridge and success programs at 4-year institutions in the U.S. and their contact information were compiled through internet searches, verbal and flyer communication at conferences, and other networking. A 10-minute survey for program leaders was designed, tested via the think-aloud protocol, and reviewed by SMEs. The survey was distributed to program leaders via email invitations and newsletters from ASEE, the National Association of Multicultural Engineering Program Advocates, and SWE. A 45-minute follow-up semi-structured interview was designed, piloted, and reviewed by SMEs. Survey participants were given the option to sign up for an interview in the survey. Eight participants were interviewed via Zoom. The survey instrument and preliminary results were reported at a conference [6]. This paper will present a case study from an interview and related survey results.

All data will be de-identified for analysis. A quantitative analysis of the Likert-scale and multiple response items survey data will be conducted using Excel and SPSS. Confidence intervals, effect size, and power will also be computed. Qualitative analysis will be conducted with open-ended survey and interview questions. Quantitative data will be analyzed along with qualitative data to provide a more complete answer to the research questions.

A Case Study and Discussions

Out of eight conducted interviews, one reported unique successful strategies for recruiting underserved students. A case study of this program (coded as the X program) at a large public university, based on the interview and related survey results, can offer valuable insights.

The X program enrolls about 50 students per year, targets in-state students from low-resource backgrounds with high potential in engineering, and focuses on academic support, community building, and dedicated mentorship. Activities include a 2-week summer bridge, semester events, study abroad, and mentorship. It was initially funded by a federal grant but later institutionalized.

Its current consistent annual funding of about $200k comes from donors and corporate partners. As a high-profile program, university and college development offices constantly fundraise for it. This confirms that successful institutionalization and institutional supports are critical to the recruitment success of similar programs. To comply with federal regulations, the X program did not use race, ethnicity, or gender in recruitment but focused on low SES and first-gen students. However, the program leader reported that most participants were URMs.

University recruitment includes two steps: admission and yield. An institution's yield rate is the percentage of admitted students who enroll at the institution after considering other offers [7]. X program recruitment is integrated into university recruitment procedures and include two steps: (1) the university admission committee reviews eligible students and filters them into specific groups: low SES, first-gen, and in-state low sending counties, and sends them an admission offer conditional on participation in the X program; (2) X program uses various strategies to increase students' awareness of X program and convince them to accept the offer. These procedures have resulted in a 50% yield rate compared to a national average of about 30-40%. This again shows the importance of institutionalizing bridge and success programs for successful recruitment.

The second step takes place from January to May. Communication channels always used are websites, emails, and mailed promotional packages with X program information, its social media QR code, and a 10-second personalized welcome video made by current X program students ("Hi ***. Welcome to University ***. I'm so happy you're a part of the X program. We hope to see you here in the fall."). Social media (primarily Instagram) and in-person campus tours that bring admitted X program students to campus are often used, while phone calls are sometimes used when the admission decision deadline approaches. Change agents always used are the X program team, current X program students, college admissions advisors, and institutional inclusive offices or initiatives. Current X program students are actively involved in planning and implementing recruitment practices. They serve on the student advisory board of X program, manage their Instagram account, make the welcome videos, prepare the promotional packages, and interact with prospective students during the campus tour. Websites, campus tours, current X program students, and X program team members are rated as very effective channels and agents while mail, email, phone, social media, and institutional inclusive offices or initiatives are rated as effective. Websites, emails, and social media are strategies meant to make underserved students aware of the X program, while websites, emails, social media, events (campus tours), and phone calls are strategies meant to convince underserved students to join the program.

According to DOI, communication channels, the nature of the social system, and the extent of change agents' promotion efforts are important variables influencing the adoption rate. It is very important to use communication channels and change agents that can spread information in the social system of the underserved students, and insider change agents are generally more effective. For the X program, current X program students are also underserved students. As insiders of underserved students' social system with trust from their community, their testimony and active promotion of the X program play a critical role in reaching and convincing other underserved students to join the program. Therefore, they are very important change agent for recruitment. DOI points out that different communication channels have important impacts in different stages of adoption. In the first two stages of the innovation-decision process

(knowledge/awareness and persuasion), websites, emails, and social media used by the X program can serve as cosmopolitan and mass media channels that are important for increasing awareness. Events (campus tours) and phone calls with more interpersonal communication can serve as local and interpersonal channels that are important for the persuasion.

Some communication channels and change agents were not used by the X program due to resource limitations rather than their ineffectiveness. For example, with more resources, the X program leader would like to involve high school counselors and advisors and host in-person events closer to most prospective underserved students. Those practices use interpersonal channels and trusted insider change agents for the underserved students that are important for the persuasion stage and can spread information within the social system of those students.

The first stage of adoption is knowledge or awareness, but increasing student awareness of the engineering bridge and success program is challenging. The X program has used many successful strategies to increase its visibility, but about half of their students were still aware of the program when they arrived at the summer advising. They accepted the admission offer without knowing the conditions of joining the X program. The program leader hopes to have more resources to implement strategies to further increase students' awareness.

There have been concerns about how to use emails, websites, and social media effectively. Some practices the X program has implemented can help programs struggling to attract prospective students to their websites, emails, and social media. They use an asset-based mindset for verbal and written communication, personalizing their emails, letters, and videos to students. They also include their social media QR code in mailed packages, which has greatly increased the traffic and message interactions on their Instagram account. In this case, social media serves not only as a mass media tool to bring visual awareness of the program but also as an interpersonal communication channel to answer questions and convince students to join the program. In contrast, programs with low social media visits often do not actively introduce their social media accounts to students. Underserved students unfamiliar with university systems are unlikely to follow a bridge or success program's social media if not introduced to them first.

Conclusion and Future Work

This BCSER project used DOI theory and an explanatory sequential mixed-methods design. The survey and interview protocols for the first stage of the project (perspectives from program leaders) were developed. A case study of successful recruitment strategies used by an engineering bridge and success program in a large public university was analyzed in this paper. The case study results confirm the importance of applying the DOI framework, particularly information on necessary communication channels, change agents, and a social system, to develop effective recruitment strategies for underserved students. Based on this case study, it is also important to recognize that many prospective participants are lost in the first stage of the adoption of engineering bridge and success programs, and we should avoid thinking "they will know us as long as it is a good program". Instead, diverse communication channels and trustworthy change agents should be used to distribute information into the social system of underserved students to constantly increase their awareness of those programs while using interpersonal communication to convince students to join the program.

For future work, the survey and interview with the engineering bridge and success program leaders are expected to be completed in the spring of 2025 and data analysis will take place over the summer. This will complete the first stage of the BCSER research project. Current federal landscape changes affect the existence of some engineering bridge and success programs as well as the mechanisms feasible for surveying and interviewing underserved students. The plan for the second stage of this project (viewpoints from prospective students of the engineering bridge and success programs on recruitment) and the third stage (comparison of perspectives from students and program leaders) is under revision. Additional professional development activities include more training on qualitative and quantitative data analysis, presentations at conferences, and mentoring undergraduates and graduates in STEM education research.

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