

The Bridge Down the Road: Review of Bridge Programs for Graduate School

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Abstract

Students have many transitions that may occur as they progress through their education, and those can be challenging. While one of these is the transition from high school to college, another transition takes place as students who choose to go to graduate school enroll in that new program. This may involve changing to a new school or shifting the focus of their studies, and definitely represents a transition in the level of work that is expected, and this transition can be challenging for some students. While not as common as bridge programs designed for students matriculating into undergraduate programs, and not as well documented in the literature, some graduate bridge programs do exist. This paper presents a literature review of such programs, with a specific focus on those applicable to engineering graduate programs. General traits of these programs are noted, as well as some gaps in knowledge that can guide future research.

Introduction

Just as students' college readiness varies based on their high school background, so too does their readiness for graduate school, with multiple factors impacting this readiness. As universities often invest significant resources in their admitted graduate students, they have a stake in those students' persistence and success in their graduate programs. In addition, many universities are putting significant efforts into building a diverse student body, inclusive of women and under-represented minorities (URM). Many of these students face additional obstacles, e.g., [1]. Some of the attempts to support women and URM students in STEM graduate programs focus exclusively on specific facets of their graduate school pathway, including programs that address preparation for graduate studies [2], recruitment into graduate school [3], and mentoring [4]. Such programs may or may not describe themselves as, or be considered as, bridge programs.

Many bridge programs for undergraduates have been reported in the literature, with a selection of papers about such programs presented in [5]. Some of those papers indicated that the literature on bridge programs was scant, despite the wealth of papers on the topic. In contrast, the literature on graduate bridge programs is far less extensive and can actually be considered to be lacking. This may reflect, to some extent, both a lack of such programs and a lack of research on them. This review paper, therefore, will illuminate some of the existing literature, discuss common issues and major differences in the programs reported, and point towards some of the work that can yet be done in the creation and research on such programs.

Methods

In contrast to the work presented in [5], where there was an abundance of papers to consider, the search for papers on graduate bridge programs yielded a considerably smaller pool. Once an initial search yielded a set of relevant papers, the reference list of each of them was examined. Additionally, the list of papers that cited those papers in that initial set was also examined, in order to yield additional relevant papers.

Some judgment calls were necessary, as not all programs that might be considered to be a “bridge” program were specifically called out as such. Therefore, when a paper described an effort to recruit, mentor, or support graduate students, it was examined carefully to determine whether it was in fact accurate to call it a bridge program. The term “bridge” was interpreted in a fairly broad sense, with the key characteristic being that such a program was designed to help students who were not as well prepared for their program as their peers to bridge that gap, such that they were prepared to be successful. One definition that could be used would be that a bridge program is one that is not part of a degree program’s standard curriculum, is designed to prepare students academically and otherwise for success in that curriculum, and enrolls a cohort of students in the program. By this definition, papers such as [6] were quite ambiguous, as the focus in this case was on programs that addressed preparation for graduate school and the impact of those programs on diversity goals as well as academic goals.

The publication dates of the papers chosen ranged from 2001 to 2022, with the distribution quite spread out over that time. The papers were published in a variety of venues, including both conference and journal papers. Many of the conference papers were drawn from the American Society for Engineering Education (ASEE) conferences. While some of the papers described a single program, there were also some that synthesized information about multiple bridge programs, either because of their similarity, as in [7] or because they yielded a broader picture of the impact of such programs, as in [8]. The literature on graduate school bridge programs included a number of STEM-focused programs, but there were also some bridge programs focused on the humanities or social sciences, such as [9]. As the focus of this paper is on STEM bridge programs, these types of bridge programs were not included in the analysis, although the writing-based nature of that program could be useful in some ways due to the writing demands of graduate school.

Findings

Most of the bridge programs described did not indicate how many students were enrolled in the programs. Those exceptions that did report the number of students typically indicated that there were small cohorts of students, with the study reported in [7] indicating that program size ranged from 3 students in a cohort to a maximum of 12. Another study, reported in [10], reported 10 students in the program. This is significantly smaller than the typical undergraduate bridge programs, which aligns with the relative number of students in undergraduate versus graduate student bodies.

Most of these programs took place either immediately before enrollment in graduate school or immediately afterwards, and were relatively short. Several papers reported program lengths of six

weeks [11] or four weeks [12]. However, there were exceptions. One program took place during the junior and senior years of undergraduate education [13], raising the question of whether it truly fits the definition of a bridge program, although it was specifically identified with that term. Another program took place after students' enrollment in graduate school and was quite extended, with activities taking place over a period of two years [7]. Another program, while it did not explicitly indicate program length, implies in its description that it is more extended in nature [14].

Some of these programs, unlike undergraduate bridge programs, feature extensive partnerships of different colleges and universities. One such example is [14], a program funded by the National Science Foundation (NSF) that includes a collaboration between North Carolina Central University, a Historically Black College/University (HBCU), and the Predominantly White Institution (PWI) of North Carolina State University. As part of this program, joint monthly seminars were held between the institutions, which were open to students not in the bridge program itself as well as those few students (approximately three) who did receive funding through the program. Similarly, [13] included multiple institutions, with 9 University of California campuses, 16 California State University campuses, and over 30 community colleges participating in the program. This program, as stated above, focused on students prior to completing their undergraduate education, and as part of the program students were provided with funding and were limited in how many hours they could work on campus, thus freeing time to spend on the program activities. These activities included research opportunities and cohort-building activities, as well as mentoring from both their home institution and another campus.

A variety of different features of these programs were examined, with those including the students targeted by the program, content, and other characteristics unique to various programs. Each of these features is discussed here, followed by a brief discussion of the available literature on program evaluation and effectiveness, which is an area that certainly presents opportunities for further study.

One of the most common features of bridge programs aimed at the transition from undergraduate to graduate school is the strong focus on URM students, with a secondary strong focus on women. The programs reported in [14, 13, 15, 11, 16, 10, 17, 8, 18, 12] all had a focus on URM students, with some also specifically mentioning women students. The program reported in [19] explicitly indicated that it included both URM and non-URM students, and some other programs did not clearly specify the student population they were aimed at. One notable outlier is the program reported in [20], which was a discipline-based bridge program. This program was aimed at students whose undergraduate major was not chemical engineering but who wished to pursue a graduate degree in that field, in other words, students who were pursuing disciplinary migration as defined in [21]. These migrating students took courses in the fundamentals of chemical engineering, which led to receiving certificates of completion.

Content of the programs varied somewhat, and had less of an academic content focus than was typically present in the undergraduate bridge programs described in [5]. One large component of many programs, such as those described in [?, 13, 11, 16, ?], was relationship development, both between the students and between students and faculty; this was a common feature between graduate and undergraduate bridge programs, with perhaps a stronger emphasis in the graduate

bridge programs. Mentoring of graduate students was an overarching theme and a large concern in many of these programs, as it is a large factor in the graduate school experience.

In addition to the mentorship component, programs had a variety of other features that varied from one to another. The NSF-funded traineeship program reported in [14] featured joint monthly seminars between the two participating universities, with presentations of research on both campuses. The program was specifically aimed at both academic and professional preparation in addition to the general mentorship aspects. The program in [11] focused on multiple themes of resource recognition, personal preparation, career preparation, and network building, along with mentoring. It required three deliverables from participants, with a requirement to set up a LinkedIn profile, send a resume or c.v. to the program coordinator, and conduct at least one informational interview. Professional development components including seminars and workshops were also reported in [10]. The program at University of New Mexico reported in [19] included workshops and field trips as part of its offerings, and a much earlier paper from the same university also reported a technical and non-technical track to their graduate bridge program.

Typically, these bridge programs focused on the doctorate, with no real mention of the master's degree. In one case, as reported in [18], the master's degree was seen as a pathway to the Ph.D.

The work reported in [15] focused more on the impact of the bridge programs on participants, with the participants being 29 mostly URM students. This work indicated that bridge programs alone will not produce the desired effects of increasing the participation and success of URM students, in part because of the intense scrutiny that is placed on participants in bridge programs and the "othering" that they may experience. However, the multistate case study reported in [17] found that bridge programs could foster confidence in students of color, help them identify as emerging scholars, and grow their passion for research and scholarship.

Discussion and Conclusion

In examining these programs, one obvious trend is the clear focus on URM students and women. A large part of the motivation for these programs, therefore, seems to be the drive to diversify the engineering profession and in particular the pool of engineers with advanced degrees. Such programs are not a total answer to the problem of under-representation of certain groups, as noted in one of the papers, but they have been shown to have some beneficial impacts. One subject for future investigation could be the way that bridge programs at the graduate level could fit into a larger effort to diversify the engineering profession, to see which of the various efforts to do so reinforce each other and which conflict with each other. This is particularly true since there are many programs aside from bridge programs that aim to prepare undergraduates for graduate school and facilitate their recruitment into graduate programs, as noted in the Introduction.

Unlike undergraduate bridge programs, the actual engineering content of graduate bridge programs tends to be minimal. There are some exceptions, such as the program aimed as disciplinary migration noted in [20], but generally the content focuses on professional skills, building supportive networks, and mentoring relationships. This may be due to the assumption

that students who are entering graduate school are generally academically prepared and that their difficulties will stem from other sources, or from the reality that graduate level research is very diverse, or perhaps both.

Another unique feature of graduate bridge programs, as opposed to undergraduate ones, is the opportunity for different institutions to partner. While this was not always done, several bridge programs did have this feature; if a set of undergraduate universities typically have large numbers of graduates going to specific institutions for graduate school, this may be a feasible option. The comparison between this type of program and other forms of bridge programs could be an interesting area for future research.

Future Work

There are many options for graduate bridge programs that could be developed and implemented, serving additional graduate school populations. One would be master's degree programs, for which there do not appear to be any bridge programs; in the various papers reviewed here, it was either explicitly stated or implied that the graduate programs were doctoral programs. This may be because of the shorter length of master's programs, which means an investment of time preparing for them is a larger percentage of the time spent in the program; this may make them less financially viable for a university to subsidize or for a participant to pay for. The reasons for this gap should be investigated, and if a need exists, such programs should be designed.

Yet another area of future work could include the possibility of developing and evaluating bridge programs aimed at disciplinary migration. As noted in [21], this phenomenon is not uncommon, and only one of the bridge programs in this review addressed it. Examining what programs are most likely to take in students who have undergraduate degrees in different disciplines could guide universities in developing appropriate graduate bridge programs to address needs in this area, which would open up additional pathways to students.

Bridge programs could also be developed, implemented, and evaluated for other pathways into graduate school. One such example would be programs aimed at returning students, those with significant industry experience after their bachelor's degree but prior to entering graduate school. The experiences of such students have been reported in a number of publications, e.g., [22]. At this time, no bridge programs appear to exist that target this specific population, and this is also a gap that could be filled.

Overall, the area of bridge programs for graduate school is far less developed than undergraduate bridge programs, and there is ample room to develop and evaluate such programs, with the ultimate aim of recruiting and facilitating the success of a larger and more diverse engineering and STEM community.

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