



## **WIP: Mitigating Transfer Shock for Undergraduates in Engineering to Increase Diversity**

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Russell Faux, Ed.D. studied philosophy at the Universities of Chicago and Wisconsin before turning to education and completing his doctorate at Boston University. He taught language and literature for six years at the University of Padua in Italy. After a year as a Spencer Scholar at Stanford University, Dr. Faux returned to Italy as a research consultant for Bolt, Beranek, and Newman. Dr. Faux held senior research positions at TERC and Riverdeep Interactive (perhaps best known for the Carmen Sandiego software) before starting Davis Square Research Associates in 2001. His work encompasses qualitative and quantitative methods, including grounded theory, instrument development and validation, quantitative modeling, and social network analysis. DSRA clients have included the National Science Foundation, the National Institutes of Health, Purdue University, the University of Maine, Tufts University, the Boston Museum of Science, Boston University, the University of Massachusetts, the U.S. Department of Education, Houghton Mifflin, Verizon, and the Corporation for Public Broadcasting.

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## **Mitigating Transfer Shock for Undergraduates in Engineering to Increase Diversity (Work in Progress)**

### **Background**

As part of its response to the anticipated workforce needs in STEM fields, the National Science Foundation S-STEM (Scholarships in Science, Technology, Engineering, and Mathematics) initiative provides essential scholarship support to academically talented and diverse students with interests in STEM careers. The success for this initiative is essential to broadening the participation of underrepresented students in STEM fields across the nation. While supporting more traditionally matriculated students remains an abiding commitment, the S-POWER (Student Pathways Opening World Energy Resources) initiative at Northeastern University has turned toward the expansion of URM (Underrepresented Minority) students transferring from Historically Black Colleges and Universities (HBCU) as well as regional community colleges. The development of the S-POWER program has entailed a complex set of efforts involving a broad set of stakeholders both within Northeastern University and between Northeastern University and the program's partner schools. This paper describes the multilevel, multifaceted S-POWER strategies for the creation and maintenance of a program supporting transfer URM students into engineering. This effort has considerable implications for the STEM professions, such as engineering, where racial/ethnic minorities, first-generation, women and the socio-economically disadvantaged constitute a disproportionately low percentage of the workforce. As noted in the ASEE yearly report, only 11.4% of bachelor's degrees in engineering were earned by Hispanic students and only 4.2% were earned by Black/African American students in the 2018 academic year. [1]

As a result of this talent development challenge, colleges and universities around the country are placing a growing emphasis on programs that allow students to gain work and research experience and are beginning to identify success outside of traditional academic metrics. A holistic integrated approach to the recruitment, selection, and support of transfer students into engineering is essential to ensure academic and career success. The theoretical framework of Bandura's Self-Efficacy model, along with the implementation of Chickering's Student Development Theory [2] have shown to be meaningful and impactful theoretical touchpoints throughout this process.

### **Introduction**

The model utilized at Northeastern University prior to and during the invited student's undergraduate experience includes but is not limited to the following:

- Pre-enrollment: pre-transfer identification, two-way institutional visits, cross-institutional peer-to-peer student interactions, experiential learning opportunities such as REUs (Research Experiences for Undergraduates), student application and financial aid support.
- Transition: participation in a Summer Bridge program (during the summer prior to the first semester matriculation and designed specifically around identified needs of transfer students).
- During: course selection advising/support, academic advising, persistence advising,

expanded mentoring (by faculty/senior administrator), peer-to-peer networking/support, supplemental instruction, providing research opportunities, workforce development and preparation (including co-op opportunities).

- Frequent collection of qualitative and quantitative data allows for continuous monitoring and informed project management.

### **Research Questions**

The S-POWER program is mentoring and supporting a cohort of 100+ STEM Scholars across 5 institutions, which consists of community colleges, an HBCU, and PWI (Predominantly White Institution). This paper will focus on exploratory research and will discuss the essential elements of the S-POWER program. As a result of Exploratory Research, the paper will address the following research questions:

1. What compilation of academic and social supports are essential to help mitigate transfer shock in STEM? How do these vary for different constituencies?
2. What pre-transfer elements increase the likelihood of bachelor's degree completion in STEM?
3. How can essential program components addressing the mitigation of transfer shock be further refined and broadly institutionalized?

### **Discussion**

The S-POWER Program was built upon foundational diversity efforts within the College of Engineering at Northeastern University. The program outlined the following vision, to reconstruct the academic and social contexts with which colleges and universities successfully educate transfer students, particularly for financially disadvantaged, underrepresented minority (URM), female and first-generation students.

S-POWER is an undergraduate/graduate scholarship opportunity for transfer students interested in completing an engineering degree at Northeastern University. Funding provides targeted scholarships, at both the host and at sending (partnering) institutions, where mentoring, research opportunities, social programming, regular workshops, seminars, and career development are all salient throughout the scholar's education. As part of this targeted scholarship, incoming students joined a student cohort that focuses on research/career opportunities aimed at solving Grand Energy Challenges.

S-POWER core program components include:

- Seamless Transfer Infrastructures – including fast-track admission and financial aid decisions, specific social and culturally relevant programs, and academic support networks.
- Cross-Institutional Mentoring and Advising – by both sending institutions and receiving institution throughout students' academic career.
- Educational and Research Offerings – Summer Bridge program before enrolling at Northeastern University. Evaluation and assessment activities are used to address curriculum reform at both sending and receiving institutions to assure S-POWER scholar success.

- Experiential Learning – S-POWER scholars (after transfer) may participate in one to two six-month-long co-op experiences in industry.

Each of these core program components guide implementation and direct student support. Seamless Transfer Infrastructures are essential to ensure students unfamiliar with the transfer process are provided essential guidance and support. Navigating the application process can be overwhelming to students, with expert advising at both the receiving institution and the sending institution as essential. [3] Transfer shock, defined by Hills as a severe drop in performance observed upon transferring to a new institution, [4,5,6] appears to be more significant for underrepresented students, most notably in the field of engineering [7]. The adjustment of transfer students across the psychological, academic and social domains is essential to the realization of successful academic and career outcomes.

## **Results**

Our program efforts to date at our receiving institution have led to documented changes in practice in several key areas.

**Admissions:** Success rates (GPA's, retention rates, etc.) are being shared with our Admissions department, which has further justified their decisions to admit more transfer students. We have seen this positively impact the number of admitted URM students, especially from HBCUs and community colleges. As a result, local stakeholders at our partner institutions have expressed a consistent increase in eagerness and enthusiasm for S-POWER opportunities.

**Retention:** The retention rate of S-POWER scholars, including those from all the sending institutions and the receiving institution, is close to 100%. To achieve this, there has been formal weekly or biweekly individual mentoring meetings for each scholar at the host institution. Feeder institutions continue to expand mentoring support internally and through expanded collaborations with industry. The psychosocial aspects of transferring are addressed through formal and informal mentoring components.

**Programming:** Our research has shown that the overall cohesiveness of the group has been an important factor in the informational and moral support networks of the S-POWER cohort. Frequent communication and the focus on regular ongoing events, such as workshops, bi-weekly social networking meetings, and facilitating attendance at events in the Boston community, has shown to be essential in the establishment and maintenance of the S-POWER network.

**Institutional Capacity:** S-POWER has been extended to better respond to students, including the offices of admissions, financial aid, and transfer credit. This has led to openness at the host institution to increase transfer student admission slots. We anticipate that as the project matures and becomes more fully institutionalized that the capacities of the faculty as well will evolve to sustain more inclusive classrooms; ones that are sharply attuned to the different skill sets, learning styles and needs of the attending students.

**Academic Advising** We have integrated a wide range of academic tools to support scholar success. Introduced in the Summer Bridge program, scholars are provided access to subject-specific tutoring, supplemental instruction and Guaranteed 4.0 Learning System (G4LS), an

innovative learning system that utilizes the latest research in cognitive science to enhance learning within formal and informal educational settings. [8] Each individual program element provides essential support; and, it is the integration of these elements with more frequent (weekly/bi-weekly) individualized academic advising that we believe has contributed to active student engagement.

### **Partner Institutions**

Partner institutions have identified several successes and challenges. These include a formalized application process for this scholarship, which is yielding successfully recruited and supported scholarship recipients since the program began. The process begins with workshops to assist students through the application process as well as applying to summer REU programs.

We established formal S-POWER student cohorts which meet on a regular basis and discuss uniquely relevant topics that included REU applications, conference experiences, study skills, etc. As a result, the cohort has maintained relationships with program alumni who serve as mentors to current students.

Curriculum expansion is underway as the general student population has demonstrated an increased interest in the Dual Degree Engineering Program. In addition, students are showing an increased interest in energy and energy-related careers. Also, new program tracks (Electrical and Chemical Engineering) were added at one partner institution, expanding the reach and relevance of the program.

### **Challenges/Adaptations**

Some transfer students were not prepared for the rigor and pace of the course work, resulting in revisions (at partner institutions) to material taught in multiple classes. Each institution has taken steps to address this challenge by seeking alignment of curriculum to ensure 100% credit transfer and producing mapping transfer logistics. Additional areas that needed to be addressed were financial aid policies. One key has been frequent follow-up with students who have transferred in order to ensure students who are considering transferring are made aware of the challenges ahead.

Some of the achievements to date include the partnering with other programs within the institution, offering frequent speaker/workshop opportunities, supporting small advisee groups to help students connect with each other, encouraging students to participate in opportunities such as REUs, mentor programs, and increasing opportunity for students to engage in “Transfer Visits.”

### **Lessons Learned**

There have been many lessons learned as a result, with many of these having been shared and implemented. These efforts include, establishing group advising, now being adapted by other STEM projects, adapting the revised application process by other STEM projects, increasing the awareness by faculty at both the sending and receiving schools of the transfer processes, and increasing the participation in REU programs to enhance student interest/persistence and engaging REU program alumni in the mentoring of prospective REU students.

Essential program elements supporting a successful transfer process have informed supporting

elements of our graduate student efforts. As a result of the S-POWER partnership, Hampton University sites a general increased interest and participation in graduate studies of their undergraduate students. Post Baccalaureate students from Hampton University now have the flexibility of choosing an engineering MS program within the College of Engineering. Students have had struggles with the rigor of the MS curriculum in their first semester. To address this issue, students have been provided with additional faculty advising and tutoring. Following the first semester students have been able to adjust to Northeastern University culture and course rigor and have achieved SAP (satisfactory academic progress) by being able to excel in their program.

To ensure project sustainability we continue with targeted faculty advising to address student needs in terms of class preparations. We continue to provide tutoring connections in addition to working with Departments to provide additional research assistantship support in addition to providing access to industry.

### **Summary**

S-POWER is documenting and creating descriptive and explanatory models using the limiting and enabling factors for URM transfer students, disaggregating the results by type of original institution (HBCU, community college, etc.). The success of the S-POWER program's new educational pedagogy being implemented is being measured and statistically explored. Predictive factors that positively influence or hinder transfer student success are being identified and shared internally through formative evaluation and wider dissemination efforts.

### Formative Evaluation

- a. Formative metrics: retention rate, grades by course, GPA, participation in organizations, Co-ops and research, retention rates, number of students in S-POWER;
- b. Scholar surveys and twice-yearly focus groups that have concentrated on timely themes (e.g., the financial aid process, learning in classes, the value of grades, etc.);
- c. Network analysis of interactions between the leadership team and S-POWER Scholars.

### Preliminary Results

- a. Self-reported students' increased self-confidence in seeking out resources, improved study habits and technical skills, a clarified sense of their engineering identity and careers after graduation.
- b. Community College scholars have found especially rewarding the broader and more research-based Program.
- c. Students with an HBCU background report a heightened sense of academic resourcefulness and an enlarged awareness of career opportunities.

### Institutional Integrations

- The advising and course transfer process into Northeastern University is now well established.
- Formal curriculum ties/advancements between the S-POWER partnering schools have been established.
- Curriculum changes including:
  - Adding C++, SolidWorks and new labs at one of the partner schools.
  - New program tracks at Community Colleges in Electrical and Chemical Engineering.
- Regular student meetings as social cohorts occur at each of the participating institutions.

## References

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