BOARD # 417: NSF S-STEM: Tracking Sense of Belonging and Grit Among Limited Income Students in STEM

Dr. Maxine Fontaine, Stevens Institute of Technology (School of Engineering and Science)

Maxine Fontaine is a Teaching Associate Professor in Mechanical Engineering at Stevens Institute of Technology. She received her Ph.D. in 2010 from Aalborg University in Aalborg, Denmark. Maxine has a background in the biomechanics of human movement, and she currently teaches several undergraduate courses in engineering mechanics. Her research interests are focused on improving engineering pedagogy and increasing diversity in engineering.

Dr. Ashley Lytle

Ashley Lytle is an Assistant Professor of Psychology at Stevens Institute of Technology in Hoboken, New Jersey, USA. Lytle earned her PhD at Stony Brook University, New York, USA. Her research explores how prejudice, discrimination, and stereotyping im

Dr. Frank T Fisher, Stevens Institute of Technology (School of Engineering and Science)

Frank T. Fisher is a Professor of Mechanical Engineering at Stevens Institute of Technology, where he served as the Interim Department Director / Department Chair from April 2013 to August 2018. He earned BS degrees in Mechanical Engineering and Applied M

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Introduction

During times of uncertainty and transition, psychosocial factors, such as sense of belonging and grit, may be protective for undergraduate students and have been associated with academic outcomes such as engagement and retention. The transition to college is a challenging time for all students but may be especially challenging for some students depending on external factors such as socioeconomic status. A growing body of research has associated psychosocial constructs such as sense of belonging and grit with key academic outcomes such as engagement and retention [1, 2].

Social connections play a pivotal role in fostering psychological well-being such as a sense of belonging. Humans are inherently social beings, driven by a fundamental need for connection and interaction. The belief that one fits in and belongs, one's sense of belonging, is a key component of academic engagement [3]. One's sense of belonging in the academic context, such as in STEM, can influence academic outcomes [1]. For example, one's sense of belonging predicts intentions to pursue a STEM field [1], whereas one's lack of belonging has been linked with decisions to leave STEM fields among students [4].

Grit has been operationalized as perseverance and passion for long-term goals [5]. Although the concept of grit may appear similar to other constructs such as resilience, a growing body of research demonstrates that grit is distinctive. The concept of grit taps into something not captured by other traditional predictors of success [6]. For example, the concept of grit predicted several achievement-based outcomes (e.g., academic outcomes of undergraduate students, ranking of National Spelling Bee contestants). Similarly, grit was predictive of academic outcomes above and beyond some of the traditional constructs and personality traits associated with achievement such as IQ, self-control, and conscientiousness [5-7]. In another study, researchers found a positive relationship between grit, engagement, and academic productivity [8] and as a predictor of academic engagement among undergraduate students [9].

At Stevens, an NSF S-STEM program centered around scholarship and mentorship was developed to support our limited-income (LI) students, i.e. those whose (FISAP/FAFSA) total family income is less than $65,000. Scholarships are awarded to selected students in their second term, renewable for up to 6 additional semesters. Each scholar is paired with a faculty mentor, following a one-to-one mentoring model. In addition, each cohort of scholars is matched with a small group of peer mentors and alumni mentors. Cohort activities include a mix of social events and professional workshops to build community and develop essential skills among our scholars.

The goals of the program include:

- increasing retention and graduation rates of our LI student body to match those of our overall STEM student body,
- increasing departmental and institutional awareness of the challenges faced by LI students in STEM, and

- developing new programming specific to LI students and integrating with existing campus supports and activities.

In this study, we examine the effects of sense of belonging and grit on student retention and academic performance among our LI and non-LI student populations. Specifically, we aim to address the following research questions (RQ):

- RQ1. Can we see differences in **sense of belonging** and **grit** among our **LI** vs. **non-LI** student population (first-year STEM)?
- RQ2. Is sense of belonging and/or grit correlated with **retention** and/or **academic performance** among our students?
- RQ3. Does the S-STEM program have an impact on **sense of belonging**?

We use the responses to a psychosocial survey disseminated to the majority of first-year STEM students to address RQ1 and RQ2. For RQ3, we have our scholars take the psychosocial survey every year, so we are able to track changes in sense of belonging and grit among this student group as they progress through their degree program. Only RQ1 is addressed in this short paper; results and analysis for RQ2 and RQ3 represent ongoing work and will be reported in the future.

Methods

All first-year students at Stevens Institute of Technology are asked to participate in subject pool activities as a part of their core humanities courses. Starting in Fall 2021, a psychosocial survey was offered as an option to fulfill this requirement. The survey includes 4 items to measure sense of belonging and Duckworth's Short Grit Scale (8 items, Likert scale 1-5) to measure grit [6].

A total of n=670 participated in this survey in Fall 2021, n=712 in Fall 2022, and n=643 in Fall 2023. Only students in STEM majors are included in this study. Demographic information of the survey participants is provided in Table 1 below. The distribution of the survey participants along income status is similar across the three years.

Table 1. Information on Survey Participants

Year	n	Low Income (LI)	Non-Low Income	% LI
Fall 2023	643	114	529	17.7%
Fall 2022	712	106	606	14.9%
Fall 2021	670	100	570	14.9%

Results and Discussion

*RQ1. Can we see differences in **sense of belonging** and **grit** among our **LI** vs. **non-LI** student population (first-year STEM)?*

Survey responses from our incoming STEM students over the past three years are summarized here, comparing sense of belonging and grit among the LI and non-LI groups.

Figure 1 shows that sense of belonging was lower among our LI first-year STEM students than their non-LI counterparts in F2021 and F2022, but interestingly, sense of belonging among the LI students steadily increases with each successive cohort, until F2023 when it slightly surpasses that of the non-LI students.

A statistical analysis comparing the LI and non-LI groups in each year revealed that only the difference in F2021 was statistically significant, as shown in Table 2. It is unclear what led to the positive change, but perhaps the new institute-wide programming efforts aimed at supporting our first-generation and limited income (FGLI) student population contributed to closing this gap. Examples of these efforts include special orientation sessions for FGLI students and families, workshops on financial literacy, and a podcast featuring interviews of FGLI students.

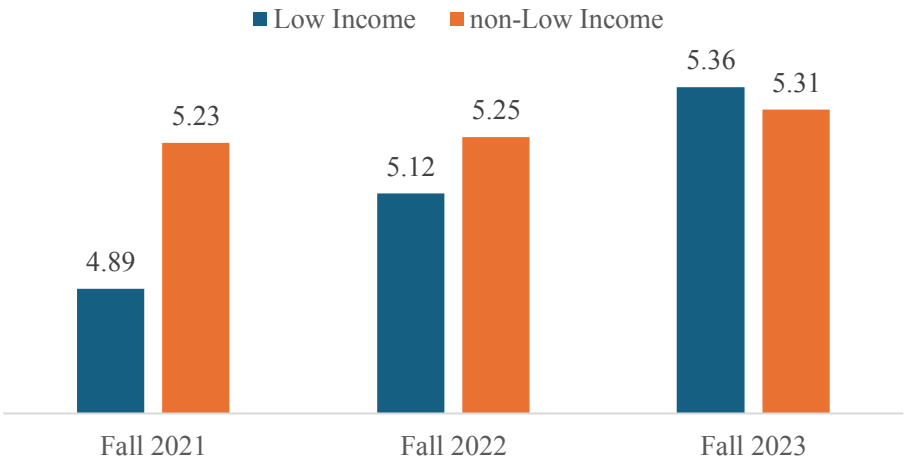

Figure 1. Average score for **sense of belonging** (scale 1-7) among LI and non-LI first-year STEM students over the last three years.

Table 2. Comparison of **sense of belonging** scores for F2021, F2022, and F2023 first-year STEM cohorts, by income status

Belonging	**Low-Income**			**Non-Low Income**			**T-Test**	
Year	*n*	*Mean*	*SD*	*n*	*Mean*	*SD*	*t-value*	*p-value*
Fall 2021	100	4.893	1.255	570	5.233	1.275	-2.468	0.014
Fall 2022	106	5.116	1.274	606	5.247	1.269	-0.984	0.325
Fall 2023	114	5.364	1.225	529	5.312	1.243	0.406	0.685

Figure 2 shows that grit is higher among our LI first-year STEM students than their non-LI counterparts each year. A statistical analysis comparing the groups each year, however, revealed that these differences were not significant, as shown in Table 3.

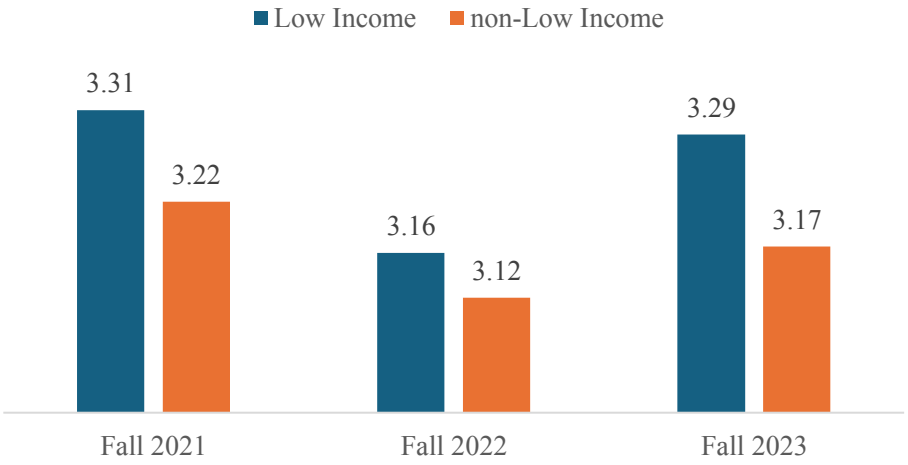

Figure 2. Average score for **grit** (scale 1-5) among LI and non-LI first-year STEM students over the last three years.

Table 3. Comparison of **grit** scores for F2021, F2022, and F2023 first-year STEM cohorts, by income status

Grit	**Low-Income**			**Non-Low Income**			**T-Test**	
Year	*n*	*Mean*	*SD*	*n*	*Mean*	*SD*	*t-value*	*p-value*
Fall 2021	100	3.310	0.646	570	3.216	0.605	1.412	0.158
Fall 2022	106	3.164	0.602	606	3.118	0.628	0.699	0.485
Fall 2023	114	3.285	0.563	529	3.170	0.594	1.891	0.059

Conclusions

The increase in sense of belonging among our LI students is promising. Student interviews may provide some insight into the reasons behind this. In addition, we plan to use data on GPA and retention statistics to investigate RQ2: *Is sense of belonging and/or grit correlated with retention and/or academic performance among our students?*

Future work also includes analysis of the longitudinal data collected from our scholars to address and RQ3: *Does the S-STEM program have an impact on sense of belonging?* Given the small sample size of our scholar cohort (n=32), we would not be able to perform a statistical analysis, but we would be interested in seeing any impact of our S-STEM program.

Acknowledgements

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