Analysis of Student Retention Trends: A Case Study of NSF S-STEM SEECS Program and Institutional Impact Since 2009

Dr. Varun K Kasaraneni, Gannon University

Dr. Varun Kasaraneni is an Associate Professor and Chair of the Environmental Science & Engineering Department at Gannon University. His teaching and scholarly work span environmental engineering, stormwater management, water treatment, and sustainable materials for environmental applications. Dr. Kasaraneni is deeply involved in curriculum development across engineering programs, advancing ABET outcomes, integrative learning, and applied research experiences for students.

Dr. Lin Zhao, Gannon University

Lin Zhao received her Ph.D. degree in Electrical Engineering from the University of Western Ontario, London, Ontario, Canada, in 2006. She is currently a Professor in the Electrical and Cyber Engineering Department at Gannon University in Erie, Pennsylvania.

Dr. Scott Steinbrink, Gannon University

Dr. Scott Steinbrink is an associate professor of Mechanical Engineering, primarily tasked with teaching computer methods and design.

Dr. Karinna M Vernaza, Gannon University

Dr. Karinna Vernaza joined Gannon University in 2003, and she is the current Dean of the College of Engineering and Business and a Professor in the Mechanical Engineering Department. She earned her Ph.D. and M.S. in mechanical engineering from the Univers

Mr. Adam Finn Nogaj

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Abstract

Since its inception in Fall 2009, the *Scholars of Excellence in Engineering and Computing Studies (SEECS)* program, supported by NSF S-STEM, has prioritized student retention and success in STEM disciplines. This paper presents a longitudinal analysis of undergraduate retention and graduation outcomes from 2009–2025 at a private primarily undergraduate institution. Outcomes for SEECS participants are compared with similarly eligible non-participants across STEM retention, institutional retention, and academic and program-connected measures including GPA ≥ 3.0 and continued program eligibility.

Results indicate that SEECS participation is associated with higher retention across outcomes, with the largest and statistically significant differences occurring in the first academic year, particularly among students with high unmet financial need. Differences narrowed in later years as overall retention increased, though SEECS participants maintained equal or higher outcomes. These findings suggest that early, integrated financial and academic support structures contribute to improved STEM persistence and degree completion.

Introduction

In Fall 2008, xxxxx university received the first of four National Science Foundation S-STEM awards supporting the Scholars of Excellence in Engineering and Computing Studies (SEECS) program. Since its inception, more than 370 one-year scholarships have been awarded, and 91 participants have graduated. This paper presents a longitudinal analysis (2009–2025) of retention and graduation outcomes among SEECS recipients compared with other students in Engineering and Computing Sciences. The SEECS program incorporates components intended to promote student persistence to graduation. In addition to financial assistance, the program provides structured community-building activities and professional development opportunities. Most scholarship recipients enter as freshmen on renewable one-year awards, contingent upon academic performance and continued enrollment in an eligible major. Scholarship eligibility requires meeting NSF criteria (citizenship, financial need, and field of study) as well as SEECS-specific requirements, including a minimum 3.0 high school GPA. Research relating to the effectiveness of scholarship funding on retention is abundant in professional literature. A sampling of recent publications can be found in [1, 2, 3, 4]. Data from this study seem to bear out the general notion that reduction of monetary concerns is a motivating factor in student persistence. The SEECS program provides approximately $7,000 per student annually and requires a minimum 3.0 GPA, continued enrollment in an eligible major, and participation in a required seminar. Students who lose funding may remain engaged in program activities, underscoring the program's emphasis on academic accountability and community support beyond financial aid. The working hypothesis is that the personal and professional enrichment opportunities and group belonging appeal to SEECS students, even if the scholarship financing is

withdrawn. This paper provides a longitudinal analysis of retention and graduation outcomes to evaluate the relationship between SEECS participation and student persistence.

Methods

Research Question. Do SEECS students have different retention/graduation rates than peers, after accounting for differences in financial need? For the purposes of this research question, five different kinds of retention were ultimately calculated:

- Retention to the university
- Retention to a STEM or SEECS major (mathematics, chemistry, biology, computing, and engineering majors)
- Retention to a SEECS major (engineering majors, only)
- Retention with a 3.0 cumulative GPA
- Retention with SEECS eligibility

Data. All necessary data were acquired from internally available official University data sources, beginning with the fall 2011 term and continuing through the fall 2025 term. Data set elements were unique combinations of students and academic year. (Students appeared once per year of university enrollment. Henceforth, discussion of "students" implies students per term.) Pertinent student statuses at the start of the academic year, such as current major and cumulative GPA, were determined by their values at the culmination of the previous term. Financial aid data were recorded by academic year. Retention was defined as enrollment in the subsequent fall term; graduation was credited if completed during or immediately following the academic year.

Study Eligibility Criteria and Definitions. Only students strictly meeting all SEECS eligibility requirements were considered in this study. SEECS students were defined as those who also received a SEECS scholarship. Having high unmet need was defined as unmet need greater than -$1,000 (financial need still unmet or barely met); unmet need was considered low, otherwise. Students' year (first, second, third, or fourth) was determined by years elapsed since first year as a matriculated undergraduate student.

Calculations. Retention/graduation rates were then calculated for SEECS students and the comparison group of SEECS-eligible non-participating students, by unmet need and year. The Python programming language, as well as NumPy and pandas packages, were used to model and manage all data and perform necessary calculations; the statsmodels package was used to calculate statistical significance.

Results

Retention and graduation outcomes were examined across student year (Freshmen to Senior referred to years 1- 4), unmet financial need level (low vs. high), and participation in the Scholars of Excellence in Engineering and Computing Studies (SEECS). Results are summarized using comparative retention matrices that report percentages for SEECS participants and SEECS-eligible non-participants across five outcome definitions.

STEM Retention or Graduation

Across all student years, SEECS participants demonstrated higher STEM retention or graduation rates than SEECS-eligible non-participants at both unmet need levels. The largest and most statistically significant differences occurred during the first academic year, particularly among students with high unmet financial need. In Year 1, STEM retention or graduation among high-need SEECS participants was 90.0%, compared to 76.7% for eligible non-participants; this difference was statistically significant ($p = 0.037$). In subsequent years, STEM retention increased for both cohorts, and differences between SEECS participants and eligible non-participants narrowed and did not reach statistical significance. Nevertheless, SEECS participants maintained equal or higher STEM retention through Year 4, with rates of 95.1% compared to 91.9% among eligible non-participants.

For students with low unmet financial need, STEM retention or graduation was high across all student years. SEECS participants consistently demonstrated higher STEM retention, reaching 100% in Years 3 and 4, compared to 93.7% and 92.0%, respectively, among eligible non-participants; however, differences in this group were not statistically significant.

The pronounced first-year STEM retention advantage among high-need SEECS participants suggests that early financial support combined with structured academic engagement may help mitigate common transition challenges that disproportionately affect STEM persistence during the freshman year.

Retention to University or Graduation

Patterns for institutional retention or graduation closely mirrored those observed for STEM retention. Among students with high unmet financial need, the largest difference again occurred in Year 1, where institutional retention or graduation for SEECS participants was 96.0%, compared to 83.7% for eligible non-participants; this difference was statistically significant ($p = 0.024$). In Years 2–4, institutional retention increased for both cohorts, and differences between SEECS participants and eligible non-participants were smaller and not statistically significant. Despite this convergence, SEECS participants maintained equal or higher institutional retention or graduation through Year 4 (95.1% vs. 91.9%). For students with low unmet financial need, institutional retention or graduation was high across all years for both groups. SEECS participants exceeded eligible non-participants in each year, reaching 100% retention or graduation in Years 3 and 4, compared to 95.1% and 92.0%, respectively, among eligible non-participants, though these differences were not statistically significant.

The parallel patterns observed for STEM and institutional retention indicate a strong linkage between STEM persistence and overall university retention, particularly in the first year, when financial and academic supports may reduce early attrition risk.

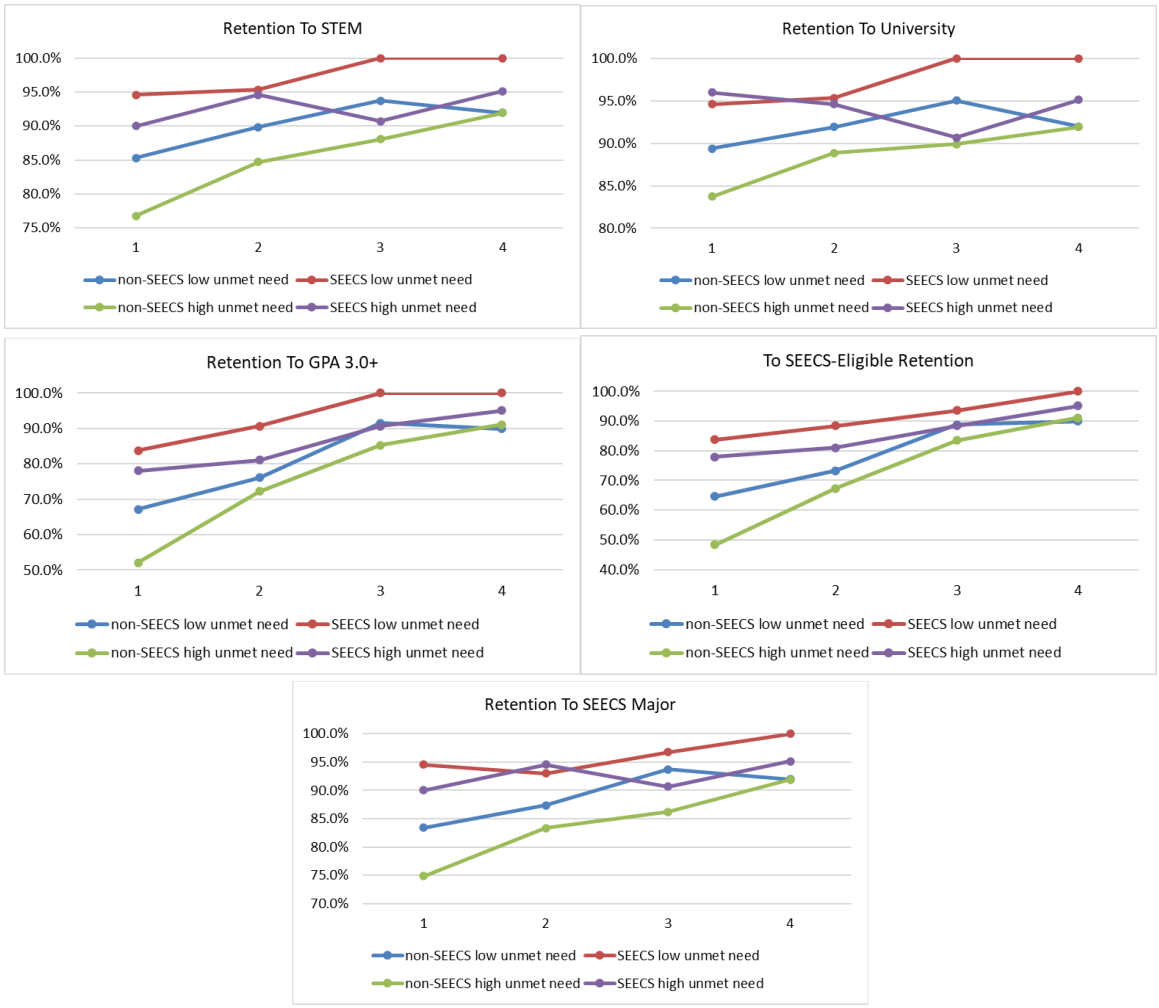

Figure 1. Comparison of STEM retention, institutional retention, and academic and program-connected retention outcomes for SEECS participants and SEECS-eligible non-participants by student year and unmet financial need.

Academic Performance and SEECS Program-Connected Retention Outcomes

Academic and SEECS program–connected outcomes, including retention with a cumulative GPA ≥ 3.0 or graduation, SEECS major retention or graduation, and retention while remaining SEECS-eligible or graduation, are grouped for discussion due to their close conceptual and programmatic alignment. Analysis of these outcomes showed the most pronounced differences between cohorts during the early undergraduate years.

Among students with high unmet financial need, SEECS participants demonstrated significantly higher GPA ≥ 3.0 retention or graduation in Year 1 (78.0% vs. 52.1%, $p = 0.0009$). A similarly strong pattern was observed for SEECS eligibility retention or graduation, where 78.0% of SEECS participants remained eligible or graduated, compared to 48.4% of eligible non-participants ($p = 0.0002$). SEECS major retention or graduation was also significantly higher for SEECS participants in Year 1 (90.0% vs. 74.9%, $p = 0.021$). These early differences in GPA-based and program-connected outcomes point to the combined influence of financial support,

academic monitoring, and structured expectations associated with SEECS participation during the transition into college-level STEM coursework.

For students with low unmet financial need, SEECS participants demonstrated significantly higher GPA ≥ 3.0 retention or graduation in Years 1 and 2 ($p = 0.0389$ and $p = 0.0316$, respectively), as well as higher SEECS eligibility retention or graduation in the same years ($p = 0.0197$ and $p = 0.0330$). Differences for SEECS major retention were smaller and did not consistently reach statistical significance beyond the first year. For students with lower unmet financial need, fewer statistically significant differences suggest that financial stress may moderate the extent to which program supports influence retention outcomes.

Across all three outcomes, differences between cohorts narrowed substantially in Years 3 and 4, as retention and graduation rates exceeded 90% for both groups. Nevertheless, SEECS participants consistently maintained equal or higher academic and program-connected retention through graduation, with SEECS students reaching 100% retention or graduation for several outcomes by Year 4. The convergence of outcomes in later years likely reflects persistence among students who have successfully navigated early academic and financial barriers, with SEECS participants maintaining comparable or slightly higher outcomes through graduation.

Conclusions

Across all outcome measures, statistically significant differences between SEECS participants and SEECS-eligible non-participants were concentrated in the first academic year, particularly among students with high unmet financial need. Early advantages were most pronounced for STEM retention, institutional persistence, and academic and program-connected outcomes, including GPA performance and continued eligibility. Although retention rates converged in later years, SEECS participants maintained equal or higher outcomes. Overall, the results highlight the importance of early, integrated financial and academic support structures in promoting sustained STEM persistence and degree completion.

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