Supporting Excellent Engineers (SEE)

Dr. Daina Briedis, Michigan State University

DAINA BRIEDIS is a faculty member in the Department of Chemical Engineering and Materials Science at Michigan State University and Assistant Dean for Student Advancement and Program Assessment in the College of Engineering. Dr. Briedis is involved in several areas of education research including student retention, curriculum redesign, and student motivation. She has been involved in NSF-funded research in the areas of integration of computation in engineering curricula and in developing comprehensive strategies to retain early engineering students. She is active nationally and internationally in engineering accreditation and is a Fellow of ABET, of ASEE, and of the AIChE.

Mr. Theodore Demetrius Caldwell, College of Engineering/Michigan State University

BIOGRAPHICAL SKETCHES

THEODORE D. CALDWELL, ASSISTANT DEAN-STUDENT INCLUSION AND DIVERSITY

Contact Information Michigan State University Cell: (517) 614-3528 Engineering Inclusion and Diversity Office: (517) 355-5156 College of Engineering Facsimile: (517) 355-2293 3424 Engineering Building E-mail: tc@egr.msu.edu East Lansing, MI 48824-1226 http://www.egr.msu.edu

(a) Professional Preparation: Undergraduate Michigan State University Advertising B.A. 1996

Professional Preparation: Graduate Jones International University Adult Education – Higher Education Leadership and Administration M.Ed. 2011

(b) Appointments 2018-Present. Assistant Dean-Student Inclusion and Diversity, Engineering Inclusion and Diversity, College of Engineering, Michigan State University. 2008-2018. Director/Assistant to the Dean for Diversity, Diversity Programs Office, College of Engineering, Michigan State University. 2007-2008. Assistant Director, Diversity Programs Office, College of Engineering, Michigan State University. 2006-2007. Retention and Recruitment Coordinator, Diversity Programs Office, College of Engineering, Michigan State University. 2005. Recruiter, Admissions Office, International Academy of Design and Technology.

(c-1) Five Closely Related Publications (out of >100 refereed publications) None.

(c-2) Five Other Significant Publications 1. Caldwell, T.D., Foster, K., Lane, T., Caldwell, R.A., Vergara, C.E., and Sticklen, Jon. What Happens After a Summer Bridge Program: The DPO Scholars Program. Accepted for publication in ASEE 2011. Paper 1790.

Five Synergistic Activities 1. Serving as Co-Principal Investigator for MSU on National Science Foundation NSF 1619681; Michigan Louis Stokes Alliance for Minority Participation (MI-LSAMP); under the direction of Martin Philbert, Herbert Winful, Edmund Tsang, Richard Ellis and Peter Bahr. Phase 3 of this grant is effective October 1, 2016 - September 30, 2022.

Collaborators and Other Affiliations Collaborators and co-authors (last 4 years): Petty, C. (Mich. St. U.); Sticklen, J. (Mich. St. U.); Briedis, D. (Mich. St. U.); Shipman, R. (Mich. St. U.); Wolff, T. (Mich. St. U.); Foster, K. (Mich. St. U.); Thompson, L. (U. of Mich.); Thompkins, G. (Wayne St. Univ.); Tsang, E. (Western Mich. U.); Lane, T. (Mich. St. U.); Caldwell, R. (Mich. St. U.)

Lisa Linnenbrink-Garcia, Michigan State University

Dr. Lisa Linnenbrink-Garcia is a professor of Educational Psychology in the Department of Counseling, Educational Psychology, and Special Education at Michigan State University. She received her Ph.D. in Education and Psychology from the University of Michigan, Ann Arbor. Her research focuses on the development of achievement motivation in educational settings and the interplay among motivation, emotions, and learning/engagement, especially in STEM fields.

Dr. Emily A. Bovee, Marquette University

Emily A. Bovee is the Director of Educational Development and Assessment at the Marquette University School of Dentistry. She earned her bachelors in psychology from Arizona State, and earned her doctorate in educational psychology and educational technology from Michigan State. Her primary areas of research interest are student learning and persistence in higher education. Her current projects explore student motivation and success in STEM disciplines at the undergraduate and professional education levels.

Mr. Harrison Douglas Lawson, Michigan State University

Graduate Student at Michigan State University pursuing a M.S. in Chemical Engineering. After graduating, I plan to pursue doctoral studies at Carnegie Mellon University. My research focuses are biology and education. After graduating I aspire to continue working with education programs and join a university as teaching faculty.

Dr. Mark Urban-Lurain, Michigan State University

Mark Urban-Lurain is retired as an Associate Professor and Associate Director for Engineering Education Research in the CREATE for STEM Institute at Michigan State University.

Alexandra Anderson Lee, Michigan State University
Ms. Amalia Krystal Lira

Amalia (Krystal) Lira is a doctoral student in Educational Psychology and Educational Technology at Michigan State University. She is interested in addressing STEM attrition among underrepresented racial and ethnic minority students using motivational frameworks.

Dr. Kristy A. Robinson, McGill University
Prof. S. Patrick Walton, Michigan State University

S. Patrick Walton is the Associate Chair and C. Robert and Kathryn M. Weir Endowed Associate Professor in the Department of Chemical Engineering and Materials Science at Michigan State University. He received his bachelors in chemical engineering from Georgia Tech, and then attended MIT where he received his masters and doctoral degrees. After a post-doc at Stanford University, he joined MSU in 2004 where his research is focused on the development of novel therapeutic and diagnostic technologies based upon the unique physical and chemical properties of nucleic acids. He is also engaged in studying engineering student persistence and success through the lens of motivation. He has been recognized for his accomplishments in both teaching and research, receiving the MSU Teacher-Scholar award, the College of Engineering Withrow Teaching Excellence Award and being named an MSU Lilly Teaching Fellow and MSU's Undergraduate Research Faculty Mentor of the Year.

Supporting Excellent Engineers (SEE)

Abstract

The Supporting Excellent Engineers (SEE) program in the College of Engineering (CoE) at Michigan State University (MSU) is building a financial, academic, and social support structure to increase persistence and success for academically talented students (GPA > 3.0) with high financial need (Pell-eligible). SEE activities build upon existing support programs and structures in the CoE and at MSU. SEE Scholars are selected from eligible rising second-year engineering students with awards of $8,000 per year for students' second and third years. At completion, SEE will have supported four cohorts of 9 students each. In addition to financial support, SEE provides research-based professional development and social cohort programming to assist students in building connections to the CoE and each other. Two explicit goals for the SEE Scholars program are for each Scholar to obtain an internship, co-op, or summer undergraduate research position and 100% retention and persistence of Scholars to graduation from the CoE. SEE support services are aligned with prior research on STEM persistence and psychological research on structures that support motivation. Leveraging ongoing assessments by members of the SEE team, the impacts of various financial and psychological supports are being examined. SEE is studying how being a SEE Scholar affects students' feelings of belonging and motivation (e.g., self-efficacy, value, identity, and perceived cost), relative to their peers. The data collected will allow us to determine the effectiveness of our support activities in enhancing students' retention and persistence to graduation on a small population of select students. To date, SEE has supported the persistence and success of 27 MSU engineering students. This paper will describe the SEE program and our ongoing programmatic and research efforts.

Vision

The overall goal of the SEE Scholars program is to increase retention and persistence to degree completion of academically talented engineering students with high financial need. SEE provides academic, professional, and psychologically supportive programs to motivate and sustain these academically talented students throughout their undergraduate careers.

Overview and Objectives

The SEE Scholars program is designed to build a financial, academic, and social support structure that will sustain academically talented students with demonstrated financial need through the critical 2nd and 3rd years of engineering studies at MSU. The SEE program is designed to (1) increase retention and student success for academically talented students with demonstrated financial need; (2) build upon and connect with existing support programs and structures in the CoE and University; and (3) evaluate the effects of SEE on student motivation, engineering identity, and sense of belonging, which are important predictors of persistence to graduation.

We have chosen to support students during the 2nd and 3rd years for four principal reasons. Firstly, at MSU, students' academic performance is evaluated during these years to determine admission to the CoE and access to junior- and senior-level engineering courses. Approximately 86% of students gaining admission to the CoE graduate from the CoE (with most of the

remaining students graduating from the University), making college admission the last significant hurdle for many engineering graduates.

Secondly, SEE-eligible students have had one year at MSU to demonstrate their achievement in college-level academic coursework. Evaluating students based on MSU academic records (as opposed to high school records) improves the likelihood that SEE awards are only given to students who will graduate from the CoE. Moreover, MSU and the CoE currently dedicate considerable resources and proven programs to support 1st-year students, giving talented but underprepared students an opportunity to perform at MSU on a more even footing with peers who had stronger K-12 support structures.

Thirdly, the 2nd and 3rd years for engineering students (including the subsequent summers) are when students most often receive their first cooperative education (co-op) or internship opportunities. These experiential education opportunities are valuable for enhancing student retention, making students competitive for full-time positions once they graduate, and important sources of funds to pay education expenses. Positioning students to be more competitive for internship and co-op positions is a principal part of SEE activities.

Fourthly, our internal studies have indicated that 2nd- and 3rd-year students have significantly lower feelings of belonging to the CoE, lower motivation in engineering (e.g., self-efficacy and value for engineering), and higher perceived opportunity, effort, and psychological costs associated with pursuing studies in engineering, relative to 1st- and 4th-year students. Given the links between these key psychological constructs and STEM persistence (e.g., [1-3]), the declines in more adaptive and increases in less adaptive motivational beliefs highlight the importance of providing support structures designed to enhance 2nd- and 3rd-year students' motivation and persistence.

Scholar Selection

SEE Scholars are selected following the spring semester of their first year. Students are recruited from those who have applied to the college-wide process for scholarships for returning students. Students who meet our academic (GPA > 3.0) and need (Pell-eligible) thresholds are invited to apply for SEE scholarships.

Applicants' are reviewed according to (a) difficulty of courses taken, (b) grades received in each course, (c) campus involvement, (d) resume, and (e) a scholarship application, including recommendations describing the student's motivation and capacity for leadership. The SEE leadership team interviews each of the finalists and makes a final determination of the SEE scholarship recipients after the completion of spring semester.

Scholars' GPAs are reviewed after each semester. Students who receive a semester GPA below 3.0 are placed on probationary status. Two consecutive semesters below 3.0 results in loss of scholarship support. Students may earn back their SEE support after cancelation, if their subsequent semester GPAs exceed 3.0 and their cumulative GPA remains above 3.0.

SEE Support Activities

It is a goal of SEE that 100% of SEE Scholars are retained and graduate from the CoE. To achieve this, we address financial and psychological risk factors that impede students' progress. Financial risk is addressed through scholarships ($4,000/semester for years 2 and 3 of their undergraduate careers). We also target students' financial risk through activities focused on career preparation and development. It is another goal of SEE that 100% of SEE Scholars have participated in an internship or co-op position by, at the latest, the summer immediately following their 3rd year. To achieve this, we coordinate closely with The Center for Spartan Engineering (the CoE's career services office). The Center hosts programs targeted at SEE Scholars to help them prepare for interviews and the workplace. These programs position students to compete for internships, co-ops, or other paid experiential education opportunities, with an average pay of $10,000/semester. Thus, students participating in these opportunities earn essentially an additional year of scholarship support.

Psychological risk is addressed through individual and cohort-based activities. Each SEE Scholar is assigned a faculty mentor from the leadership team. Scholars meet with mentors once or twice per semester, with these meetings structured around questions designed to support students' motivation. SEE also organizes social and academic events where Scholars can interact and develop interpersonal connections that support their persistence and success. Finally, students are encouraged to participate in experiential education opportunities, which allow students to engage in relevant activities, see connections between their coursework and future job possibilities, and support students' autonomy by giving them strategies for comparing the merits of different opportunities and choosing the best fit among them. As a result, participation in experiential education addresses multiple common sources of psychological risk.

Results

The SEE Scholars program has provided support for work leading to a number of conference and journal papers. Details of these are provided below.

Journal Articles:

Robinson, K. A., Lee, Y.-k., Bovee, E. A., Perez, T., Walton, S. P., Briedis, D., & Linnenbrink-Garcia, L. (2019). Motivation in transition: Development and roles of expectancy, task values, and costs in early college engineering. *Journal of Educational Psychology, 111*(6), 1081–1102. https://doi.org/10.1037/edu0000331.

- This work studied development in expectancy for success, task value, and perceived cost for engineering students during their first 2 years of college.

Conference Papers:

Robinson, K. A., Lira, A. K., Walton, S. P., Briedis, D., and Linnenbrink-Garcia, L. (2020). Instructional supports for motivational trajectories in introductory college engineering. Annual Meeting of the American Educational Research Association. San Francisco, CA.

- This work is looking at students' perceptions of the motivational climate (instructors' motivationally supportive practices) in intro engineering and how those perceptions relate to changes in student motivation for engineering.

Walton, S.P., Lira, A.K., Lee, A.A., Lawson, H.D., Bovee, E.A., Briedis, D., Linnenbrink-Garcia, L. (2020). Taking the next step to engineering careers: Career-related activities, value,

and belonging. Annual meeting of the American Educational Research Association. San Francisco, CA.

- In this work, the relationship of engaging in career-related activities and student motivation was examined.

Bovee, E. A., Lira, A. K., Briedis, D., Linnenbrink-Garcia, L., & Walton, S. P. (2019). The impacts of scholarships on engineering students' motivation. American Society of Engineering Education (ASEE) Annual Conference and Exposition. Tampa, Florida.

- This paper described our initial efforts to examine how scholarships influence engineering students' motivation.

Bovee, E. A., Mahmood, Z., Robinson, K. A., Walton, S. P., Briedis, D., & Linnenbrink-Garcia, L. (2019). Antecedents of engineering major persistence: An exploration with machine learning. Annual Meeting of the American Educational Research Association. Toronto, Canada.

- Machine learning was examined as an alternative analytical approach for identifying complex relations among achievement, course-taking, motivation, and persistence.

Lee, Y., Bovee, E. A., Robinson, K. A., Perez, T., Lira, A. K., Briedis, D., Walton, S. P., & Linnenbrink-Garcia, L. (2018). Latent interactions between expectancy and values in predicting engineering outcomes. Annual meeting of American Psychological Association (APA). San Francisco, CA.

- This study examined whether expectancies for success and motivated behavior depend on individuals' task values and vice versa for first-year engineering undergraduates.

Ranellucci, J., Robinson, K. A., Bovee, E. A., Briedis, D., Walton, S. P., & Linnenbrink-Garcia, L. (2018). Gender and engineering: The importance of anticipatory emotions. Annual meeting of the American Educational Research Association. New York, NY.

- This study focused on the relations between emotions, gender, self-efficacy, and planned persistence in STEM among first-year undergraduate students in engineering.

Bovee, E. A., Lee, Y., Sansone, A., Briedis, D., Walton, S. P., & Linnenbrink-Garcia, L. (2018). Making connections: Belonging in engineering fosters career intentions through value. Annual Meeting of American Educational Research Association. New York, NY.

- Using Expectancy-Value Theory, this work examined the relations of college engineering students' feelings of belonging to their motivation and their career intentions.

Robinson, K. A., Lee, Y., Bovee, E. A., Walton, S. P., Briedis, D., Linnenbrink-Garcia, L. (2018). Not all values are created equal: Development and roles of expectancy and values in engineering. Annual Meeting of the American Educational Research Association. New York, NY.

- Development in expectancy and three types of value (utility, interest, and attainment) was studied for engineering students in their first two years of college

References

1. Marra, R. M., Rodgers, K. A., Shen, D., & Bogue, B. (2012). Leaving engineering: A multiyear single institution study. *Journal of Engineering Education*. 101, 6–27.
2. Perez, T., Cromley, J. G., & Kaplan, A. (2014). The role of identity development, values, and costs in college STEM retention. *Journal of Educational Psychology*. 106, 315-329.
3. Wang, M. T., & Degol, J. (2013). Motivational pathways to STEM career choices: Using expectancy-value perspective to understand individual and gender differences in STEM fields. *Developmental Review*. 33, 304-340.