

An Intervention of Financial Literacy in Engineering Training Programs to Support Retention of Financially Vulnerable Students

Dr. Erika Moore, University of Maryland College Park

Dr. Erika Moore is an Assistant Professor in the Fischell Department of Bioengineering at the University of Maryland, College Park. She earned her B.S. in Biomedical Engineering from Johns Hopkins University in 2013 and her Ph.D. in Biomedical Engineering from Duke University in 2018. As Principal Investigator of the Moore Lab, Dr. Moore leads research in immunoengineering and biomaterials, focusing on macrophage biology in tissue repair, lupus, and uterine fibroids. Complementing her scientific research, Dr. Moore is also deeply committed to engineering education, with a particular emphasis on advancing financial literacy for students in STEM. At the University of Maryland, she has integrated financial literacy into federally funded student training programs, including the NIH Maximizing Access to Research Careers (MARC T34) program and the LSAMP BRIDGE program. Through these initiatives, she has designed and delivered structured workshops on financial psychology, budgeting, credit management, and investing, demonstrating measurable improvements in student confidence and reduced financial stress. Dr. Moore's work highlights the importance of embedding financial education into engineering training as a means to increase persistence, reduce barriers to degree completion, and prepare a resilient engineering workforce. She has been recognized nationally for her contributions to both research and education, earning honors such as the NIH R35 Maximizing Investigators Research Award, Lupus Research Alliance Career Development Award, 3M Non-Tenured Faculty Award, NSF CAREER Award, recognition as a 2020 Forbes 30 Under 30 honoree in Healthcare, and selection as a 2024 TED Fellow.

An Intervention of Financial Literacy in Engineering Training Programs to Support Retention of Financially Vulnerable Students

Introduction

The United States faces an increasing demand for a highly skilled engineering workforce to sustain innovation, global competitiveness, and economic growth. At the same time, engineering education continues to grapple with persistent challenges related to student retention, well-being, and equitable access to professional pathways. One of the most significant, and often under-addressed, barriers is financial insecurity. Financial stress has been consistently linked to negative academic outcomes, including reduced persistence, lower academic performance, and adverse mental health impacts among undergraduate students, particularly those from low-income and historically marginalized backgrounds [1]-[4]. In engineering programs, which are characterized by high academic rigor and extended time-to-degree, challenges associated with financial stress are amplified.

Despite the central role of economic decision-making in both personal and professional engineering practice, structured financial literacy education remains largely absent from undergraduate engineering curricula. While within technical coursework, engineers routinely engage in resource-constrained design, cost optimization, and economic tradeoff analyses, few programs provide formal preparation for managing personal finances, evaluating compensation structures, or navigating debt and investment decisions associated with internships, graduate training, and early career transitions [2], [5], [6]. At universities, existing financial literacy interventions are often limited to optional workshops or generalized resources that lack disciplinary relevance and sustained curricular integration [5], [6]. As a result, many engineering students graduate with strong technical skills but limited preparation for the financial realities that shape career mobility, professional decision-making, and long-term stability.

This gap is particularly consequential given current trends in student debt and financial preparedness. Over 58% of U.S. college graduates carry student loan debt, with average balances approaching \$37,000 at graduation, and national student loan debt exceeding \$1.7 trillion [7]. At the same time, financial literacy among young adults remains chronically low. National surveys indicate that fewer than half of young adults can correctly answer basic financial literacy questions, and even fewer demonstrate competency in areas such as budgeting, risk management, or investment decision-making [8]. Because many engineering students either pursue advanced degrees or employment with complex compensation structures, including equity or deferred benefits, gaps in financial literacy pose risks not only to individual well-being but also to workforce readiness and retention.

Within engineering education, experiential and cooperative learning models have been widely recognized as effective mechanisms for preparing students for professional practice. Cooperative education programs, internships, and federally funded training initiatives provide students with applied, work-integrated learning opportunities that bridge academic preparation and workforce participation. However, even within these experiential contexts, non-technical professional competencies, such as financial decision-making, are rarely addressed explicitly. This omission

represents a missed opportunity to support students as they navigate critical transitions from student to professional engineer.

In response to this need, the present study examines the design, implementation, and assessment of an engineering-specific financial literacy curriculum embedded within undergraduate training programs at one large public research university. Financial literacy modules were integrated into the NIH Maximizing Access to Research Careers (MARC T34) program and the Louis Stokes Alliances for Minority Participation (LSAMP) BRIDGE program as a core professional development component. These programs function as structured experiential pathways into research and engineering careers, making them an ideal context for applied financial literacy instruction. The curriculum is designed to simulate real-world financial decisions students encounter during training and early career development. The topics covered include financial psychology, budgeting, credit management, and investing.

The significance of this work lies in its positioning of financial literacy as an experiential, workforce-relevant competency rather than a peripheral or optional skill. Drawing on prior research demonstrating the relationship between financial stress, academic persistence, and professional outcomes [1], [3], [9], this study contributes evidence that targeted financial literacy interventions can improve students' financial self-efficacy and reduce perceived financial stress. Moreover, by embedding instruction within existing experiential training programs, this approach offers a scalable and transferable model aligned with cooperative and experiential education frameworks.

The scope of this study is limited to undergraduate engineering students participating in two structured programs at one large public research university, and outcomes are assessed using self-reported measures of confidence, understanding, and stress via Likert-type surveys. While these measures provide valuable insight into short-term impacts, they do not capture long-term financial behaviors or career outcomes. Nevertheless, this work establishes a foundation for integrating financial literacy into experiential engineering education and informs broader efforts to develop scalable, evidence-based models that support workforce readiness and equitable participation in engineering.

Experimental Methods/Materials/Project Approach

Study Design and Context

This study employed a pre–post survey design to evaluate the impact of an engineering-specific financial literacy intervention embedded within undergraduate training programs at one large public research university. The intervention was implemented within the NIH Maximizing Access to Research Careers (MARC T34) program and the Louis Stokes Alliances for Minority Participation (LSAMP) BRIDGE program. These programs provide structured, experiential training pathways for undergraduate students preparing for research-intensive and professional engineering careers, making them an appropriate context for applied financial literacy instruction.

The study was reviewed by the university’s Institutional Review Board and determined to be exempt from full IRB review under federal regulation 45 CFR 46.104(d)(2)(i–ii). Participation in the research component (surveys) was voluntary and not required for workshop attendance.

Participants and Recruitment

Participants were undergraduate students enrolled in the university’s MARC T34 or LSAMP BRIDGE programs. Eligibility criteria required participants to be at least 18 years of age and actively participating in the associated training program during the academic year of the intervention. Recruitment occurred via program-administered email invitations distributed by program staff, which included a description of the study purpose and a link to the anonymous online survey. No additional recruitment materials (e.g., flyers or direct outreach) were used, minimizing selection pressure. Sample sizes for each program cohort and time point are summarized in **Table 1**.

Enrollment was limited by cohort size within the training programs, with approximately five students per year participating in the MARC T34 program and thirty students participating in the LSAMP BRIDGE program. Across multiple interventions, participation reflected the natural enrollment of these programs rather than targeted sampling. The data presented in this study reflect two independent program cohorts (one cohort per program) collected within a single academic cycle; analyses were conducted separately for each cohort and were not aggregated across multiple years.

Financial Literacy Intervention

The intervention consisted of a multi-session, interactive financial literacy workshop led by the principal investigator. The workshop was designed as a professional development module aligned with experiential education principles and focused on real-world financial decisions relevant to undergraduate engineering students. Content areas included:

- Financial psychology and decision-making
- Budgeting and savings strategies while enrolled as students and after graduation
- Student loans, debt, credit establishment and credit management
- Introduction to investing and long-term financial planning

Instructional delivery combined short didactic segments with applied examples drawn from engineering career contexts, such as budgeting on internship or entry-level salaries and considering financial implications of graduate training. Workshops were delivered in-person or

synchronously online, depending on program logistics, and were integrated into the broader professional development curriculum of each program.

Survey Instrumentation

Workshop impact was assessed using anonymous pre–post surveys administered electronically via a secure, university-supported online survey platform. The survey required approximately five minutes to complete and collected no personally identifiable information.

Survey items used a 5-point Likert-type scale (Strongly Agree to Strongly Disagree) to assess self-reported financial confidence, understanding, interest, and stress. Core outcome measures included confidence in budgeting, ability to act on financial goals, understanding of investing, and perceived financial stress. Several items were informed by established financial literacy constructs used in large-scale assessments, including the Organisation for Economic Co-operation and Development Programme for International Student Assessment (PISA) financial literacy framework, adapted for relevance to undergraduate engineering students.

The same survey items were administered before and immediately after the workshop to enable within-subject comparison of perceived changes in financial literacy and confidence.

Data Collection Procedures

Survey links were distributed via email by program staff prior to the workshop and again immediately following the workshop. Informed consent was obtained electronically at the beginning of each survey, consistent with IRB-approved procedures. Participants could attend the workshop without completing surveys and could withdraw from the research component at any time without penalty.

Responses were automatically aggregated by the survey platform and stored on password-protected university systems accessible only to the research team. No identifiable information was collected in the survey results.

Program	Cohort Structure	Pre-Workshop (n)	Post-Workshop (n)	Matched pre–post (n)
MARC T34	Single cohort (n=5)	5	4	4
LSAMP BRIDGE	Single cohort (n=36)	36	33	33

Table 1. Sample sizes for financial literacy intervention cohorts by program and time point.

The table summarizes the number of undergraduate engineering students participating in the MARC T34 and LSAMP BRIDGE programs who completed pre- and post-workshop surveys, as well as the number of matched pre–post responses included in within-cohort analyses. Data reflect single cohorts for each program and were analyzed within program (not pooled across years).

Data Analysis

Data analysis focused on within-group comparisons of pre- and post-workshop responses. Because the MARC T34 and LSAMP BRIDGE data were collected from two independent cohorts, all analyses were conducted within each program cohort separately rather than pooled across cohorts or across years. Likert-type scale responses were treated as ordinal data. Descriptive statistics were calculated to summarize participant responses before and after the intervention. For cohorts with sufficient sample size, nonparametric statistical tests (e.g., Mann–Whitney U tests) were used to assess differences in pre- and post-workshop responses, consistent with best practices for analyzing ordinal survey data.

Analyses emphasized changes in financial confidence, understanding, and stress rather than absolute financial knowledge, reflecting the study’s focus on professional self-efficacy and experiential learning outcomes.

Ethical Considerations and Limitations

The study posed minimal risk to participants, limited primarily to potential discomfort when reflecting on personal financial stress. Risk mitigation strategies included anonymity, voluntary participation, and secure data storage.

Several limitations should be noted. The study relied on self-reported measures rather than objective assessments of financial behavior or long-term outcomes. Sample sizes were constrained by program enrollment and limited to a single institution, which may affect generalizability. Additionally, the pre–post design captures short-term changes and does not assess persistence of financial literacy gains over time. Despite these limitations, the methodology provides a reproducible and scalable approach for evaluating applied financial literacy interventions embedded within experiential engineering education programs.

Results and Discussion

Overview of Outcomes

This section presents the impact of the financial literacy intervention on students’ self-reported financial confidence, financial understanding, and perceived financial stress. Outcomes are reported separately for the MARC T34 and LSAMP BRIDGE program cohorts, reflecting two independent student populations. Figures 1 and 2 summarize the distribution of pre- and post-workshop responses across key survey items related to budgeting, investing, and financial stress. Together, these results evaluate whether participation in the workshop was associated with measurable shifts in financial self-efficacy and perceived financial well-being.

MARC T34 Program Outcomes: Financial Confidence and Understanding

Pre- and post-workshop survey responses from MARC T34 participants indicate statistically significant improvements in financial confidence and understanding following the intervention (**Figure 1**). Prior to workshop participation, students most commonly reported neutral or disagree responses to statements such as “I feel I can confidently budget my earnings to try to meet some of my personal goals” and “I understand how to invest my earnings.” Following the workshop, responses shifted toward agreement across both measures.

Nonparametric analysis using the Mann–Whitney U test identified significant differences between pre- and post-workshop responses ($*p < 0.05$), supporting the conclusion that even a single-session, targeted intervention can meaningfully increase students’ perceived financial competence. These findings are consistent with prior work linking financial self-efficacy to reduced stress and improved academic persistence among college students, particularly those navigating financial insecurity [10].

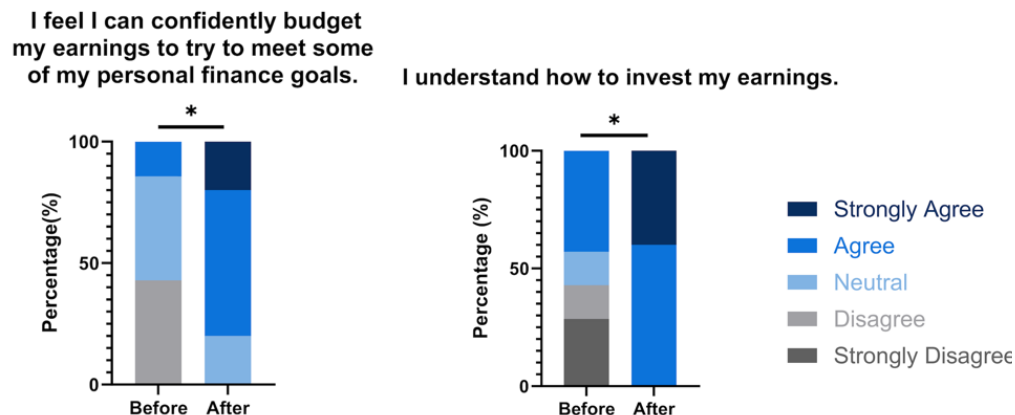


Figure 1. Impact of the financial literacy curriculum on MARC T34 scholars. Distribution of responses (percentage) to the statements “I feel I can confidently budget my earnings to meet personal goals” and “I understand how to invest my earnings” before and after participation in the financial literacy workshop. Responses were collected using a 5-point Likert scale (Strongly Disagree to Strongly Agree). Mann–Whitney U tests were used to assess differences between pre- and post-workshop responses, with statistically significant differences indicated by ($*p < 0.05$). Sample sizes: pre-workshop ($n = 5$) and post-workshop ($n = 4$).

LSAMP BRIDGE Program Outcomes: Financial Confidence and Perceived Stress

Students participating in the LSAMP BRIDGE program demonstrated similar positive trends following the financial literacy intervention (**Figure 2**). In addition to increased agreement with statements related to understanding and acting on financial goals, LSAMP participants reported a reduction in perceived financial stress after the workshop; however, this change was not statistically significant.

This finding is notable given that LSAMP BRIDGE serves first-year engineering students, a population often experiencing heightened transition-related stress. The observed reduction in financial stress aligns with prior research suggesting that perceived control and financial understanding can buffer the negative effects of economic strain on student well-being [11]. These outcomes suggest that financial literacy interventions may be particularly impactful when delivered early in the undergraduate experience, supporting persistence during critical transition periods.

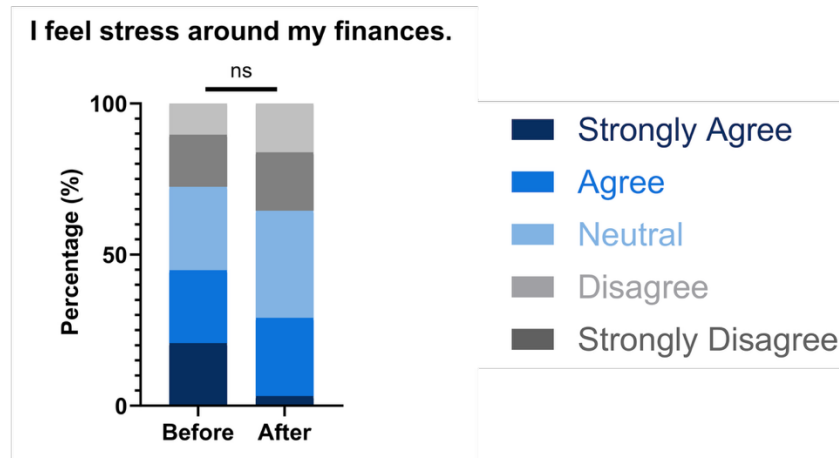


Figure 2. Self-reported perceived financial stress before and after participation in the LSAMP financial literacy workshop. Responses are shown as percentage distributions across a 5-point Likert scale (Strongly Disagree to Strongly Agree). Data reflect a single cohort of LSAMP BRIDGE participants pre ($n = 36$) and post ($n = 33$). Although participants reported improved understanding of and confidence in acting on financial goals, changes in perceived financial stress were not statistically significant (Mann–Whitney U test; ns, $p \geq 0.05$).

Comparison to Existing Financial Literacy Efforts

Unlike generalized financial education programs targeting broad student populations, the interventions described here are explicitly tailored to engineering students aged 18–25 and embedded within experiential training pathways. Existing programs such as K–12 financial education initiatives or general college financial wellness resources rarely address the specific financial contexts encountered by engineering students, including internship compensation, graduate stipends, relocation costs, and early-career employment decisions. The observed gains in confidence and reductions in stress suggest that disciplinary relevance and contextualization are key contributors to program effectiveness.

Limitations and Opportunities for Improvement

Several limitations warrant consideration. First, outcomes are based on self-reported measures rather than objective assessments of financial behavior. Second, sample sizes are constrained by program enrollment and reflect a single institutional context. Third, the pre–post design captures short-term changes and does not assess the durability of financial literacy gains.

Despite these limitations, the findings provide valuable early evidence that targeted, discipline-specific financial literacy interventions can improve students' perceived financial competence and reduce stress-related barriers to persistence. These results demonstrate the feasibility and potential impact of integrating financial literacy into experiential engineering training programs.

Future studies incorporating longitudinal follow-up and multi-institutional datasets would strengthen the evidence base and enable examination of downstream academic and career outcomes.

Future Goals and Broader Impacts

Building on these findings, future efforts will focus on scaling and institutionalizing financial literacy within engineering education, consistent with the goals of NSF Improving Undergraduate STEM Education (IUSE) initiatives. Planned next steps include the development of a scalable peer-mentor–led financial literacy model, in which trained undergraduate and graduate engineering students deliver workshops within departments, student organizations, and experiential learning programs. This tiered mentoring approach draws on established evidence that peer-led instruction can enhance engagement and learning outcomes while expanding program reach [12]–[14].

In parallel, this work will inform the submission of an NSF IUSE proposal focused on national dissemination of a modular, engineering-specific financial literacy curriculum. The proposed project will emphasize (1) integration into cooperative education, internship preparation, and research training programs; (2) faculty and staff training for sustainable implementation; and (3) rigorous multi-site assessment of student outcomes, including confidence, stress, and persistence. By aligning financial literacy with experiential education frameworks, this work seeks to position financial competence as a core professional skill essential to workforce readiness and equitable participation in engineering.

Conclusion

This study addresses a critical but underexplored barrier to engineering student success: financial insecurity and limited financial literacy preparation. By embedding a targeted financial literacy curriculum within MARC T34 and LSAMP BRIDGE experiential training programs, this work demonstrates that even brief, discipline-specific interventions can improve students' financial confidence and understanding, with promising trends toward reduced financial stress.

These findings highlight the importance of integrating financial literacy into engineering education as a workforce-relevant professional competency that supports student persistence and well-being. The results also provide a foundation for future multi-institutional and longitudinal studies aimed at evaluating the long-term impact of financial literacy training on academic progression, career decision-making, and retention in engineering pathways.

Acknowledgment

The authors thank [de-identified graduate assistant] for assistance with data analysis and interpretation. This work was supported in part by the National Science Foundation through a CAREER award.

References

- [1] K. M. Whitcomb and C. Singh, “Underrepresented minority students receive lower grades and have higher rates of attrition across STEM disciplines: A sign of inequity?” *Int. J. Sci. Educ.*, vol. 43, no. 7, pp. 1054–1089, 2021.
- [2] S. L. Britt, M. R. Mendiola, G. H. Schink, R. H. Tibbetts, and S. H. Jones, “Financial stress, coping strategy, and academic achievement of college students,” *J. Financ. Couns. Plan.*, vol. 27, no. 2, pp. 172–183, 2016.
- [3] A. G. T. T. Tran, C. K. Lam, and E. Legg, “Financial stress, social supports, gender, and anxiety during college: A stress-buffering perspective,” *Couns. Psychol.*, vol. 46, no. 7, pp. 846–869, 2018.
- [4] D. R. Adams, S. A. Meyers, and R. S. Beidas, “The relationship between financial strain, perceived stress, psychological symptoms, and academic and social integration in undergraduate students,” *J. Am. Coll. Health*, vol. 64, no. 5, pp. 362–370, 2016.
- [5] C. R. Bennett, W. N. Collins, and M. A. McVey, “A tiered mentoring model for deepening student learning across undergraduate and graduate design courses,” in *Proc. ASEE Annu. Conf.*, Columbus, OH, USA, 2017, doi: 10.18260/1-2--27528.
- [6] F. Zhen, T. Graves-Boswell, M. S. Rugh, and J. M. Clough, “‘I have no idea how I will get a stipend’: The impact of COVID-19 on graduate students’ financial security,” *Front. Educ.*, vol. 9, 2024.
- [7] K. L. Zeiser, R. J. Kirshstein, and C. Tanenbaum, *The price of a science Ph.D.: Variations in student debt levels across disciplines and race/ethnicity*. Washington, DC, USA: American Institutes for Research, 2014.
- [8] H. Lim, S. Heckman, C. P. Montalto, and J. Letkiewicz, “Financial stress, self-efficacy, and financial help-seeking behavior of college students,” SSRN, 2014.
- [9] Author self-citation withheld to preserve anonymity during review.
- [10] Lim, H., Heckman, S., Letkiewicz, J., & Montalto, C. (2014). Financial stress among college students: New data about student loans, financial aid, and campus jobs. *Journal of College Student Development*, 55(3), 287–295.
- [11] T. Richardson, P. Elliott, and R. Roberts, “Psychological factors associated with financial hardship and mental health,” *Clinical Psychology Review*, vol. 54, pp. 62–75, 2017.
- [12] F. Vick, S. Nagel, and H. Tober, “A meta-analysis of the effect of Peer Instruction on learning gain,” *Studies in Educational Evaluation*, vol. 54, pp. 71–82, 2017.
- [13] C. O. F. Macchiavello, S. A. Cohen, and L. Simon, “Peer-Led Team Learning is associated with an increased retention of students in STEM majors,” working paper, 2023.
- [14] T. Rayford, “Educational enrichment: The benefits of near-peer mentoring for undergraduate engineering students,” in *Proc. ASEE Annu. Conf. Expo.*, 2022.

#