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Engineering Leadership Through Peer Mentoring by High-Performing Students as Catalysts for Academic Success

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***Abstract*—Peer mentoring has become a widely adopted strategy in engineering education to support students facing demanding coursework, strengthen academic integration, and enhance the learning experience through collaborative, near-peer support. This paper reports the design and early program analytics of the Peer Mentoring of Excellence (PME) program, an initiative led by high-achieving engineering students who provide individualized tutoring and exam-preparation support to peers across engineering majors. Using a mixed-methods program evaluation, we analyzed two academic years of implementation (four consecutive semesters) combining operational records (number of mentors, mentees, tutoring sessions, supported courses, and "study jam" events), satisfaction data collected after tutoring sessions, and qualitative feedback from participating peer mentors. PME engaged students from 17 engineering academic programs and delivered 9,101 tutoring sessions to 3,726 mentees across the four semesters. Program capacity remained stable over time, with 62–72 peer mentors per semester and 1,206–2,985 tutoring sessions delivered per semester, supporting 108–133 courses per semester. Satisfaction ratings were consistently above 90% across semesters. Qualitative evidence indicates that peer mentors strengthened leadership, communication, and assertiveness, while also reinforcing their own technical understanding through mentoring. Overall, these results provide a data-driven baseline that supports the feasibility and scalability of a high-achiever-led peer mentoring model in engineering programs and motivates future analyses linking participation to academic performance and persistence outcomes.**

Keywords—*Academic peer mentoring, student retention, peer mentor programs, Academic success*

I. INTRODUCTION

Peer mentoring has emerged as a prevalent strategy in higher education to promote student development and integration through structured, near-peer academic support. Prior work has documented associations between peer mentoring and improved academic performance, persistence, emotional well-being, and social integration, particularly among students transitioning into university environments and facing high cognitive and emotional demands during the first semesters [1,2,3]. In this context, peer mentoring is commonly defined as a structured relationship between students at similar academic stages, where a more experienced student provides guidance, academic support, and knowledge transfer to a peer who is navigating specific learning challenges [1,2]. Its effectiveness and relative scalability have contributed to its widespread adoption as a support mechanism in engineering and other STEM programs.

A. Academic Peer Mentorship in Higher Education

Evidence from the last two decades suggests that higher education institutions continue to face challenges related to student performance and degree completion [4]. According to reports from global experts in higher education, the increase in university dropout rates is attributable to a combination of financial pressures, the effects of online learning, and changing student expectations. For instance, the 2024 NCES report shows that 23.3% of full-time university students in the US do not obtain a degree [5,6]. Within this landscape, academic peer mentoring and peer tutoring programs have been proposed as evidence-informed interventions to improve learning outcomes and reduce academic disengagement by providing timely, discipline-relevant support [2,4].

Consequently, the generation of initiatives that facilitate the promotion and enhancement of student participation and performance within the context of higher education is of paramount importance to a diverse array of stakeholders.

The integration of peer mentoring into academic programs has garnered significant attention on a global scale, particularly in developed countries, as a highly effective strategy for addressing issues such as academic difficulties, student retention, emotional stress, and social integration. This approach has been shown to play a crucial role in the prevention of higher dropout rates. This is since it results in more fulfilling learning experiences and can cultivate a stronger sense of institutional belonging and mutual responsibility, thereby improve student retention and increase graduation rates. [6].

In this sense, peer mentoring has emerged as a prevalent strategy in higher education to promote student development and integration. This approach has been shown to directly impact various factors, including the academic evaluations of mentored students, the reduction of their intention to withdraw from their studies, the enhancement of their sense of belonging, and their academic and social integration [7,8]

B. Advantages of the Peer Academic Mentoring

Peer mentoring leverages social learning dynamics in which students tend to emulate the behaviors and strategies of peers perceived as credible and successful role models [9]. The literature reports several recurring advantages of peer academic mentoring:

a) Academic performance: Participation has been associated with improved academic performance, often

attributed to individualized support, clarification of difficult concepts, and the adoption of effective study strategies [2], [10], [12].

b) Motivation and confidence: Mentored students may experience higher academic confidence and motivation when mentors serve as relatable role models and provide encouragement and structured guidance [11,12].

c) These programs also encourage the development of interpersonal skills, as both mentors and mentees enhance their communication and collaboration skills through interactions facilitated by a commonly understood language [13].

d) Skill development and communication: Peer mentoring interactions can foster interpersonal competencies—such as communication, collaboration, and empathy—while also reinforcing mentors' technical understanding through the teaching/mentoring process [9,10].

e) Stress reduction and academic engagement: Students frequently report a stronger sense of support and understanding from peers, which may reduce academic stress and promote engagement during challenging academic periods [2,14].

From an institutional perspective, these programs can also contribute to retention by strengthening students perceived connection to the academic community and providing structured support networks [12,13]. Mentors similarly benefit by developing leadership, teaching, and time-management skills that are relevant for their professional formation [10,15].

C. *The Peer Mentoring of Excellence (PME) Program*

The Peer Mentoring of Excellence (PME) program was developed by the Academic Improvement Office at XXX (Mexico) as a strategy to support engineering students who require targeted academic assistance in demanding courses. PME is led by high-performing engineering students who provide individualized tutoring and exam-preparation support to peers across multiple engineering majors. The program seeks to (i) expand access to timely academic support, (ii) strengthen students' academic integration through near-peer guidance, and (iii) promote mentor development through structured tutoring experiences.

In general, it is an academic advising model operated by high-achieving engineering students who share their knowledge and success strategies with other students, thus promoting peer learning to improve the academic performance of their mentees.

The objective of this study is to present PME program and evaluate its impact on the achievement of academic success of engineering students who participated as mentees. The research question that this study aims to answer is: Is there any impact of the Peer Mentoring of Excellence (PME) Program on the academic success of engineering students who participated as mentees, as well as on the peer mentors?

The remainder of this paper is organized as follows: Section II describes the methodology and data sources; Section III presents the main results; and Section IV summarizes conclusions and future work.

II. METHODOLOGY

The Peer Mentoring of Excellence (PME) program was created to provide engineering students with structured, near-peer academic support through high-achieving student mentors. In PME, experienced students ("peer mentors") guide and support peers ("mentees") in course-specific learning needs and exam preparation, through sessions delivered either in person or virtually.

To document implementation and generate early evidence, the program was monitored over a two-year period (2024–2025), covering four academic terms: February–June 2024 (FJ24), August–December 2024 (AD24), February–June 2025 (FJ25), and August–December 2025 (AD25). The evaluation follows a mixed-methods, program-evaluation approach that integrates (i) operational records from the tutoring platform (mentors, mentees, sessions, courses supported, and "study jam" events), (ii) post-session satisfaction ratings provided by mentees, and (iii) qualitative feedback from peer mentors. This combination supports a descriptive assessment of program reach, participation patterns, and perceived quality, while identifying opportunities for improvement.

A. *Application of the PME Program and Criteria for Selection*

Admission to PME as a peer mentor follows a structured process designed to ensure transparency and quality. Candidates must meet the following academic requirements: (i) a cumulative GPA of 90 or higher in their bachelor's program, and (ii) grades of 95 or higher in the courses they intend to tutor.

Interested students contact the Academic Improvement Department via email to express interest and then schedule an interview with the program coordinator. As part of the application process, candidates complete a questionnaire describing their academic background. In addition, candidates register their tutoring project following the Scholarship Department guidelines, since tutoring hours can be counted as scholarship service hours. Completion of these steps and fulfillment of the prerequisites are required for selection as PME peer mentors.

B. *Participating Engineering Academic Programs*

PME serves students across 17 engineering academic programs. A complete list of participating programs and acronyms is provided in Table I.

This multi-program coverage enables students to seek support from peers with similar disciplinary backgrounds and course experience, thereby expanding access to mentorship across engineering specialties and supporting academic and professional development.

C. *Tutoring student registration*

Tutoring sessions can be delivered in person or virtually. Students who wish to receive tutoring register through a dedicated online platform accessed with their institutional account. Within the platform, mentees can review peer mentor profiles and relevant information to support mentor selection and scheduling, including:

a) Peer mentor name

b) Number of tutoring sessions previously delivered

c) Hours of tutoring experience

d) Peer achievements and recognitions

e) Courses tutored

f) Available schedule

g) Tutoring registration button

h) Peer mentor evaluation section

i) Registration button to apply as a peer mentor candidate

TABLE I: ENGINEERING PROGRAM PARTICIPANTS IN THE PME

Acronym	Name
IAL	B.S. in Food Engineering
IBT	B.S. in Biotechnology Engineering
IDM	B.S. in Data Science and Mathematics Engineering
IDS	B.S. in Sustainable Development Engineering
IC	B.S. in Civil Engineering
IE	Electronic and Semiconductor Engineering
IFI	B.S. in Engineering Physics
IID	B.S. in Innovation and Development
IIS	B.S. in Industrial Engineering with minor in Systems Engineering
IM	B.S. in Mechanical Engineering
IMD	B.S. in Biomedical Engineering
IMT	B.S. in Mechatronics Engineering
INA	B.S. in Nanotechnology Engineering
IQ	B.S. in Chemical Engineering
IRS	B.S. in Robotics and Digital Systems Engineering
ITC	B.S. Computer Technologies Engineering
ITD	B.S. in Business Digital Transformation Engineering

The main interface of the tutoring registration platform is shown in Fig. 1.

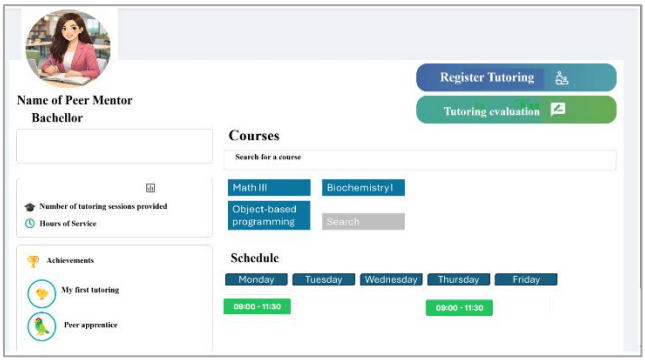

Fig. 1. Main Screen of the Tutoring Registration Platform

By centralizing mentor information and scheduling, the platform supports transparency, facilitates matching between mentors and mentees, and streamlines the registration workflow. It also integrates the post-session evaluation process used for continuous improvement.

D. Peer Mentor Evaluation

Mentees evaluate peer mentors after each tutoring session through the platform. The evaluation uses a five-point Likert scale to capture mentee satisfaction with the mentoring received:

1 – **Strongly Disagree**: The mentee reported lack of fulfillment from the mentoring experience and perceived no value.

2 – **Disagree**: The mentee perceived the mentoring as unsatisfactory and the goals or expectations as unmet.

3 – **Neutral** (Neither Agree nor Disagree): The mentee perceived the experience as neither positive nor negative, without a discernible impact.

4 – **Agree**: The mentee found the mentoring useful and satisfactory and believed the objectives were achieved.

5 – **Strongly Agree**: The mentee expressed complete satisfaction, reporting the mentoring exceeded expectations and provided substantial value.

This evaluation approach enables the collection of quantitative and qualitative feedback on perceived mentoring quality, supporting the identification of improvement opportunities and the recognition of effective practices.

III. RESULTS

This section summarizes early implementation evidence from the Peer Mentoring of Excellence (PME) program, integrating (i) mentee quantitative satisfaction ratings, (ii) qualitative feedback from peer mentors, and (iii) operational program analytics collected across four consecutive semesters (FJ24, AD24, FJ25, AD25).

A. Evaluation of Peer Mentor. Quantitative feedback

Mentees evaluated peer mentors after each tutoring session using a five-point Likert scale (1 = Strongly Disagree to 5 = Strongly Agree). Overall results are shown in Fig. 2.

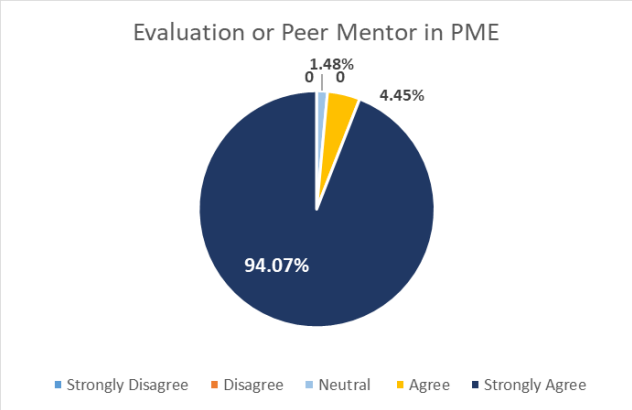

Fig. 2. Quantitative evaluation of Peer Mentors

Satisfaction was consistently high: 94.07% of responses corresponded to “Strongly Agree,” 4.45% to “Agree,” and 1.48% to “Neutral.” No responses were recorded in the “Disagree” or “Strongly Disagree” categories. These results suggest that mentees perceived the tutoring experience as useful and aligned with their expectations.

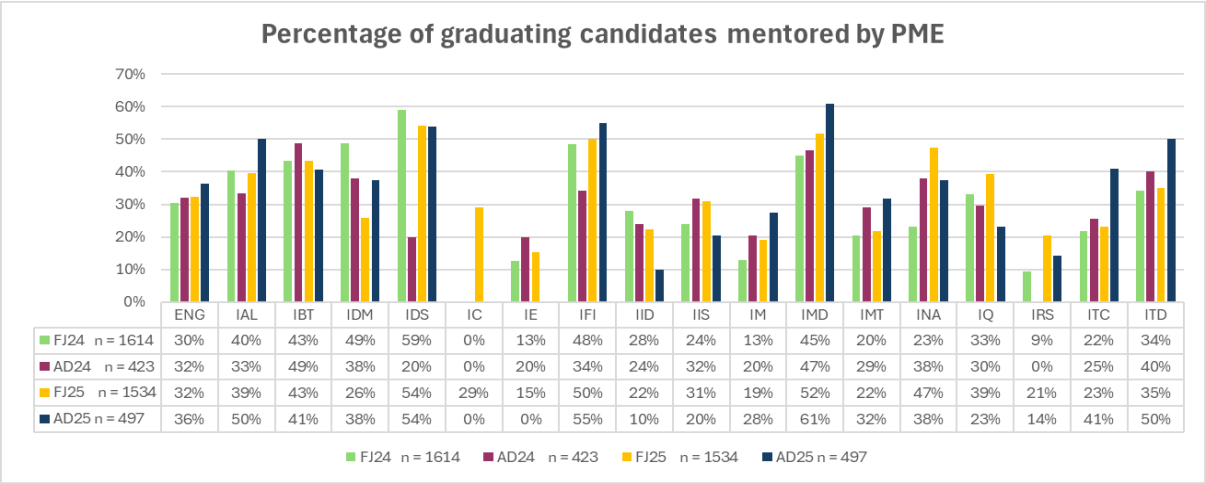

Fig 3.Percentage of graduating candidates mentored by PME

B. A Focus on Graduation Candidates

A critical element of this program is the emphasis placed on students in their final undergraduate semester who are on track to graduate (CAG). These students are of particular concern, as it is imperative to enhance their academic performance to elevate their graduation success rate.

These students are particularly susceptible to failure, thus requiring mentorship and the quantification of their support to ensure academic success. Consequently, mentoring is regarded as one of the program's fundamental components. As illustrated in Figure 3, the average utilization of peer mentoring services among engineering (ENG) graduating students during the two-year period of PME program monitoring ranged from 30% to 36%.

It is noteworthy that the B.S. programs in Biomedical Engineering (IMD), Engineering Physics (IFI), and Sustainable Development Engineering (IDS) were the ones that most frequently utilized peer mentoring services, with over 50% of their respective cohorts being served. This provides insight into the program's efficacy and its role in the academic success of graduating students.

The acquisition of this information confers a multitude of advantages for strategic decision-making in the education sector:

- First, the quantification of support and utilization of mentoring services enables the identification of engineering programs that are reaping the greatest benefits and those whose courses may require further improvement. This identification process is critical for understanding which areas are functioning efficiently and which require more attention, thus enabling better management of resources and efforts.
- Secondly, it facilitates a more effective allocation of resources, ensuring that programs with high demand for mentoring receive the necessary support to maintain or improve their levels of academic success.

The equitable allocation of resources is imperative to guarantee that all students have access to the tools and support necessary to achieve their academic objectives. This may involve the allocation of additional mentors in specific areas, the implementation of new support technologies, and the development of targeted teaching materials.

Furthermore, students in their final undergraduate years benefit from mentoring, which provides personalized guidance that helps them overcome specific challenges, improve their academic and professional skills, and increase their chances of academic success.

C. Perceptions of Peer Mentors. Qualitative feedback

The results obtained from PME mentors correspond to a qualitative evaluation. PME peer mentors have expressed positive perceptions about their participation in the program. Overall, the experience has enabled them to recognize different learning styles, enhance their teaching and communication strategies, and adapt to collaborating with diverse individuals in teams.

In the exit survey, the mentors stated that they developed self-confidence, improved their ability to transmit knowledge effectively, and learned to communicate better with other students and mentors. Table II summarizes some examples of peer mentors' opinions about the program

TABLE II: EXAMPLES OF THE OPINIONS OF PEER MENTORS ENROLLED IN PME PROGRAM.

I've learned that I don't have to know everything to help someone. The more I learn, the more I realize what I don't know. Being a teaching assistant has taught me different ways of understanding, studying, explaining, and navigating university life.
I've learned that everyone absorbs knowledge differently, and that an explanation that works for me won't necessarily work for someone else. Therefore, I've learned how to best convey what I know to others, whether they're in my field or even in a different career.
I have learned how to communicate better with others, and I have also been learning how to develop web pages to facilitate the process of providing support to students.
What I like about the program is the camaraderie we have created and the positive environment where we are willing to help.

As evidenced by the mentees' evaluations, the program is regarded as being highly beneficial. The program has been instrumental in enhancing their communication skills and fostering a deeper understanding of the principles of empathy and adaptability.

Additionally, the camaraderie and positive atmosphere, characterized by a willingness to collaborate with colleagues, are highly regarded.

This environment has played a pivotal role in cultivating new competencies, including the development of websites to support students, a crucial element in their academic success.

D. Program analytics by semester

Program analytics were collected semi-annually across the two-year observation period. Table III summarizes key operational indicators by semester, including the number of peer mentors, tutoring sessions delivered, mentees served, courses supported, and "study jam" events.

TABLE III: SUMMARY OF INFORMATION GATHERED OVER TWO YEARS OF THE PROGRAM

Information by semester				
Categories	FJ24	AD24	FJ25	AD25
Number of Peer Mentors	62	67	66	72
Number of tutoring sessions provided	2,163	2,747	1,206	2,985
Number of Mentees	726	1082	537	1381
Number of Courses	108	129	124	133
Study Jams(General reviews before exam period)	19	11	4	19

As shown in Table III, despite the variability in the number of subjects encompassed by tutoring sessions, which has increased from 108 in FJ24 to 133 in AD25, thereby signifying a more extensive coverage of topics, it is imperative to examine the subjects that have been allocated the highest number of tutoring sessions. This analysis offers significant insights that can inform the enhancement of disciplinary content, particularly in domains where deficiencies have been identified.

Finally, a notable increase in demand for advising in AD25 compared to previous semesters is evident, suggesting heightened recognition of and engagement with the program. This phenomenon can be attributed to several factors, including enhanced promotional efforts for the program, the efficacy of prior advising sessions, and a favorable student perception.

Moreover, the augmentation of peer mentors and the expansion of subject coverage have been pivotal in this escalation in demand. This increase indicates that students are recognizing the value of the academic support provided and are more inclined to actively engage in advising sessions.

This information is crucial for evaluating the overall effectiveness of the program and making strategic adjustments to optimize its long-term results. In summary, an analysis of the collected data facilitates the identification of trends and patterns that enable the prediction of future needs and the proactive adaptation of the mentoring program. This strategy ensures that the program remains both relevant and effective in the present, while also preparing to respond to future challenges. Consequently, it ensures the program's sustainability and continued success.

IV. CONCLUSION

This paper reported the design and early implementation evidence of the Peer Mentoring of Excellence (PME) program, a high-achiever-led peer mentoring initiative that provides course-specific academic support to engineering students through individualized tutoring sessions and structured exam-preparation activities. Using a mixed-methods program-evaluation approach, we described PME's reach and operational stability over four consecutive semesters (2024–2025), integrating platform-based program analytics, post-session satisfaction ratings, and qualitative feedback from participating peer mentors.

Across the monitoring period, PME demonstrated stable capacity (62–72 peer mentors per semester) and sustained demand, delivering 9,101 tutoring sessions to 3,726 mentees and supporting 17 engineering academic programs. Mentee satisfaction was consistently high, with more than 90% of responses in the top Likert categories. Qualitative evidence from peer mentors further suggests that participation contributed to the development of transferable competencies such as leadership, communication, assertiveness, empathy, and adaptability, while reinforcing mentors' disciplinary understanding through the tutoring experience.

In addition, the program enabled monitoring of mentoring utilization among graduation candidates (CAG), where average participation ranged from 30% to 36% across the two-year period, with several programs exceeding 50%. This information can support academic decision-making by informing targeted resource allocation, identifying high-demand courses and programs, and strengthening graduation-oriented support strategies.

Future work will focus on linking mentoring participation to academic outcomes (e.g., course performance, course completion, and persistence indicators) using comparative and/or longitudinal analyses, as well as refining the qualitative component to better characterize mentoring mechanisms and improvement opportunities. Overall, PME provides a scalable, data-informed model for peer mentoring in engineering education that combines academic support for mentees with leadership development for high-achieving student mentors.

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