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Longitudinal Cohort Analysis of a First Year Peer Mentor Program for Improved Retention

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Abstract

Per ASEE FPD guidelines, this paper is the type Complete Paper: Evidence-Based Practice. This paper assesses a peer mentoring program in a school of engineering. Building upon the first wave of data in a previous study, the current study analyzes the third year of the program. The current analysis identifies program changes, describes their rationale, and assesses their impact on student retention rates. There are four contributions to this approach. First, the paper contributes evidence regarding an engineering education practice: peer mentoring. Second, the paper builds upon data collected across three cohorts of program implementation and reported in a series of publications, the former of which inform this analysis. Third, the current analysis attempts to identify which factors were changed between each wave of data. More generally, this project contributes to broader understanding of first-year students and their supportive contexts.

Program Rationale: Peer mentoring has been found to be integral to student success and retention. For example, support from peers can enhance student wellbeing and improve self-efficacy. Hosting a peer mentoring program also could symbolize institutional support. Informed by this evidence, a peer mentor program was developed within a school of engineering based in a small, private university within a large metropolitan area.

Program Goals: A primary goal of the program was to improve student retention by providing students with social belonging, a key aspect of the retention process. The expectation is that the peer mentoring program facilitates a community context in which first-year students can gain a sense of belonging. Peer mentoring can have bidirectional benefits for students.

Program Details: Since Fall 2022, a peer mentoring program has been implemented in three academic years: Program Year 1 (2022-2023), Program Year 2 (2023-2024), Program Year 3 (2024-2025). All first-year students are required to participate in the peer mentor program. Each peer mentor is assigned to approximately 10 first-year students. The mentors meet and connect with students, helping them to connect with the campus and engineering school community. Peer mentors are available to answer any questions the students may have, though this is distinct from a separate tutoring activity.

Program Changes: Slight modifications were made to the program each year. The broader project previously analyzed initial program results (PY1, PY2). Learning from prior evidence-based practices [1-2], the current analysis sought to limit the number of changed variables at a single point in time toward better assessing their impact. The main changes made between PY2, PY3 of the program include changing: (1) meeting frequency, (2) meeting mode (virtual option), (3) funding for mentor events, and (4) program expectations. Peer mentors who register for the leadership course are required to plan a school-wide social event and/or a school-wide service event. Effects of these changes are reported via longitudinal analysis of retention data across three years, and a Sankey Chart is used to visualize the flow of students through the program.

Study Design: The over-time design of the larger study that informs the current analysis lessens potential for self-selection effects in the results. Since selection effects are present within the initial cohort of entering students, and the changes over time are compared to the same cohort at an earlier point in time, the potential for unmeasured variables is to some degree lessened. Though eliminating self-selection effects is not possible, attempts are made to collect evidence that informs educational practices based upon different cohorts of students entering each year.

Future Studies: A similar program was also expanded across campus to a different unit. As such, the implications of implementing a similar program design within different departments across campus will be examined in a future study that builds upon this larger peer mentoring project.

Introduction

This work continues to monitor and report on a peer mentoring program for first-year engineering students aimed to optimize student success in engineering and increase retention rates. This study examined a new program at a small, private institution in the Midwest, and initial findings are reported in Refs. [1-2]. The first two years of this program showed higher rates of retention among students involved in the mentoring program, and student survey responses indicated that the program facilitated leadership development, provided a way to meet new people and destress, and offered avenues for getting more connected to other university and club events. The current study continues to evaluate and improve the program by collecting and analyzing data across now three years of data. Results are analyzed before and after program modifications to assess impact on the program's mission. This work details the implementation of the program, highlights the changes and improvements made for Fall 2024, and reports retention results across three years.

In a systematic review of 55 studies spanning a decade of data collection (2009-2019) from a range of disciplines, higher education researchers found that the majority of interventions aimed at improving undergraduate retention target the first year [3]. Most of the barriers to student success are experienced intensely during the first year, and without proper support, students can drop out, receive lower grades, and ultimately delay their graduation [4]. Difficulties are experienced in the transition from familiar academic and social demands to a new context in which university expectations, systems, and social groups can feel daunting [5]. These "transitional challenges" are mediated by mentoring programs and acceptance from peers [6]

Peer mentoring refers to the opportunity for students to support other students, their peers, by sharing their knowledge and skills [3]. Some programs involve peer-tutoring and others forms of peer-assisted learning or peer-led study groups. Yet, across a variety of implementations, peer mentoring programs evidence social benefits with favorable impacts on retention. In a systematic review of a decade of studies on peer mentoring (2013-2023), accumulated evidence indicates that peer mentoring improves retention rates, academic performance, social integration, and student wellbeing [4]. One of the key facets of success in these programs is their bidirectional impact: students who receive mentoring demonstrate improved outcomes, as do the peer mentors who gain self-efficacy (confidence in their adaptability and needed know-how), interpersonal communication, and leadership skills [7]. Somewhat counterintuitively, receiving information

and cognitive support from peers was not as effective as the social support that students receive from peers [5].

Impacts on retention appear to occur primarily through the social benefits of voluntary actions, such as peer mentoring. For example, one study found that student mentors described three categories of benefits - relational knowledge, greater self-awareness, and development toward career goals [8]. Peer mentored students feel a greater sense of connection with their university, and interconnectedness among students in their program [4]. Additionally, gains in coping strategies and other emotional intelligence abilities result in decreased stress and anxiety, and increased belief in ability to succeed [9]. In summary, the social benefits of peer mentoring include a sense of belonging, civic engagement on campus, and improved leadership skills.

In the context of these existing studies, the current work investigates a peer mentoring program within an engineering school and assesses the long-term gains on first-year retention.

Methods

The first-year engineering peer mentor program began in Fall 2022 (PY1: 2022-2023), and data in this analysis are also compared to the prior year (PY0: 2021-2022) before the program began. Additionally, the current analysis adds a new year of data (PY3: 2024-2025). Details of the program and its prior analysis can be found in Ref. [1-2]. In this paper, we briefly summarize the program and focus analysis on changes made between PY2 and PY3.

In April, an invitation was sent to all upper-class engineering students to serve as first year peer mentors the following Fall semester. Students interested in service as peer mentors were strongly encouraged to register for a variable 0.5 - 1.0 credit Engineering Leadership independent study course; students who took the class for 1.0 credit had to plan twice as many events for other students. At this time, all students who had the initiative to volunteer and sign up for the course were selected for the program. In the future, if the demand for being a peer mentor exceeds the need, an application and selection process will be implemented.

Peer mentors introduced themselves to first-year students shortly before the start of classes during a first-year orientation event. The peer mentor program was explained to the first-year students, and the benefits of being active in the program were also explained, backed by data. During the orientation, students could scan a QR code for a link to the biographies of all the peer mentors along with a peer mentor preference survey. The biographies mostly included mentor interests and hobbies outside of class. In the preference survey, first-year students indicated which peer mentor(s) they were interested in being paired with. The QR code links were also emailed to all first-year students at this time. First-year students were encouraged to select peer mentors based on shared interests: watching sports, playing sports, playing video games, baking, music, reading, etc; rather than picking a mentor based on major. During the first year of implementation (Fall 2022), 60% of the incoming students completed the interested survey. The most recent year’s (Fall 2024) response rate improved to 88.8%, likely since the survey was advertised and sent out during orientation.

To indicate peer mentor preference, students answered the following question for each peer mentor: “Use the following scale to share how interested you are in each group. If you do not select an option for a specific mentor, then it will be considered a neutral response. Do you want to be in this peer mentor's group? (4 = Absolutely, 3 = Yes, 2 = Neutral, 1 = No).

Based on feedback from previous years, a new question was added to the preference survey: “What are your preferred methods of communication?” Students could select one or more of the following options: Text, Email, Phone, Google Chat, Other…(fill in the blank). The results of this was shared with the peer mentors so that they could facilitate communication better.

Peer mentors attended a 2-hour orientation and training session before the start of the semester. During this training, the peer mentor's expectations, roles, responsibilities, and guidelines were communicated to them. This was followed by an open discussion where mentors have the opportunity to ask any questions they might have. Leadership videos on what makes a good leader were also shared with the peer mentors. Throughout the semester, the peer mentors met with faculty leads for guidance; one-on-one feedback meetings were held to discuss questions and concerns in the peer mentor process, go over topics related to leadership and mentoring, and review any planning items.

Faculty manually distributed the first-year students among the peer mentors to create the mentor groups based on first-year student preferences. Those who did not complete the survey were randomly assigned to peer mentors. In Fall 2024, each peer mentor was paired with nine to ten first-year students. Of those who completed the peer mentor preference survey, all were assigned to those who they rated as a 3 or 4, and the average score for all first-year students was 3.76.

A number of modifications were made in Fall 2024. The first of these allowed mentors to either meet their mentees in a group *or* 1-on-1. This was a change from the previous year where it was expected to always meet as a group. Peer mentors were required to (or at least attempt to) meet or connect with each peer mentor at least once a month. This was a reduction from the previous year where the expectation was to hold weekly meetings. The program also allowed some flexibility in the connecting method. Peer mentors could connect with their mentees either virtually or in-person, although in-person was encouraged. Those peer mentors taking the Engineering Leadership course had additional requirements: (1) to meet with one of the lead faculty (and instructor) for a 1-on-1 meeting where they discussed how things were going with their mentees, suggestions for improvement, and event planning. (2) to plan a School-wide social event and/or service event. Students registered for 0.5 credits needed to stage one of these events, while students registered for 1.0 credits were required to facilitate two events. Finally, during Fall 2024 more funding was available for the peer mentor to help host events. These additional funds helped cover the cost for events such as bowling nights, haunted house visits, and social gatherings with food.

During the semester, these large school-wide events included guest lecture events, game nights, an end-of-semester pot-luck lunch held during finals week, and meeting together to write thank-you cards for healthcare workers. The engineering school also requires First-year students to participate in two service activities throughout the semester, so having peer mentors lead these brought students together. In addition to these school-wide events, peer mentors hosted small

group events for their smaller group of mentees, exemplified by video game nights, movie nights, bowling, and dinners.

Participation in the peer mentorship program was required for all first year students during their first Fall semester, while continuation in the program in the spring semester was optional. The timeline in Figure 1 shows the years of this longitudinal study of the peer mentor program. *Mid-Year* retention rates are reported and represent the percentage of students who continue within an engineering program going from the first to the second semester of college. In this paper, the *Mid-Year* retention rates are used as the primary metric and indicator of the program's success given that the peer mentor program is only required during the first semester, and at the time of this paper (Sem II 2025), these are the only comparable data available for all four years.

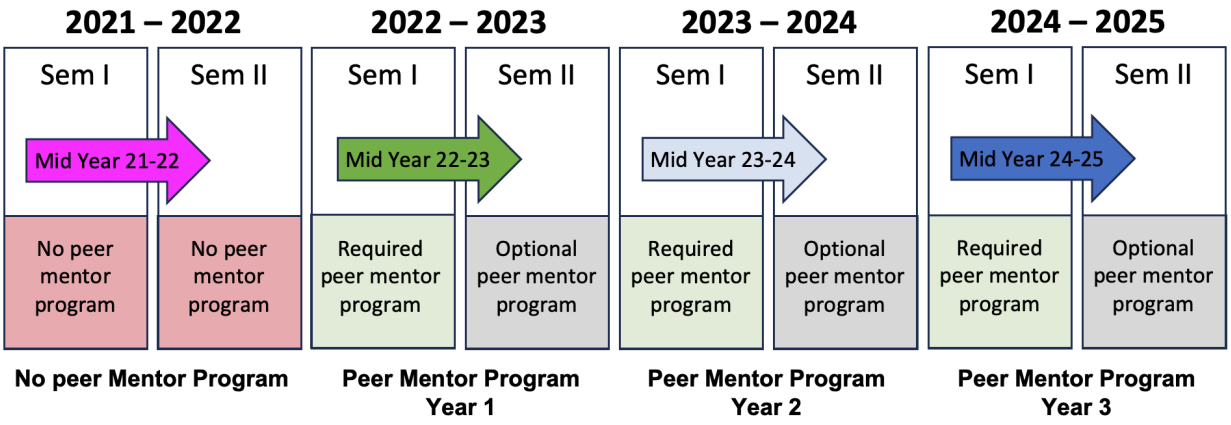

Figure 1. Visualization shows the timing of the peer mentor implementation and when retention is measured.

Results

First-year retention appears to have improved and continues to improve each year, Figure 2.

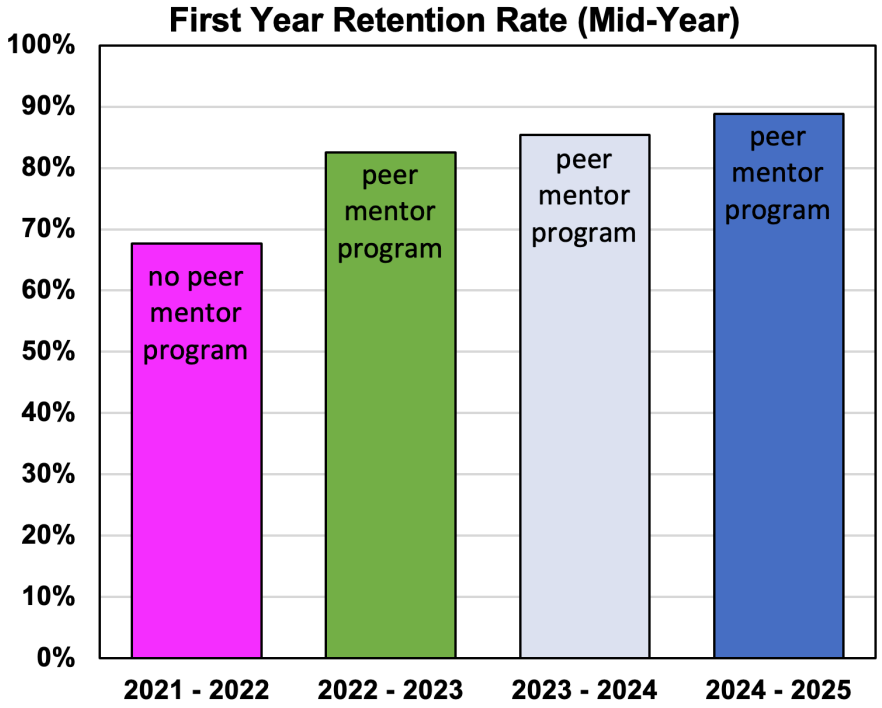

Figure 2. Mid-year retention rates (Semester I to Semester II) for first-year engineering students. Chart compares numbers for the last three years of implementation of the peer mentor program, to the last year there was no peer mentor program (2021).

The First-Year retention rate is calculated by considering all of the new (non-transfer) first-year engineering students still enrolled in Sem II of their freshman year and then dividing by the total number of these enrollments at the start of Fall (Semester I).

Figure 3 shows longitudinal retention data for the last four cohorts. The peer mentor program is only required of students during their first semester of their first year. Figure 3 shows that retention after the first semester (0.0 to 0.5) is stronger when compared to the year without a peer mentor program (2021). However, this is not necessarily the case for the percent change from winter break to the start of year one. The percent change from 0.5 to 1.0 years for the years in Figure 3 are as follows: 2021: -29.4%, 2022: -28.8%, 2023: -37.9%. These numbers indicate that, perhaps, the peer mentor program should also be required for all first-year students during their second semester of their first year in order to minimize this decrease. Ref. [2], shows retention numbers for students who opt-in to the semester II peer mentor program have a ~30% point greater retention rate as compared to those who opt-out in the semester II peer mentor program during their first year.

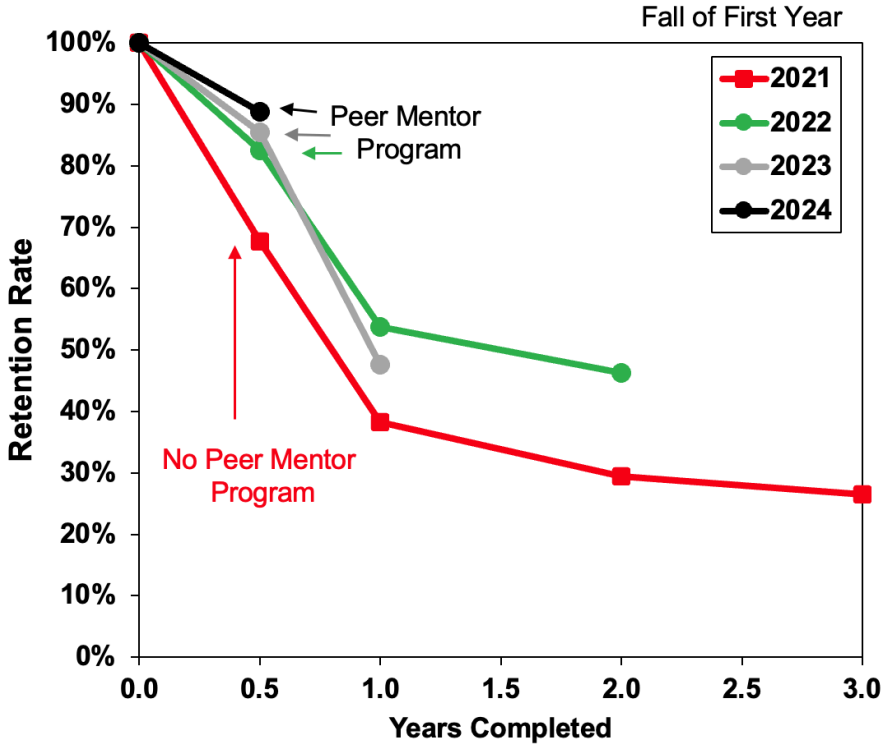

Figure 3. Retention rate for the last four cohorts. For the 2021 Fall first-year students, there was no peer mentor program. Retention has improved for each cohort that participated in the peer mentor program.

These numbers are only measuring retention within engineering programs. If a student switched majors out of engineering, they are counted as not-retained in these data. When including students who switched majors, but remained enrolled at the university, the overall mid-year university retention rate for students starting in engineering was 92.9% for Fall 2024. Of the students who left the university, 28.6% did not communicate or make an attempt to respond to their peer mentors, 42.9% never met with peer mentors, and 57% only met once at most. Therefore, if these students actively participated in the program, it is possible that their retention outcome could have changed.

Another way to track the behavior and retention of each cohort is through a Sankey chart. Figure 4 shows the flow of students who participated in this peer mentoring program for PY1: 2022-2023 and PY2: 2023-2024. These charts depict the propagation of these students through the semesters, including students who transferred during the second semester and were required to participate in the program.

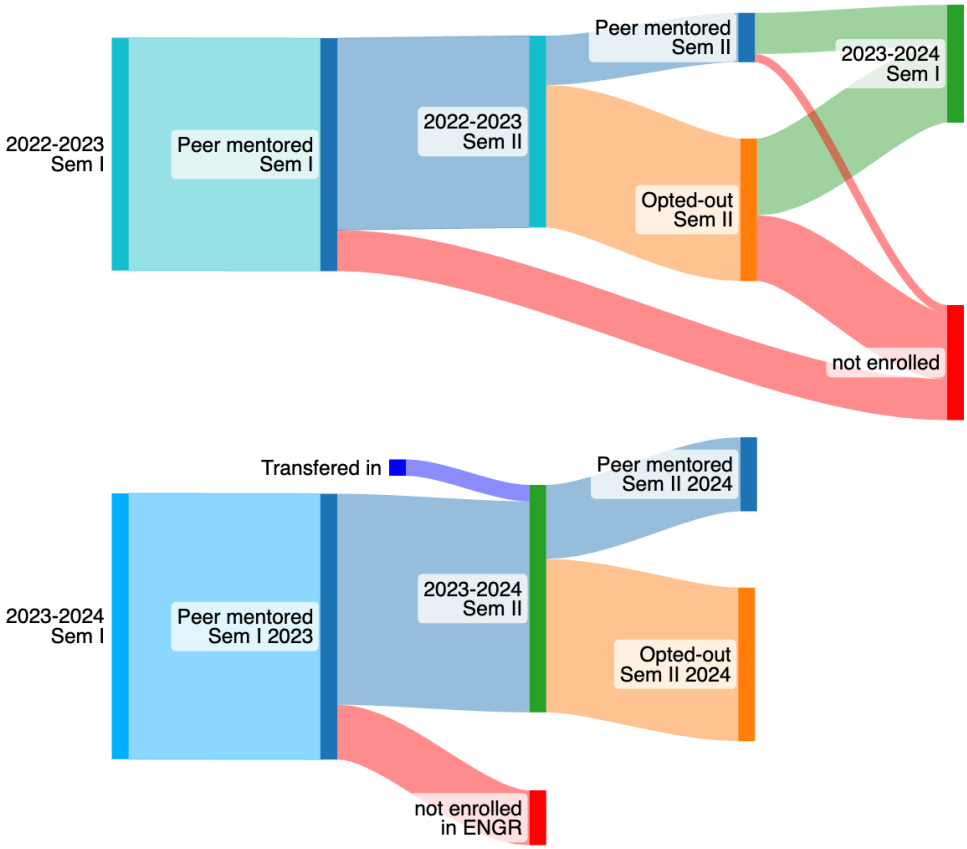

Figure 4. Sankey Charts at a snapshot from Summer 2024. Showing the flow of students from two different cohorts through each semester (made at SankeyMATIC.com).

Discussion and Conclusion

These results may indicate that the implementation of the peer mentor program contributes to student retention. The minor changes made each year appear to have contributed to improvement of the program over time, at least to the extent that minimal changes have been identified and are not due to unmeasured self-selection effects.

One of the biggest challenges of the peer mentor programs is getting first-year students to participate in and respond to peer mentors. As mentioned before, the goal of this peer mentor program is to foster community and belonging, which can potentially have rippling effects as they are encouraged through peer support to participate and be more engaged with the community, attend class more, and participate in other academically-rich activities like studying and doing homework with the peers. Before they engage in these activities, the program entices students with fun, relationship-building activities with their peer mentors.

In addition to motivating students to participate in the peer mentor program through fun activities, meeting other people, and free food, the program also motivates them through course requirements. In our first-year Orientation to Engineering course that all first-year engineering students must take, the program requires students to meet with peer mentors and provide

evidence of this. Additionally, there are two service activity requirements in this course, which align with the University's motto "Education for Service." Often, the peer mentors organize these service activities, and it brings together students again in peer communities.

In conclusion, the peer mentor program, which has now been going on for three years, continues to help improve retention rates. The initial large increase in retention at the outset of the peer mentor program is worth highlighting, and adjustments to the program each year have slightly helped improve the Sem I to Sem II retention numbers. Attendance and participation are one of the biggest struggles.

Extending the required peer mentor meeting deadline to the end of first month instead of the end of the first week seemed to help give the students time to connect, and there seems to be more positive support and outcomes about the program with required monthly meet-ups rather than requiring weekly meetings. Charismatic, motivating, and out-going peer mentors seem to be the most successful at getting their mentees to participate and connect with them.

Future Work

Future work includes continuing the program for many years, also carefully looking at retention data throughout the four years of the student's time at the university. Next, a similar program could be implemented in other departments across campus to assess its transferability. Future work could also investigate student trends and answer questions such as: Where do students go when they leave engineering? Do students leave the university or switch majors? If students leave for another university, why? Do they move out of state or "stopout" of college?

References

[1] Herzog, J. B., Matutes, J., Hacker, S., Spicklemire, S. J., and Reid, K., "WIP: Impact of Peer Mentor Program on First Year Engineering Students Success," 14th Annual First-Year Engineering Experience (FYEE) Conference, (2023, July) doi: 10.18260/1-2--44856.

[2] Matutes, J., Hacker, S., Herzog, P. S., Spicklemire, S. J., Reid, K., Martinez, J., Leonard, B., and Herzog, J. B., "Peer Mentor Program Strategy for Improvement in First-Year Student Retention," 2024 ASEE Annual Conference & Exposition, (2024, June) doi: 10.18260/1-2--47837.

[3] N. Eather, M. F. Mavilidi, H. Sharp, and R. Parkes, "Programmes targeting student retention/success and satisfaction/experience in higher education: A systematic review," Journal of Higher Education Policy and Management, vol. 44, no. 3, pp. 223–239, May 2022, doi: 10.1080/1360080X.2021.2021600.

[4] H.-G. Le, S. Sok, and K. Heng, "The Benefits of Peer Mentoring in Higher Education: Findings from a Systematic Review," Journal of Learning Development in Higher Education, 2024, Accessed: Feb. 21, 2025. [Online]. Available: https://eric.ed.gov/?id=EJ1447398

[5] P. J. A. C. Van Der Zanden, E. Denessen, A. H. N. Cillessen, and P. C. Meijer, “Domains and predictors of first-year student success: A systematic review,” Educational Research Review, vol. 23, pp. 57–77, Feb. 2018, doi: 10.1016/j.edurev.2018.01.001.

[6] A. Tsang, “The value of a semi-formal peer mentorship program for first-year students’ studies, socialization and adaptation,” Active Learning in Higher Education, vol. 24, no. 2, pp. 125–138, Jul. 2023, doi: 10.1177/1469787420945212.

[7] B. T. Dixon, O. Agboola, A. Hauck, M. Argento, C. Miller, and A. L. Vaughan, “Peer Mentoring: Benefits to First-Time College Students and Their Peer Mentors,” Journal of Higher Education Theory and Practice, vol. 23, no. 2, Feb. 2023, Accessed: Feb. 21, 2025. [Online]. Available: https://articlearchives.co/index.php/JHETP/article/view/5497

[8] M. Marshall, J. Dobbs-Oates, T. Kunberger, and J. Greene, “The peer mentor experience: benefits and challenges in undergraduate programs,” Mentoring & Tutoring: Partnership in Learning, vol. 29, no. 1, pp. 89–109, Jan. 2021, doi: 10.1080/13611267.2021.1899587.

[9] V. Shenaar-Golan, O. Walter, Z. Greenberg, and A. Zibenberg, “Emotional Intelligence in Higher Education: Exploring its Effects on Academic Self-Efficacy and Coping with Stress,” College Student Journal, vol. 54, no. 4, pp. 443–459, Dec. 2020.