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Learning Coaches as Facilitators for Collaborative Academic and Professional Culture Among Undergraduate Biomedical Engineering Students

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As a Ph.D. candidate enrolled in the University of North Dakota's Biomedical Engineering Program, I am actively engaged in an enriching Innovative-Based Learning (IBL) experience. Within this dynamic academic setting, I have undertaken a leadership role in groundbreaking research focused on Parkinson's disease, collaborating seamlessly with a diverse cohort of both online and in-person graduate and undergraduate students.

One of my greatest sources of satisfaction lies in leveraging my knowledge and skills to mentor undergraduate students, guiding them in the refinement of their research and professional capabilities. I take immense pride in fostering an inclusive and collaborative environment where students can thrive, encouraging their academic growth and contributing to the broader community of biomedical engineering scholars.

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Learning Coaches as Facilitators for Collaborative, Academic, and Professional Culture Among Biomedical Engineering Students

Abstract

Graduate students serve an important role in mentoring students, with many universities actively implementing mentorship programs to enhance the development of their students. At the University of North Dakota, this approach is being refined by utilizing graduate students as learning coaches. In this implementation, learning coaches serve two roles: as one-on-one coaches or as project mentors. The learning coaches serve as a bridge between faculty and students, offering practical advice, facilitating teamwork, and encouraging intrinsic motivation. A one-on-one coach is a peer graduate student who provides academic, professional, and personal mentorship to undergraduate students. Project mentors offer similar guidance in the context of vertically integrated research teams, guiding students through practical aspects of conducting engineering projects. Much of the research on the topic of graduate student mentors focuses on the role of generic mentoring, coaching techniques, or ethical considerations. There is a need to evaluate the specific impacts on collaborative, academic, and professional culture that arises from incorporating graduate students as learning coaches.

In this research, we investigated the influence that a learning coach and project mentor has on building a culture of academic collaboration and professionalism among biomedical engineering (BME) students at the University of North Dakota within an Innovation-Based Learning (IBL) program. In this context, culture refers to the shared values, attitudes, and practices that shape the behaviors of undergraduate students to foster an environment where professionalism and collaboration are prioritized. Professionalism is a highly valued skill sought after by potential employers in the biomedical engineering sector, highlighting the significance of fostering this type of culture early on. Additionally, academic collaboration builds other critical “soft skills” such as teamwork, leadership, and communication. Professionalism and collaboration can be seen as essential mindsets and skills that work together to develop a successful engineer. Motivating an undergraduate culture built around these tenets can prepare student engineers to succeed upon graduation.

We hypothesized that the implementation of Learning Coaches helps to foster this culture of professionalism and academic collaboration among students at the University of North Dakota. We administered the Professional Development Attitude section of the Professional Development Survey for Engineering Undergraduates (PDS), developed by Clemson University, to assess student attitudes toward professional development at the University of North Dakota. The results demonstrate that learning coaches may have a positive influence on developing a culture of professionalism and collaboration among students. There was a statistically significant effect when comparing graduate students to undergraduates, but the effect size was weak. There was also a statistically significant difference between online and in person students, but the effect size was determined to be weak as well. Finally, we provide recommendations for techniques that Learning Coaches at other institutions can adopt to promote positive academic, collaborative, and professional culture.

Introduction

The use of graduate students as peer mentors has been shown to serve a positive role in supporting the personal and intellectual growth of students [1], [2], [3], [4], [5], [6], [7]. Many universities actively implement formal mentorship programs to enhance the development of both graduate and undergraduate students [8], [9], [10]. There is less research examining how graduate mentoring programs might facilitate collaborative, professional, and academic culture among engineering students. Two questions now arise:1) What is "culture" in this academic setting and 2) Why is it important to influence these cultures among engineering students?

A succinct definition of "culture" as it applies in the academic setting may be found in the Merriam-Webster Dictionary, which states that culture is "the set of values, conventions, or social practices associated with a particular field, activity, or societal characteristic [11]." Within the context of this paper, culture is defined to be the shared values, attitudes, and practices that shape the behaviors of engineering students to foster an environment where professionalism and collaboration are prioritized. As to the "why?", developing a culture can promote a sense of belonging, increase retention, and foster development [12], [13], but also lays a foundation for critical skills essential in the engineering profession. Professionalism is a highly valued skill sought after by potential employers in the engineering sector and is outlined in the code of ethics for engineers, highlighting the significance of fostering a professional culture in students early on [14], [15], [16]. Additionally, academic collaboration builds other critical "soft skills" such as teamwork, leadership, and communication. Professionalism and collaboration can be seen as essential mindsets and skills that work together to develop a successful engineer [16]. Motivating an academic environment shaped by these cultures can prepare student engineers to succeed in industry upon graduation.

Professionalism among students has been measured in a variety of ways, depending on the focus of the research. One method available is the "Engineering Professional Responsibility Assessment Tool" which evaluates social responsibility attitudes in students [17]. Another is the "Professional Development Survey" (PDS) [18]. The PDS measures various domains including "Professional Development Attitude" which is based upon the ABET Engineering Criteria 2000 (EC2000), an accreditation criteria focused on learning outcomes rather than curriculum [19]. The PDS aligns with the goals of this research and was selected to evaluate the influence of learning coaches on professionalism among engineering students. The PDS has been validated in prior research to assess the professional development of engineering students at Clemson University and aligns with ABET EC200 criteria. While it was originally designed for broader university assessment, the modifications made in this study, which replace the focus of "Clemson University" to "Learning Coaches", maintain the integrity of the validated survey while tailoring the scope to this research.

At the University of North Dakota, the primary tool to ensure student success in the industry is through an educational pedagogy termed Innovation Based Learning (IBL), which emphasizes collaborative research among undergraduate and graduate students, with a "design, build, test, learn" philosophy [20], [21], [22], [22], [23]. Engineering students within the IBL

framework develop professional skills through these research projects, which helps to drive intrinsic innovation and external impact in the engineering field.

The use of graduate students as mentors for graduate and undergraduate students is implemented as a supportive tool to the IBL program. The graduate mentor role takes a different shape than traditional methods through the implementation of “Learning Coaches”. The Learning Coach implementation differs from traditional mentoring methods in its structured, dual-role approach of one-on-one coaching and project mentorship. Traditional methods often focus on using graduate students as research or teaching assistants, whereas the Learning Coaches provide a holistic support for professional development, academic success, and research project mentorship. Unlike traditional mentorship programs that primarily focus on short-term research or course instruction, Learning Coaches engage with students continuously over multiple semesters, ensuring sustained mentorship focusing on long-term student outcomes. This structure helps students develop both technical and soft skills through personalized, structured, and continuous guidance. Learning Coaches serve two primary functions for students: as one-on-one coaches or as project mentors. A one-on-one coach is a peer graduate student who provides academic, professional, and personal mentorship to undergraduate students. This is accomplished through weekly meetings where the student has the opportunity to utilize their Learning Coach in a variety of ways. Primarily, the Learning Coach is used to offer resources, guidance, and support tailored to the student’s academic and professional needs. This may include offering career advice, helping develop soft skills such as communication and time management. Project mentors offer similar guidance in the context of vertically integrated research teams, guiding students through practical aspects of conducting engineering projects. The project mentors further cement professional and collaborative ideals to promote teamwork, professionalism, and communication in the research teams. The Learning Coaches additionally serve as a bridge between faculty and students, offering practical advice, relaying improvement recommendations, addressing concerns, and sharing positive feedback to enhance the student learning experience.

At the University of North Dakota, Learning Coaches play an important role in the IBL program, offering a unique mentorship model to promote the academic, professional, and collaborative development of biomedical engineering (BME) students. As part of the IBL program, all students engage with Learning Coaches in both one-on-one coaching and project mentorship roles. Therefore, responses were not analyzed separately based on mentorship type, as all students experience both forms of the Learning Coach program. Students work with Learning Coaches on a weekly basis, typically meeting anywhere from 15-30 minutes per week over the course of the entire semester. Although the timing is not controlled and depends upon individual student needs. The Learning Coaches themselves are selected by faculty and receive structured training to prepare them for their mentorship roles. This includes weekly meetings with faculty throughout the semester to discuss various mentoring strategies, refine mentoring approaches, and ensure consistency for students. Some Learning Coaches serve for multiple semesters, which allows for development of mentoring skills and assisting new Learning Coaches. Project mentors often mentor multiple research groups, but this is dependent upon LC availability and department needs.

While mentorship has been studied in the literature, the specific impact of Learning Coaches on shaping a culture of collaboration, academic success, and professionalism within the context of the IBL program remains to be fully understood. This research examines how Learning Coaches contribute to the development of this culture, providing insight into the potential of this mentorship program to prepare students for success in a quickly evolving industry. By focusing on measurable outcomes related to professional development attitudes, this study seeks to quantify the impact of this mentorship model within the context of the biomedical engineering IBL program.

Methods

All procedures performed in this study involving human participants were approved by the University of North Dakota Institutional Review Board under approved protocol IRB0005373. This study utilized the Professional Development Attitude section of the Professional Development Survey for Engineering Undergraduates (PDS) to evaluate the impact of learning coaches on the academic, professional, and collaborative culture among students at the University of North Dakota [18]. The language of the questions was modified to pertain specifically to assess the influence of Learning Coaches versus the University. Although the survey falls under the Professional Development Attitude domain, many of the questions cover general academic, professional, and collaborative topics that pertain to the focus of this research. The questions administered in the survey are shown in Table 1.

The responses use a 7-point ordinal Likert Scale, where "1" was defined to be "not at all true" and "7" is "very true" [24]. The professionalism survey of 30 questions was administered through the "MOOCIBL" platform, which is a free online platform that tracks the IBL student environment [25]. The MOOCIBL platform ensured anonymous collection of survey data from each participant and provides a uniform method for administering and managing the survey. This also ensures that participants can access the survey regardless of online or in-person participation.

Table 1: Professionalism Survey Questions

1	The Learning Coach Program is preparing me well for my future career.
2	The support from my learning coach is important to my professional growth.
3	I am satisfied with the guidance provided by my learning coach regarding my major.
4	My overall attitude towards the Learning Coach Program is positive.
5	My learning coaches have helped me improve my public speaking skills
6	I feel confident in my problem-solving skills with the help of my learning coach.
7	My learning coaches have helped me connect coursework to professional development.
8	I can effectively apply my knowledge of mathematics, science, and engineering, thanks to my learning coaches.
9	I feel more capable of designing and conducting experiments with guidance from my learning coaches.
10	My learning coaches have enhanced my ability to analyze and interpret data.

11	I can design better systems, components, or processes that meet specific needs, thanks to my learning coaches.
12	My overall attitude about how learning coaches support my major is positive.
13	I can function effectively on problem-solving teams with the help of my learning coaches
14	My learning coaches have helped me identify, formulate, and solve engineering problems.
15	I have developed an understanding of professional and ethical responsibility with guidance from my learning coaches.
16	I have improved my writing skills with support from my learning coaches.
17	My learning coaches are helping me prepare for my first job.
18	I prefer working with my learning coaches rather than doing professional development activities alone.
19	My learning coaches have helped me make connections between my science courses and practical engineering applications.
20	I feel I am gaining a broader understanding of the impact of engineering solutions globally, with support from my learning coaches
21	My learning coaches have helped me recognize the importance of, and ability to engage in, lifelong learning.
22	My learning coaches have introduced me to modern engineering techniques, skills, and tools necessary for practice.
23	I am satisfied with the progress I am making with my learning coaches.
24	I feel challenged in a productive way by my learning coaches.
25	My learning coaches are helping me explore new ideas related to my engineering courses.
26	I feel supported by my learning coaches in my studies and professional development.
27	I am enjoying my learning experience with the help of my learning coaches.
28	I feel more confident with the encouragement of my learning coaches.
29	My learning coaches have helped me think critically about engineering problems.
30	The guidance from my learning coaches has prepared me for my current coursework.

Survey data was processed in Microsoft Excel and IBM SPSS Statistics Version 27. Overall responses were analyzed by assessing central tendency measures, with median values serving as the primary metric. A response of 4 on the Likert scale represents a neutral stance, indicating neither true nor untrue. To evaluate if there is a statistically significant difference in professionalism attitudes between undergraduate and graduate responses, a Mann-Whitney U test was performed, since we are not assuming normality in the dataset and the data is ordinal scale [24], [26]. A p-value of less than 0.05 was defined to be statistically significant.

Results

A total of 75 students from the BME program participated in the study during the Fall 2024 semester, including 53 undergraduate and 23 graduate students. None of the survey respondents previously served as Learning Coaches. The participants represented a mix of online and in-person students, with approximately 60% having no prior experience with a Learning

Coach. A total of 2,250 responses were collected from 75 students across all survey questions. The cumulative percentage of responses for each Likert category is illustrated in Figure 1.

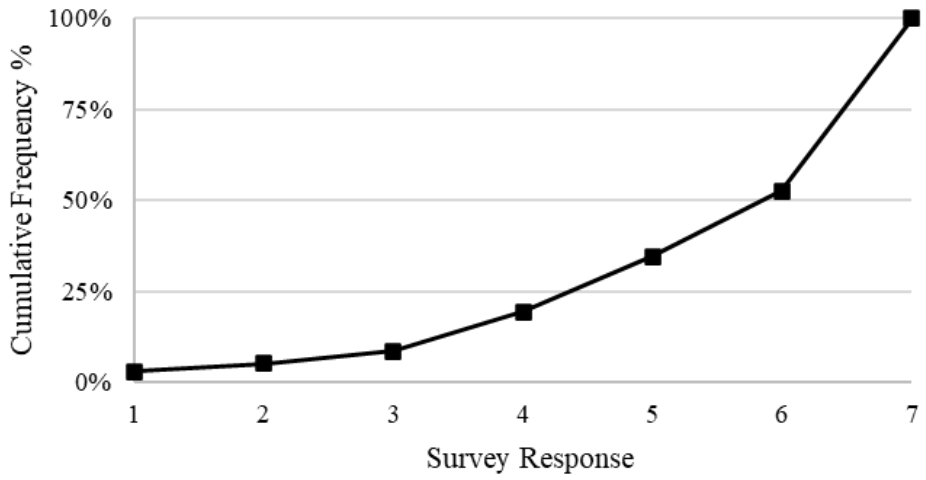

Figure 1 Cumulative frequency percentage by total responses

The overall median response across all survey responses was 6, reflecting a positive perception of Learning Coaches and professional development attitude. Specific survey questions, such as questions 2 and 4 from the survey, had a median score of 7, indicating "very true" agreement on the importance of Learning Coaches to professional growth. Figure 2 shows a plot of all questions that had a median score of 7 to identify trends in questions with very positive responses.

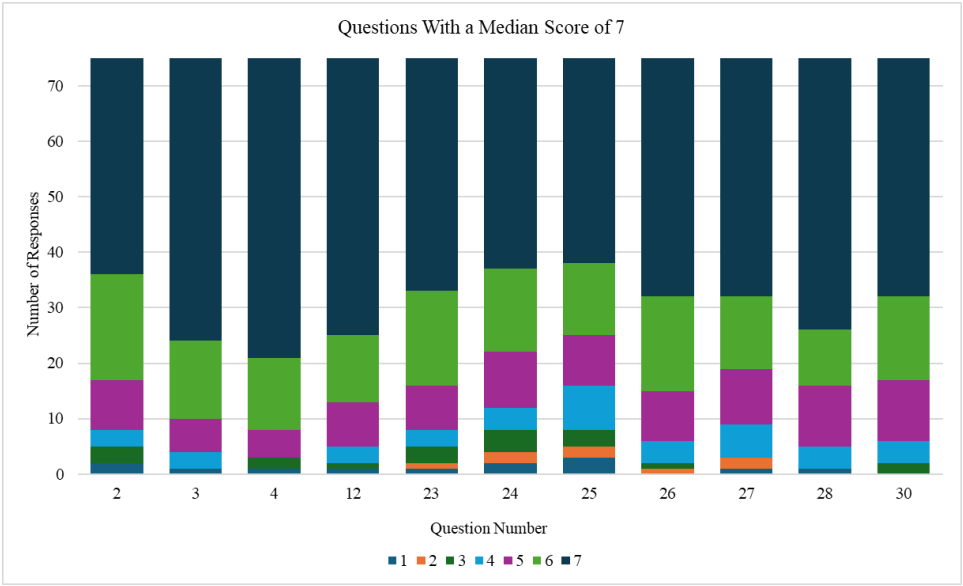

Figure 2 Questions with a median score of 7

Four questions in the survey (5, 16, 17, and 19) yielded a median score of 5, representing a somewhat true stance. Questions where at least 30% of cumulative responses were rated 4 or

lower are shown in Figure 3. These questions had a higher proportion of neutral or negative responses compared to other survey questions. A total of five questions met this criterion. This threshold was chosen to identify questions where a substantial (roughly one-third) of respondents did not provide a clearly positive response, allowing for further investigation into common themes or potential trends.

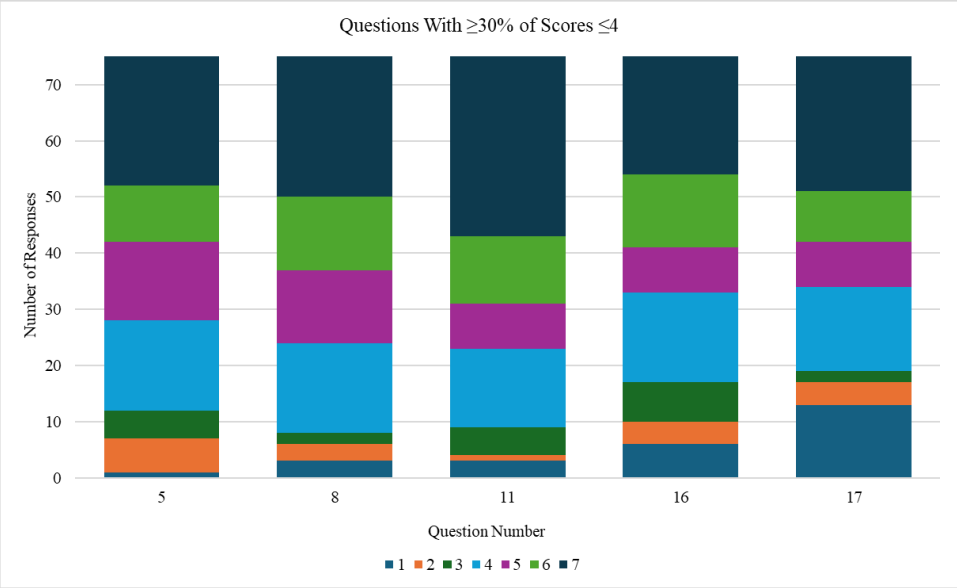

Figure 3 Questions with at least 30% of scores 4 or below.

Graduate students had a higher median response (Mdn = 7) compared to undergraduates (Mdn = 6). A Mann-Whitney U test was conducted to compare whether this was a statistically significant difference in response regarding student attitudes toward Learning Coaches and professionalism between undergraduate and graduate students. The results indicated a statistically significant difference between the two groups ($Z = -4.89$, $p < 0.001$). To investigate the difference further, the effect size was calculated using the equation (1):

$$r = \frac{Z}{\sqrt{n}} \quad \text{(eq. 1)}$$

Where, r is the correlation coefficient, Z is the Z-score and n is the total number of observations [27], [28]. The correlation coefficient ($r = -0.103$) indicates a small effect size with only 1.06% of the difference in response explained by academic classification. The Glass rank-biserial correlation was calculated using the following equation (2):

$$r = \frac{2(R_1 - R_2)}{n} \quad \text{(eq. 2)}$$

R_1 and R_2 are the mean ranks for each group and r is the Glass rank-biserial correlation coefficient. The Glass rank-biserial correlation ($r = -0.123$) further supports the weak effect of academic classification.

Online students had a higher median response (Mdn = 7) compared to in-person students (Mdn = 6). The Mann-Whintey U test indicated a statistically significant difference between the

two groups ($Z = -2.74$, $p = 0.006$). However, the effect size was small, with the correlation coefficient ($r = -0.058$) and Glass rank-biserial correlation ($r = 0.063$), both suggesting that while there was a statistically significant difference between online and in-person students, the magnitude of the effect was weak.

Discussion

This study aimed to evaluate the influence of Learning Coaches on influencing a culture of collaborative academic and professional culture among biomedical engineering students in an IBL program at the University of North Dakota. The median score of 6 across all questions supports a positive attitude toward the overall Professional Development Attitude domain survey. This survey was developed from the criteria outlined by ABET EC2000, emphasizing the importance of continuing to promote these attitudes among engineering students [29]. Notably, questions 2 and 4 addressed overall attitude toward Learning Coach program and their role in professional growth, yielding a median score of 7.

There were statistically significant differences ($p<0.001$) in responses between undergraduate and graduate students, with graduate students reporting higher median scores ($Mdn = 7$) compared to undergraduates ($Mdn = 6$). This finding may suggest that graduate students, who may have more professional experience or clearer career goals, perceive Learning Coaches as playing a more impactful role in their professional development. It is also possible that graduate students may have prior exposure to traditional mentorship programs, which could influence their responses. While this study did not separate responses based on mentorship history, future research could explore whether prior mentorship experience contributes to differences in how students engage with or benefit from the Learning Coach program. The effect size of this difference was small, indicating that while graduate students provided slightly more positive responses, the overall perceptions of both groups were similar. Future studies could explore whether these differences are influenced by factors such as prior exposure to Learning Coaches or varying expectations between undergraduates and graduate students.

There were statistically significant differences ($p = 0.006$) in responses between online and in-person students, with online students reporting higher median scores ($Mdn = 7$) compared to in-person ($Mdn = 6$). However, the effect size suggests the magnitude of this effect is weak. This trend may still indicate factors that could influence student perceptions toward Learning Coaches that warrant further investigation in future studies.

There were four questions in the survey (5, 16, 17, and 19) that yielded a median score of a 5, which is the lowest median score among the survey questions. However, only questions 5, 8, 11, 16, and 17 had at least 30% of cumulative responses rated 4 or below. Interestingly, question 17 yielded the highest accumulation of “negative” survey responses, stating “My learning coaches are helping me prepare for my first job”. Questions 5 and 16, related to public speaking and writing skills, exhibited similar trends, with a median score of 5. While the median response among these questions is a 5, representing a “somewhat true” stance on this question, these trends might identify areas for improvement in the Learning Coach program.

The findings from this research demonstrate that students have a positive attitude toward the Learning Coach program and suggest a positive influence of Learning Coaches in academic success, professionalism, and collaboration. The median score of 6 across 30 survey questions supports the effectiveness of Learning Coaches in fostering these outcomes. The positive feedback from both undergraduate and graduate students further demonstrates the value of integrating this type of mentorship throughout all levels of engineering education. Analyzing the results of individual survey questions provides deeper insight into specific areas where Learning Coaches are contributing significantly to student attitudes and outcomes. Although this research did not include comparisons with student attitudes outside of the BME program, the results strongly support the continued implementation of Learning Coaches. This unique mentorship offers a unique framework that other disciplines could adapt to promote a positive and professional culture among their engineering students.

Limitations

There are several limitations to consider when interpreting the results. First, the sample size among graduate students is half that of undergraduate students, which might affect the findings. It also noteworthy that this undergraduate group was predominantly freshmen, in which case their attitudes toward professional development may feel like a priority. The responses were not sorted by students who previously had a Learning Coach in prior semesters. This could introduce bias or a tendency to provide a more positive response. Additionally, since participation was voluntary, self-selection bias may be present. Prior experience with other mentorship programs was not controlled for, which could influence responses. While Learning Coaches and prior Learning Coaches were excluded from the survey, it is possible that respondents had previously acted in other mentorship roles, which may have influenced their perspectives on professional development. However, since this study focused on evaluating the Learning Coach program's impact on fostering professional development, prior experience was not considered a necessary factor for analysis. The goal was to assess how students perceive the program within the IBL framework, rather than compare responses based on previous exposure to the program. The results were not compared against a control group, or a group of students with no Learning Coaches in the semester, which could help to solidify the interpretations. Administering the full PDS survey to assess all domains, alongside using the original question phrasing focused on the university rather than Learning Coaches, could provide broader context and serve as an interesting point of comparison. Additionally, the survey was administered during the Fall semester, which may have limited the exposure of students to certain topics that may be addressed by Learning Coaches later in the year, such as career preparedness which may take a more natural segway in the Spring semester. While it is difficult to measure "culture", a longitudinal study might be appropriate to quantify cultural influences of Learning Coaches. The duration and frequency of meetings with LC's were not controlled in this study. This raises an interesting question as to whether these factors influence mentorship efficacy, which future research could explore. The results also provide useful insights to improve the Learning Coach program. More emphasis could be placed on supporting career development and preparation. This could include assistance in the development of writing skills or having Learning Coaches discuss interview techniques during 1-on1 meetings.

Future Work

While this research didn't distinguish between the one-on-one coach and the project mentor, further work could quantify the specific student attitude toward each role. Future research should consider tracking changes in student attitude over time using longitudinal surveys. Qualitative methods, such as interviews, could provide deeper insights into student perception of program culture and the specific influence of Learning Cultures toward that culture. Comparison of this data to programs that do not incorporate Learning Coaches in their curriculum could offer control data for further interpretation of the findings. Finally, investigating the relationship between survey responses and tangible outcomes, such as career placements or internships, could further validate the impact of Learning Coaches on professional culture within the university.

Conclusion

This study aimed to evaluate the effectiveness of Learning Coaches in fostering a culture of collaborative academic and professional culture among biomedical engineering students in an IBL program at the University of North Dakota. A total of 75 students participated in a Professional Development Attitude survey designed to assess their attitudes to Learning Coaches and various aspects of professional growth. The median overall score of 6 reflects a positive stance on many topics relating to Learning Coaches and professional development. There was a statistically significant difference between undergraduate and graduate scores, with median responses of 6 and 7, respectively, although the effect size was weak.

These findings demonstrate the value of Learning Coaches in supporting professional and academic growth, aligning with the broader goal of facilitating a student culture that promotes measurable professional outcomes. By facilitating collaboration, professionalism, and academic success, Learning Coaches are helping the IBL program prepare students for success in a rapidly evolving industry. This mentorship model offers a promising framework for encouraging a positive student culture and enhancing professional readiness in other engineering programs.

References

[1] M. E. Kiersma, N. Hagemeier, A. M. H. Chen, B. Melton, M. Noureldin, and K. S. Plake, "A graduate student mentoring program to develop interest in research," *Am. J. Pharm. Educ.*, vol. 76, no. 6, p. 104, Aug. 2012, doi: 10.5688/ajpe766104.

[2] H. R. Asbill, M. A. Letchworth, A. M. Rynearson, and C. A. Pantoja, "The graduate student role in undergraduate research mentoring: a systematic literature review," presented at the *2024 ASEE Annual Conference & Exposition*, Jun. 2024. Accessed: Sep. 25, 2024. [Online]. Available: https://peer.asee.org/the-graduate-student-role-in-undergraduate-research-mentoring-a-systematic-literature-review

[3] D. A. Dooley, R. m. Mahon, and E. a. Oshiro, "An undergraduate research opportunity: Collaboration between undergraduate and graduate students," *J. Food Sci. Educ.*, vol. 3, no. 1, pp. 8–13, 2004, doi: 10.1111/j.1541-4329.2004.tb00034.x.

[4] C. González, "Undergraduate research, graduate mentoring, and the university's mission," *Science*, vol. 293, no. 5535, pp. 1624–1626, Aug. 2001, doi: 10.1126/science.1062714.

[5] E. Dolan and D. Johnson, "Toward a holistic view of undergraduate research experiences: An exploratory study of impact on graduate/postdoctoral mentors," *J. Sci. Educ. Technol.*, vol. 18, no. 6, pp. 487–500, Dec. 2009, doi: 10.1007/s10956-009-9165-3.

[6] J. Terrion, "Motivation of paid peer mentors and unpaid peer helpers in higher education," *Int. J. Evid. Based Coach. Mentor.*, vol. 8, pp. 85–103, Jan. 2010. [Online] Available: https://www.researchgate.net/publication/242567045_Motivation_of_paid_peer_mentors_and_unpaid_peer_helpers_in_higher_education

[7] M. McLean, "Does the curriculum matter in peer mentoring? From mentee to mentor in problem-based learning: a unique case study," *Mentor. Tutoring Partnersh. Learn.*, vol. 12, no. 2, pp. 173–186, Aug. 2004, doi: 10.1080/1361126042000239929.

[8] "Grad Coaching | Student Learning Programs." Accessed: Sep. 25, 2024. [Online]. Available: https://studentlearning.stanford.edu/academic-skills/gradcoaching

[9] "Graduate Student Mentorship Program | Supporting Graduate Students' Academic and Professional Success." Accessed: Sep. 29, 2024. [Online]. Available: https://gradmentors.ucr.edu/

[10] "Graduate Students Mentoring Undergraduates | Office of Academic Diversity Initiatives." Accessed: Sep. 29, 2024. [Online]. Available: https://oadi.cornell.edu/signature-programs/graduate-students-mentoring-undergraduates

[11] "Definition of CULTURE." Accessed: Jan. 12, 2025. [Online]. Available: https://www.merriam-webster.com/dictionary/culture

[12] S. Edmonson *et al.*, "Creating a collaborative culture," Aug. 2001. Accessed: Jan. 12, 2025. [Online]. Available: https://eric.ed.gov/?id=ED470755

[13] S. Gruenert, "Correlations of Collaborative School Cultures with Student Achievement," *NASSP Bull.*, vol. 89, no. 645, pp. 43–55, Dec. 2005, doi: 10.1177/019263650508964504.

[14] "Code of Ethics | National Society of Professional Engineers." Accessed: Jan. 12, 2025. [Online]. Available: https://www.nspe.org/resources/ethics/code-ethics

[15] "Why Is Professionalism Important? Expert Insight for Recent Graduates," Rasmussen University. Accessed: Jan. 12, 2025. [Online]. Available: https://www.rasmussen.edu/student-experience/college-life/four-reasons-why-you-need-to-be-professional/

[16] A. Berglund, "Professionalism For Engineers: Soft Skills In Engineering Education To Prepare For Professional". *Proceedings of the 14th International CDIO Conference,*

Kanazawa Institute of Technology, Kanazawa, Japan, June 28 - July 2, 2018. Accessed: Jan 12, 2025 [Online]. Available: https://www.cdio.org/knowledge-library/documents/professionalism-engineers-soft-skills-engineering-education-prepare
[17] Anonymous, "Engineering Professional Responsibility Assessment Tool (EPRA)," 2019, *Online Ethics Center*. doi: 10.18130/EQMC-WS21.
[18] D. Switzer *et al.*, "A Professional Development Survey for engineering undergraduates," presented at the 2004 Annual Conference, Jun. 2004, p. 9.87.1-9.87.9. Accessed: Jan. 12, 2025. [Online]. Available: https://peer.asee.org/a-professional-development-survey-for-engineering-undergraduates
[19] "History," ABET. Accessed: Jan. 12, 2025. [Online]. Available: https://www.abet.org/about-abet/history/
[20] M. Pearson, R. Striker, E. M. Swartz, E. A. Vazquez, L. Singelmann, and S. S. Ng, "Innovation-based Learning: A new way to educate innovation," presented at the 2021 ASEE Virtual Annual Conference Content Access, Jul. 2021. Accessed: Jan. 12, 2025. [Online]. Available: https://peer.asee.org/innovation-based-learning-a-new-way-to-educate-innovation
[21] L. N. Singelmann and D. L. Ewert, "Leveraging the Innovation-Based Learning framework to predict and understand student success in innovation," *IEEE Access*, vol. 10, pp. 36123–36139, 2022, doi: 10.1109/ACCESS.2022.3163744.
[22] L. Singelmann *et al.*, "Predicting and understanding success in an Innovation-Based Learning course". *Data Mining 2020 Conference, 2020.* [Online] Available: https://educationaldatamining.org/files/conferences/EDM2020/papers/paper_92.pdf
[23] L. Singelmann, E. Alvarez, E. Swartz, M. Pearson, R. Striker, and D. Ewert, "Innovators, learners, and surveyors: Clustering students in an Innovation-Based Learning course," in *2020 IEEE Frontiers in Education Conference (FIE)*, Oct. 2020, pp. 1–9. doi: 10.1109/FIE44824.2020.9274235.
[24] A. Joshi, S. Kale, S. Chandel, and D. K. Pal, "Likert Scale: Explored and explained," *Br. J. Appl. Sci. Technol.*, vol. 7, no. 4, Art. no. 4, Jan. 2015, doi: 10.9734/BJAST/2015/14975.
[25] E. A. Vazquez *et al.*, "The MOOCIBL platform: A custom-made software solution to track the innovation process with blockchain learning tokens," in *2021 ASEE Virtual Annual Conference Content Access*, 2021. Accessed: Jan. 10, 2025. [Online]. Available: https://peer.asee.org/the-moocibl-platform-a-custom-made-software-solution-to-track-the-innovation-process-with-blockchain-learning-tokens
[26] G. M. Sullivan and A. R. Artino, "Analyzing and interpreting data from Likert-type scales," *J. Grad. Med. Educ.*, vol. 5, no. 4, pp. 541–542, Dec. 2013, doi: 10.4300/JGME-5-4-18.
[27] E. Tomczak and M. Tomczak, "The need to report effect size estimates revisited. An overview of some recommended measures of effect size," *Bibl. Akad. Wych. Fiz. W Poznaniu*, 2014, Accessed: Jan. 13, 2025. [Online]. Available: https://www.wbc.poznan.pl/dlibra/publication/413565/edition/325867
[28] G. M. Sullivan and R. Feinn, "Using effect size—or why the p value is not enough," *J. Grad. Med. Educ.*, vol. 4, no. 3, pp. 279–282, Sep. 2012, doi: 10.4300/JGME-D-12-00156.1.
[29] J. Ventura, "Accreditation criteria for engineering programs - implementing EC-2000 criteria," 2003. Accessed: Jan. 13, 2025. [Online]. Available: https://www.semanticscholar.org/paper/Accreditation-Criteria-for-Engineering-Programs-Ventura/44004019ae082883316656ece4254cf95bb14486