Title

Work in Progress: Investigation of Student-Faculty Micro-Interactions on Students' Sense of Belonging through Organized Student-Faculty Lunches

Authors

Chan, Tiffany

Chatfield, Tate

Wang, Xianglong

Publication Date

2024-06-23

DOI

10.18260/1-2--48500

Work in Progress: Investigation of Student-Faculty Micro-Interactions on Students' Sense of Belonging through Organized Student-Faculty Lunches

Tiffany Chan, University of California, Davis

Tiffany Chan is a 3rd-year undergraduate student in biomedical engineering at UC Davis and the recipient of the 2024 ASEE-PSW Section Undergraduate Student Award. She actively contributes to the cube3 Lab, where her interests lie in community building and inclusive practices. Tiffany is involved in various DEI (Diversity, Equity, and Inclusion) research initiatives within the lab, including organizing student-faculty lunches and participating in the gender equity first-year seminar program. Additionally, she serves as the chair of the undergraduate subcommittee for the department's Health, Equity, and Wellness committee and holds the position of Make-a-thon chair in the BMES student chapter at UC Davis.

Tate L Chatfield, University of California, Davis

Tate Chatfield is a fourth-year biomedical engineering undergraduate student at UC Davis. She is a former research assistant in the cube3 lab with interests in improving mental health and increasing access to resources for the undergraduate community. She is the current president of Tau Beta Pi – CA Lambda chapter, and student leader for Mariachi Los Mesteños. She is currently researching small animal PET/MR scanning in collaboration with labs affiliated with the UC Davis Medical Center Department of Radiology. She is keen on advancing the field of multimodal medical imaging in the pursuit of exploring MR based therapeutic biomarkers in neuro-oncologic disease.

Dr. Xianglong Wang, University of California, Davis

Dr. Xianglong Wang is an Assistant Professor of Teaching in Biomedical Engineering at the University of California, Davis. He is the principal investigator of the cube3 lab. The cube3 lab actively performs research in community building and gender equity in engineering, as well as problem-based learning in core biomedical engineering courses. Before joining UC Davis, he was a career-track Assistant Professor at Washington State University (WSU). Dr. Wang is the recipient of the 2024 ASEE-PSW Section Outstanding Early Career Teaching Award, 2023 UC Davis Biomedical Engineering Excellence in Teaching Award, and 2022 WSU Reid Miller Teaching Excellence Award. Dr. Wang received his Ph.D. in Biomedical Engineering and Scientific Computing from the University of Michigan.

Work in Progress: Investigation of Student-Faculty Micro-Interactions on Students' Sense of Belonging through Organized Student-Faculty Lunches

Introduction

This WIP research investigates the effect of student-faculty micro-interactions on students' senses of belonging using a population of undergraduate biomedical engineers (BMEs). Establishing a strong sense of belonging is inextricably linked with student engagement [1, 2], community building [3, 4], and retention of college students [5]. Students who feel like they belong to their university, their major, or at least feel a sense of belonging in their higher education are not only more likely to stay with their field of study [1] but also perform better academically [6], engage more attentively in their classes [7], and become more persistent [8]. Strategies for improving the sense of belonging have documented an increase in the performance of students and successful graduation from their respective engineering major, which translates into improved success in setting and achieving goals within their professional life. [9, 10] These principles can be applied to entire disciplines or narrowed to apply to specific majors.

The field of undergraduate engineering education is continually evolving, with a growing emphasis on fostering a sense of belonging among students. [11] The impact of formal, pedagogical interactions between students and faculty have been well-documented. [12-15] Formal interaction is defined by Komarraju as in-class or instruction-related interaction between students and faculty members. [15] Faculties engaging in behaviors such as learning students' names have shown to facilitate establishing an environment conducive to learning [16] and students receiving encouragement from their instructors demonstrate higher aptitude for engagement than students that did not [17]. Informal interaction is established as interaction outside of relevant classroom instruction. [15] Reported benefits of informal faculty interaction include improved clarity in career goals for undergraduate students [18] and increased GPA [19]; however, specific recommendations have yet to be investigated. Our study investigates informal student-faculty micro-interactions and their potential to shape students' perceptions of belonging within the field of biomedical engineering (BME) and the BME department. A 2019 internal survey within one specific BME department uncovered a concerning trend, revealing that one-sixth of undergraduate students felt discomfort within the major, all of whom were a part of the 34% with no affiliation with BME undergraduate student-focused groups. Moreover, one-third of the surveyed students seriously contemplated leaving the major, highlighting the urgency of addressing these issues to ensure the retention and success of students pursuing BME.

To address these challenges also seen in our department, our study introduces an intervention in the form of organized monthly student-faculty lunches based on shared interests. These interactions aim to provide a platform for informal engagement between students and faculty members, potentially fostering a supportive community [20] within the department. Albeit an uncommon type of interaction [21], our proposed interventions provide a potential avenue to facilitate informal interactions between students and faculty. Our research uses Driscoll et al.'s [14] student-faculty interaction assessment model to evaluate students' sense of belonging, incorporating Likert-scale questions and free-response inquiries to capture nuanced aspects of their experiences. By focusing on both immediate and lasting impacts, our investigation seeks to identify improvements in students' perceptions and assess the sustainability of these positive outcomes over time.

This study contributes to the broader discourse on student engagement, community building, and retention strategies in engineering or higher education in general with the translation from BME education. The findings not only provide insights into the effectiveness of informal student-faculty micro-interactions but also offer a scalable and cost-effective approach that may be applicable across diverse academic settings. The introduction of such initiatives becomes increasingly crucial in ensuring that students, especially those at risk of disengagement, find a supportive and inclusive environment that enhances their sense of belonging and contributes to their overall academic success [20] and well-being in BME.

Methods

Twenty-three (23) non-graduating BME undergraduate students that have at least one year left in their academic plan, recruited during April to December 2023, in groups of 3-5, participated in department-sponsored lunches with faculty members based on shared interests. Recruitment of the students was based on an initial survey where students were given prescribed topics of interest such as undergraduate research, career advice, or graduate school. Students were given the option to write their own topics of interest in case the prescribed ones did not match what the students would like to discuss during the lunch. Confirmed students completed an anonymous pre-intervention survey of ten (10) questions, with 8 Likert-scale questions (1: strongly disagree, 5: strongly agree) derived from the Driscoll model [14] and Leibowitz et al.'s validated survey [22] and 2 free response questions to understand the students' motivation for attending the lunch. The 8 Likert-scale questions (shown in Table 2) explore dimensions of belonging including knowledge and satisfaction of events, self-efficacy, sense of belonging in department, clarity of career goals, and knowledge of diversity, equity, and inclusion (DEI). These topics were derived from Driscoll et al.'s model in the areas of inclusion like career choices, sensitivity to diversity, awareness of community and self-awareness [14].

The two free-form questions sought to inform the faculty with students' goals and specific questions that may be useful for the discussion. Demographic information including class standing, gender, and ethnicity was also voluntarily obtained using the pre-survey. The lunches consisted of open-ended discussions with the faculty member and participating students, based on topics that students submitted beforehand, although students were encouraged to ask any questions that arose during the lunch. Covered topics ranged from inquiries about undergraduate research opportunities and directions, advice for undergraduate life, and general inquiries regarding post-graduate studies (master's or PhD). A member of the investigating team was present during every lunch to facilitate discussion and conduct the logistics of the study, such as establishing the meeting location and administering the post-survey.

Immediately following the lunch, students took a linked anonymous post-survey with the identical Likert-scale questions and two additional free-form questions for feedback. The Likert-scale questions were reissued as a second anonymous post-survey one month later. We used Qualtrics to conduct all surveys. We chose a significance level of 0.05 for all comparisons. Paired t-tests were performed on results in each Likert-scale question from pre- vs. post-survey and pre- vs. one-month post-survey. Holm-Bonferroni corrections for multiple comparisons were performed in analysis of data involving the one-month post-survey. Python 3.11 was used to implement the statistical routines and create the illustrations. Our IRB approved our project as an exempt study (IRB #2030008-2).

Results

The demographics of student participants who responded to our post and one-month post-surveys are included in Table 1, which comprises of the data set that we analyzed in this study.

Table 1. Demographics of responding students in the post-intervention survey (post-survey, 20 participants) and the one-month post-survey (14 participants) in percentage of students who responded to the respective surveys. Note that the sum of all ethnicities exceeds 100% because students may identify as multiple ethnicities.

Demographic	**Range (post-survey, *n*=20)**			
Class standing	1st year	2nd year	3rd year	4th year or higher
	25.0%	30.0%	40.0%	5.0%
Gender	Male	Female	Nonbinary/third gender	
	10.0%	85.0%	5.0%	
Ethnicity			White:	35.0%
			Asian/Asian American	70.0%
			Hispanic/Spanish Origin:	5.0%
			Mexican/Mexican American/Chicanx:	5.0%
			African American/African/Black:	5.0%
			American Indian/Alaskan Native:	5.0%
Demographic	**Range (one-month post-survey, *n*=14)**			
Class standing	1st year	2nd year	3rd year	4th year or higher
	21.4%	35.7%	35.7%	7.1%
Gender	Male	Female	Nonbinary/third gender	
	14.3%	78.6%	7.1%	
Ethnicity			White:	42.9%
			Asian/Asian American	71.4%
			Hispanic/Spanish Origin:	7.1%
			African American/African/Black:	7.1%
			American Indian/Alaskan Native:	7.1%

Table 2. Likert-scale questions (1: strongly disagree; 5: strongly agree) administered in the survey to the participating students with average scores of the questions from the pre-intervention survey (pre-score) and immediate post-intervention survey (post-score) out of 5.00. n=20.

Question	Pre-score /5.00	Post-score /5.00
Q1. I am aware of the undergraduate-oriented events and opportunities (for example, the BME Open House) in the department of Biomedical Engineering at UC Davis.	3.25	4.05
Q2. I have participated in the events and am satisfied with the quality of such undergraduate-oriented events in the department.	3.05	3.80
Q3. I feel that I belong in the department of BME at UC Davis.	3.55	4.05
Q4. I am clear about my undergraduate academic study plan (the course schedules) in BME at UC Davis.	3.45	3.70
Q5. I know my strengths and weaknesses in my concentration of study in BME.	3.25	3.55
Q6. I would like to complete my B.S degree in BME at UC Davis.	4.50	4.70
Q7. I am clear about my career goals in biomedical engineering.	3.10	3.80
Q8. I am aware of the challenges associated with the biomedical engineering industry in terms of diversity, equity, and inclusion.	3.20	3.70

We received 20 valid responses (87.0% response rate) for the immediate post-survey and 14 responses (60.9% response rate) for the one-month post-survey. Comparisons of the results from the pre and the post-surveys are shown in Table 2 and Figure 1. Students reported significant improvement in multiple aspects from our survey, including Q1 (knowledge of events, $p<0.001$), Q2 (participation and satisfaction of events, $p=0.007$), Q3 (sense of belonging in department, $p=0.004$), Q7 (clarity of career goals, $p<0.001$), and Q8 (knowledge of DEI, $p=0.021$).

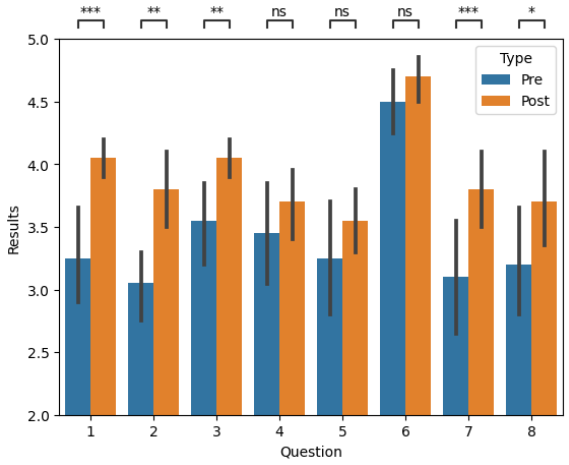

*Figure 1. Pre- (blue) vs post-survey (orange) results for 20 participants. Questions 1-8 correspond to Q1-8 in Table 2. *: p<0.05; **: p<0.01; ***: p<0.001.*

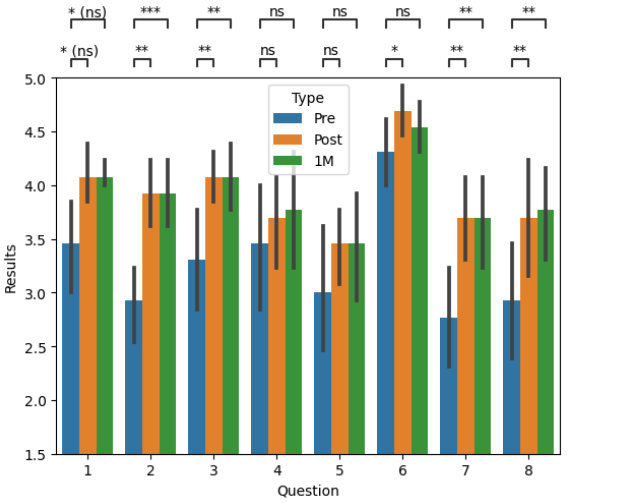

*Figure 2. Pre- (blue) vs post-survey (orange) and pre vs. one-month post-survey (green) results for 14 participants. Questions 1-8 correspond to Q1-8 in Table 2. *: p<0.05; **: p<0.01; ***: p<0.001; * (ns): p<0.05 but did not survive the Holm-Bonferroni corrections for multiple comparison.*

The one-month post-survey results, found in Figure 2, featured fewer students yet achieved statistical significance that lasted through the one-month post-survey in Q2, Q3, Q7, and Q8 with similar significance levels. One notable difference is that Q6 (intention to graduate from major) showed significance in the pair of pre- vs. the immediate post-survey ($p=0.019$), although this trend diminished somewhat in pre- vs. one-month post-survey ($p=0.082$). In general, the improvements in the one-month post-survey followed the same trend as the immediate post-survey and minimal changes happened one month after the lunch.

Discussion

The data thus far suggest a positive correlation between students' sense of belonging and informal student-faculty micro-interactions through the organized lunches. Our findings are consistent with existing literature, such as the improvement in the clarity of career goals [18]. Students showed good improvement from the pre-intervention in each question, from awareness of BME events to a sense of belonging, while resulting in five pairs of statistical significance in the post-survey. Figure 2 indicates this improvement is lasting despite a single intervention. We hypothesize that the lasting improvement resulted from students entering lunch with a clear understanding of their goals and knowledge of the faculty that they would be having lunch with. Our approach is extremely translatable with minimal cost and commitment of human resources. Documentation of our methods and assessments can be distributed to other majors or colleges to provide foundational guidelines for the execution of a similar intervention, although individual

departments are recommended to exercise caution since the reception of student-faculty interactions have been reported to be variable by major. [21]

Our survey assessed the sense of belonging in BME quantitatively using 8 Likert-scale questions. These 8 questions were written to adopt a broad coverage on the theoretical framework provided in Driscoll et al.'s model [14] while ensuring a high rate of retention in participation of our post-surveys. Results from our study will serve as a steppingstone for our future studies that involve more detailed assessments in sense of belonging due to informal student-faculty interactions. With better developments of the survey questions and potential validation, we will be more confident in teasing out subjectivity in subjects' interpretations to our current Likert-scale questions and reveal the exact areas where our interventions have benefits in.

Three questions received positive improvements in the post-survey but did not fall significant at the 0.05 level. Q4 and Q5 relate to the academic plan and performance/competence of the students in BME. We postulated that the lower improvement may be due to faculties not necessarily knowing all the courses offered in our BME curriculum and all the concentration offered by the department, as well as the faculties' research focus not completely aligning with the students' concentration of interest.

The main reason for us not to achieve a significant result on Q6 (I would like to complete by B.S. degree in BME at UC Davis) is the high base level (4.50/5.00 on pre-survey, in between strongly agree and agree). The results from the pre-survey suggest that the lunch participants may already be determined in finishing their BME degree at our school, which may or may not be the population that increased student-faculty interactions will be the most beneficial for. Although, Q1 and Q2 (knowledge, participation, and satisfaction of events; 3.25 and 3.05 in the pre-survey) suggest that we have adequately reached out to groups that did not know or have attended undergraduate-focused events in our department, potentially building community within this group. We will continue brainstorming ideas under our approved IRB for reaching out to the subgroup that are on the fence of completing their BME degree here. However, reaching out to "proper" populations remain a challenge for studies involving student engagement.

The results we presented are an aggregate or average behavior of all participants. Improvements may not be even as individuals have unique methods of processing information, and the format of discussion over lunch may be more appealing to some students compared to others. Feedback comments made by a few participants indicated that their goals were not fully achieved in the lunches, though all responses indicated they learned something new regarding either their professional life, academia, or getting to know BME faculty better. One student indicated that their interests did not completely overlap with the faculty member they had lunch with, as the student was highly interested in going to industry immediately. Although uncommon in our results, we would like to caution the departments who would like to adopt our approach to use clear language and matching criteria for recruiting students, as mismatch in students' and faculties' interest will be detrimental in the outcome of such lunches.

Table 1 suggests that we have acquired a reasonable distribution of class standing and ethnicity data, which are not far from our department's distribution. However, we are getting an unusually high representation of females involved in the student-faculty lunches. We would like to investigate this behavior further in our future studies.

We have additional work planned to move on from WIP to a full submission. To improve response rate for one-month post surveys, we plan on distributing gift cards as an incentive to

completing the one-month post-survey, since currently, the completion of the one-month post-survey is completely voluntary. We will continue enrolling subjects for our student-faculty lunches. With a larger sample size, we may be able to find more statistically significant improvements in other questions we included in the survey. A larger sample size also allows us to investigate the potential equity of the effects more accurately across demographics, as a larger sample size will likely represent the distribution of the demographic better. We are motivated by the literature that indicates a disproportionate number of college students that belong to marginalized groups in terms of ethnicity [23, 24], gender [25], or educational status [26] have a lowered sense of belonging than their peers. Research on engineering students is concurrent with these findings, as engineering students who pertain to these minority groups report a lower sense of belonging. [26-29] Once we perform subgroup analysis with each respective demographic group, we also plan to interview individuals from all demographic groups to tailor the execution of the monthly lunches to better improve students' sense of belonging. We will also perform coding analyses on the free-response questions submitted by the students to identify certain themes that are commonly mentioned or asked, so that we could provide the department with suggestions for potential improvements in undergraduate education. The coding analyses will also be beneficial in preparing the faculty participants and setting faculties' expectations before the students submit their pre-survey.

We plan to continue investigating more instances of student-faculty micro-interactions in the same lunch setting as well as other informal activities such as board game nights with faculty. To control for confounding variables, we plan to administer student-only lunches with a graduating student acting as the mentor in place of the faculty in some of these lunches to assess the efficacy of informal student-student interactions versus student-faculty interactions, to provide a better sense of direction on implementations of the project in the next stage. We are actively looking for collaborators on our project; with more collaborators, validation and further development of our surveys could be performed for a more in-depth study of the specific impact of these lunches on students' sense of belonging.

Conclusion

The organized monthly student-faculty lunches revealed positive and lasting correlation between informal student-faculty micro-interactions and improvement in non-graduating undergraduate BME students' sense of belonging. The observed enhancements in satisfaction with events, knowledge of concentration, sense of belonging, career goals, and awareness of diversity, equity, and inclusion underscore the potential of this approach in fostering a supportive community within academic departments. With its scalability, minimal resource commitment, and encouraging results, this intervention provides a promising avenue for other departments to adopt our approach to address challenges related to student comfort and retention within their majors.

Acknowledgments: This work is funded by the Health, Equity, and Wellness committee of the Biomedical Engineering department; the Undergraduate Research Center TAF23-01 grant; and the Provost's Undergraduate Fellowship grant PF23-42 at UC Davis. The authors would like to thank Eileen Panguito, Megan Villasenor, Dr. Marc Facciotti, Dr. Steven George, Dr. Yi Xue, Dr. Soichiro Yamada, Dr. Jennifer Choi for their support in these lunches.

References

[1] R. Masika and J. Jones, "Building student belonging and engagement: insights into higher education students' experiences of participating and learning together," *Teaching in Higher Education*, vol. 21, no. 2, pp. 138–150, Feb. 2016, doi: 10.1080/13562517.2015.1122585.

[2] M. A. Hope, "The Importance of Belonging: Learning from the Student Experience of Democratic Education," *J Sch Leadersh*, vol. 22, no. 4, pp. 733–750, Jul. 2012, doi: 10.1177/105268461202200403.

[3] K. F. Osterman, "Students' Need for Belonging in the School Community," *Rev Educ Res*, vol. 70, no. 3, pp. 323–367, Sep. 2000, doi: 10.3102/00346543070003323.

[4] D. Wilson, D. Spring, and L. Hansen, "Psychological sense of community & belonging in engineering education," in *2008 38th Annual Frontiers in Education Conference*, IEEE, Oct. 2008, pp. F3F-21-F3F-24. doi: 10.1109/FIE.2008.4720650.

[5] E. Judson, J. Ernzen, Y.-C. Chen, S. Krause, J. Middleton, and R. Culbertson, "What is the effect of establishing programs that address sense of belonging on undergraduate engineering retention?," in *2015 IEEE Frontiers in Education Conference (FIE)*, IEEE, Oct. 2015, pp. 1–8. doi: 10.1109/FIE.2015.7344202.

[6] S. Al-Qudah, J. Davishahl, E. Davishahl, and M. Greiner, "Investigation of Sense of Belonging to Engineering in Undergraduate Introductory Classes," in *2018 ASEE Annual Conference & Exposition Proceedings*, ASEE Conferences, 2018. doi: 10.18260/1-2--30730.

[7] M. L. Pedler, R. Willis, and J. E. Nieuwoudt, "A sense of belonging at university: student retention, motivation and enjoyment," *J Furth High Educ*, vol. 46, no. 3, pp. 397–408, Mar. 2022, doi: 10.1080/0309877X.2021.1955844.

[8] T. Dwyer, "Persistence in higher education through student–faculty interactions in the classroom of a commuter institution," *Innovations in Education and Teaching International*, vol. 54, no. 4, pp. 325–334, Jul. 2017, doi: 10.1080/14703297.2015.1112297.

[9] C. R. Glass and C. M. Westmont, "Comparative effects of belongingness on the academic success and cross-cultural interactions of domestic and international students," *International Journal of Intercultural Relations*, vol. 38, pp. 106–119, Jan. 2014, doi: 10.1016/j.ijintrel.2013.04.004.

[10] S. Parkes, "Fostering a sense of belonging: supporting the early formation of student identity as successful learners in higher education," *Journal of Learning Development in Higher Education*, no. 7, Jun. 2014.

[11] P. O'Keeffe, "A sense of belonging: Improving student retention," *Coll Stud J*, pp. 605–613, 2013.

[12] A. Cook-Sather and P. Felten, "Where Student Engagement Meets Faculty Development: How Student-Faculty Pedagogical Partnership Fosters a Sense of Belonging," *Student Engagement in Higher Education Journal*, vol. 1, no. 2, Sep. 2017.

[13] A. L. Miller, L. M. Williams, and S. M. Silberstein, "Found my place: the importance of faculty relationships for seniors' sense of belonging," *Higher Education Research & Development*, vol. 38, no. 3, pp. 594–608, Apr. 2019, doi: 10.1080/07294360.2018.1551333.

[14] A. Driscoll and B. Holland, "An Assessment Model for Service-Learning: Comprehensive Case Studies of Impact on Faculty, Students, Community, and Institution," *Mich J Community Serv Learn*, pp. 66–71, 1996.

[15] M. Komarraju, S. Musulkin, and G. Bhattacharya, "Role of Student–Faculty Interactions in Developing College Students' Academic Self-Concept, Motivation, and Achievement," *J Coll Stud Dev*, vol. 51, no. 3, pp. 332–342, May 2010, doi: 10.1353/csd.0.0137.

[16] Y. K. Kim and L. J. Sax, “The Effects of Student–Faculty Interaction on Academic Self-Concept: Does Academic Major Matter?,” *Res High Educ*, vol. 55, no. 8, pp. 780–809, Dec. 2014, doi: 10.1007/s11162-014-9335-x.

[17] J.-S. Lee, “The effects of the teacher–student relationship and academic press on student engagement and academic performance,” *Int J Educ Res*, vol. 53, pp. 330–340, Jan. 2012, doi: 10.1016/j.ijer.2012.04.006.

[18] E. T. Pascarella, “Student-Faculty Informal Contact and College Outcomes,” *Rev Educ Res*, vol. 50, no. 4, pp. 545–595, Dec. 1980, doi: 10.3102/00346543050004545.

[19] M. T. Guzzardo *et al.*, “‘The Ones that Care Make all the Difference’: Perspectives on Student-Faculty Relationships,” *Innov High Educ*, vol. 46, no. 1, pp. 41–58, Feb. 2021, doi: 10.1007/s10755-020-09522-w.

[20] J. J. Endo and R. L. Harpel, “The effect of student-faculty interaction on students’ educational outcomes,” *Res High Educ*, vol. 16, no. 2, pp. 115–138, 1982, doi: 10.1007/BF00973505.

[21] G. D. Kuh and S. Hu, “The Effects of Student-Faculty Interaction In the 1990s,” *Rev High Ed*, vol. 24, no. 3, pp. 309–332, Mar. 2001, doi: 10.1353/rhe.2001.0005.

[22] J. B. Leibowitz, C. F. Lovitt, and C. S. Seager, “Development and Validation of a Survey to Assess Belonging, Academic Engagement, and Self-Efficacy in STEM RLCs,” *Learning Communities: Research & Practice*, 2020.

[23] M. Meeuwisse, S. E. Severiens, and M. Ph. Born, “Learning Environment, Interaction, Sense of Belonging and Study Success in Ethnically Diverse Student Groups,” *Res High Educ*, vol. 51, no. 6, pp. 528–545, Sep. 2010, doi: 10.1007/s11162-010-9168-1.

[24] D. R. Johnson *et al.*, “Examining Sense of Belonging Among First-Year Undergraduates From Different Racial/Ethnic Groups,” *J Coll Stud Dev*, vol. 48, no. 5, pp. 525–542, 2007, doi: 10.1353/csd.2007.0054.

[25] K. L. Tonso, “ENGINEERING GENDER-GENDERING ENGINEERING: A CULTURAL MODEL FOR BELONGING,” *J Women Minor Sci Eng*, vol. 5, no. 4, pp. 365–405, 1999, doi: 10.1615/JWomenMinorScienEng.v5.i4.60.

[26] E. Liptow, K. C. Chen, R. Parent, J. Duerr, and D. Henson, “A Sense of Belonging: Creating a Community for First-generation, Underrepresented groups and Minorities through an Engineering Student Success Course,” *2016 ASEE Annual Conference & Exposition*, 2016.

[27] E. Litzler and C. Samuelson, “How Underrepresented Minority Engineering Students Derive a Sense of Belonging from Engineering,” in *2013 ASEE Annual Conference & Exposition Proceedings*, ASEE Conferences, 2013, pp. 23.674.1-23.674.20. doi: 10.18260/1-2--19688.

[28] A. Rainey, D. Verdín, and J. Smith, “Classroom Practices that Support Minoritized Engineering Students’ Sense of Belonging,” *Proceedings of the American Society for Engineering Education*, Jan. 2021.

[29] K. L. Tonso, “Engineering Identity,” in *Cambridge Handbook of Engineering Education Research*, Cambridge University Press, 2014, pp. 267–282. doi: 10.1017/CBO9781139013451.019.