

Work In Progress: Faculty Partnering With Students in Biomedical Engineering Undergraduate Curriculum Development

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Abstract

The Wallace H. Coulter Department of Biomedical Engineering at Georgia Tech is currently infusing entrepreneurial minded learning and critical reflection throughout the undergraduate curriculum. One unique aspect of this effort is the creation of student-faculty partnerships that are focused on developing more entrepreneurially minded and reflective pedagogy within specific core courses. In this pilot effort, eight biomedical engineering students were recruited based on previous course experience, academic performance, and expressed interest in entrepreneurially minded learning and course development. These student partners formed a core team of course implementation assistants (CIA) that were overseen and supported by one faculty member serving as team leader. Six biomedical engineering core courses were selected for modification as an initial trial. Instructional teams for each of these courses were then matched with one or more CIA student partners and charged with redesigning portions of their courses to incorporate entrepreneurial mindset development and critical reflection. Student-faculty partnerships of this nature have most often been seen in liberal arts programs. However, involving undergraduate students as partners in curriculum development within an engineering program represents a significant innovation in engineering education. While sometimes met with resistance, these types of student-faculty partnerships at work in liberal arts curricula have been shown to foster empathy, self-authorship, and a sense of belonging in both the students and the faculty involved. In this work in progress paper, we characterize the features of these student-faculty partnerships at Georgia Tech and discuss lessons learned from student and faculty perspectives on their collaboration over the course of a semester.

Introduction

The Wallace H. Coulter Department of Biomedical Engineering at Georgia Tech is currently making an intentional effort to vertically integrate entrepreneurial minded learning and critical reflection within the undergraduate curriculum. With funding from the Kern Family Foundation, the goals of this work are not only to better equip students to meet the demands of the modern marketplace but also to empower students to tell the story of their intentional growth into entrepreneurially minded engineers. A unique aspect of this effort is the intentional involvement of students as faculty partners in curriculum development to incorporate more entrepreneurially minded and reflective pedagogy into specific core courses.

Although some debate exists in the literature over the most appropriate terminology for these types of activities (Cook-Sather et al., 2018), the practice of “students as partners” or “student-faculty partnerships” is most clearly defined by students and faculty engaging together in a process “through which all participants have the opportunity to contribute equally, although

not necessarily in the same ways, to curricular or pedagogical conceptualization, decision-making, implementation, investigation, or analysis” (Bovill et al., 2011). Scholarship in the area of students as partners has increased significantly in recent years as evidenced by the number of conference papers, journal articles, book chapters, books, and research reports produced (Mercer-Capstone et al., 2017) as well as the 2017 creation of the *International Journal for Students as Partners* (IJSaP) as a new open access, online journal focused on students as partners in learning and teaching in higher education.

Healey et al. (2017) have described student-faculty partnerships as “arguably one of the most important issues facing higher education in the 21st century” and classified the multiple contexts and practices of student-faculty partnerships into four categories: subject-based research and inquiry, scholarship of teaching and learning, curriculum design and pedagogic consultancy, and learning, teaching, and assessment. They have also identified eight values significant to effective student-faculty partnership practice. These are authenticity, inclusivity, reciprocity, empowerment, trust, challenge, community, and responsibility.

Cook-Sather et al. (2018) have highlighted how the practice of faculty-student partnerships “rejects traditional hierarchies and assumptions about expertise and responsibility”, challenges the idea of students as consumers, “questions the roles of complacency and compliance in the classroom” offering a different way of thinking about the relationships between teachers and learners. Cook-Sather and colleagues have identified numerous benefits derived from student-faculty partnerships in a variety of settings. These benefits include increased student engagement, ownership of learning, increased confidence, and increased self-awareness (Cook-Sather et al., 2014) as well as increased empathy and appreciation of differences in perspectives and dispositions (Cook-Sather, 2015). Through significant contribution to this field, Cook-Sather et al. (2014) have described respect, reciprocity, and responsibility as the three guiding principles of effective student-faculty partnerships. The eight values identified by Healy et al. (2017) map closely to these guiding principles and we have used aspects of both frameworks in our analysis described below.

Although student-faculty partnerships have received significant attention in recent years, work involving undergraduate students as partners in curriculum development within engineering programs is not common in the literature (Mercer-Capstone et al., 2017) and thus, represents a significant innovation in engineering education. As such, in this paper we will characterize the features of our initial efforts in the area of student-faculty partnerships within the biomedical engineering program at Georgia Tech and discuss lessons learned from both faculty and student perspectives over the course of a semester.

Design

As part of an effort to incorporate entrepreneurial mindset development and critical reflection into six core biomedical engineering courses, we intentionally chose to involve students as faculty partners in this curriculum development. Eight biomedical engineering

students were recruited based on previous course experience, academic performance, and expressed interest in entrepreneurially minded learning and course development. These student partners formed a core team of course implementation assistants (CIA) that were overseen and supported by one faculty member serving as team leader. Six teams of student-faculty partnerships were formed to work on six different core courses. Student partners had some choice in their team assignments but were required to have completed the course they selected. Appendix A contains the list of courses and number of participants in each student-faculty team.

Student-faculty teams co-created and deployed new course content related to entrepreneurial mindset and a variety of new reflective assignments for their specific courses during the Fall 2018 semester. Teams took different approaches depending on the context of their particular course. Example reflective assignments include written reflections on the relationship of entrepreneurial mindset to the design process after each design phase, video reflections on the application of entrepreneurial mindset to biomedical engineering problems, reflections on the connections of core concepts in physiology to biomedical engineering and the entrepreneurial mindset, and reflections on the value created by mathematical modelling in a course on conservation principles in biomedical engineering.

At the end of the semester, we sought to understand both student and faculty perspectives on these initial student-faculty partnerships. The nature of these student-faculty partnerships aligned most closely with Healey's category of curriculum design and pedagogic consultancy. Thus, we chose in part to focus on assessing a sense of community (Healey et al., 2017) within these partnerships but also chose to assess the values of respect, reciprocity, responsibility (Healey et al., 2017, Cook-Sather et al., 2014), and empathy (Cook-Sather, 2015) based on other benefits of student-faculty partnerships seen in the literature. We assessed faculty and student perspectives on these partnerships through a survey administered at the end of the semester. Appendix B contains the survey questions posed to both students and faculty. All responses were de-identified after survey completion. The value being assessed by a given question as defined in the original works cited above is also included in Appendix B although these were not communicated to the survey participants. Additionally, respondents were also asked to identify areas for future improvement.

Results and Discussion

Ten out of 17 participants responded to the requests to complete the end of the semester survey. There were five student respondents and five faculty respondents. Appendices C & D contain summaries of the student and faculty response data and individual comments from survey participants. Our intent was to assess the perspectives of students and faculty with relation to the values of sense of community (Healey et al., 2017), respect, reciprocity, responsibility (Healey et al., 2017, Cook-Sather et al., 2014), and empathy (Cook-Sather, 2015) based on the definitions from the original works.

As seen in the response data, both faculty and students viewed their partnerships in generally positive ways overall with respect to the assessed values. All five student participants either agreed or strongly agreed with all of the values expressed through the survey. From the students' perspectives, the values of respect, reciprocity, and empathy characterized these partnerships more strongly relative to those of responsibility and community. All five students strongly agreed with the value of respect characterizing their partnership while four out of five strongly agreed that reciprocity and empathy characterized their student-faculty partnership. The individual comments from the students also support these data. From a student perspective, partnerships were characterized by respect and reciprocity through phrases like "helpful and supportive of my ideas" and "really respected my ideas and opinions, and was very encouraging". In addition, the value of responsibility was not as highly ranked in the survey responses, but was revealed as important in individual comments such as "I felt a large sense of ownership of the project, and really think I did something valuable. He or she trusted me with completing my work...".

Overall, faculty perspectives also showed generally positive characterizations of these partnerships with respect to the values assessed. Although the faculty perspectives were more diverse than the student perspectives, the value of respect characterized these partnerships most significantly from a faculty point of view. In fact, four out of five faculty participants strongly agreed that respect characterized their student-faculty partnerships. In addition, the value of empathy characterized by understanding a student's perspective of a course was emphasized through individual faculty comments such as "(I) gained some perspectives I would not have otherwise had" and "(my student partner) brought a student perspective to the planning process. Really invaluable." One faculty respondent did not agree with characterization of the partnerships in the areas of reciprocity, responsibility, community, or empathy. However, the responses of this particular faculty member may be explained by their individual comments which included statements such as "personally I was not as involved as the other team members."

Future Work

This work represents our initial efforts in using student-faculty partnerships as a tool for curriculum development and thus, our first attempt at characterizing these partnerships within our biomedical engineering program. This initial work has helped prepare us to maximize the potential of student-faculty partnerships in the future. To leverage more fully the power of these partnerships long term, future work will include a more thorough investigation and implementation of best practices in this area as well as development of more formal methods of characterizing these partnerships. We also plan to expand the role of student-faculty partnerships beyond the context of individual courses in order to implement programmatic changes within our department.

References

- Bovill, C., Cook-Sather, A., & Felten, P. (2011) Students as co-creators of teaching approaches, course design, and curricula: implications for academic developers, *International Journal for Academic Development*, 16(2).
<https://doi.org/10.1080/1360144X.2011.568690>
- Cook-Sather, A. (2015). "Dialogue Across Differences of Position, Perspective, and Identity: Reflective Practice In/On a Student-Faculty Pedagogical Partnership Program." *Teachers College Record*, 117(2).
- Cook-Sather, A., Bovill, C., & Felten, P. (2014). *Engaging Students as Partners in Learning and Teaching: A Guide for Faculty*. San Francisco, CA: Jossey-Bass Higher and Adult Education.
- Cook-Sather, A., Matthews, K. E., Ntem, A., & Leathwick, S. (2018). What we talk about when we talk about Students as Partners. *International Journal for Students As Partners*, 2(2), 1-9. <https://doi.org/10.15173/ijpsap.v2i2.3790>
- Healey, M., Flint, A., & Harrington, K. (2014, July). Engagement Through Partnership: Students as Partners in Learning and Teaching in Higher Education. *The Higher Education Academy*.
- Mercer-Mapstone, L., Dvorakova, S., Matthews, K., Abbot, S., Cheng, B., Felton, P., & Knorr, K. (2017, May). A Systematic Literature Review of Students as Partners in Higher Education. *International Journal for Students as Partners*, 1(1).
- (n.d.). In *International Journal for Students as Partners*. Retrieved from <https://mulpress.mcmaster.ca/ijpsap>

Appendix A: Courses Involved in Faculty-Student Partnership

<u>Course</u>	<u>Number of Faculty</u>	<u>Number of CIA</u>
2210 Conservation Principles in BME	2	1
2250 Problems in BME	2	1
2310 Intro to BME Design	2	1
3100 Systems Physiology	2	2
3110 Quant. Eng. Physiology Lab I	1	1
3610 Quant. Eng. Physiology Lab II	1	1

Appendix B: Questions Used in Student and Faculty Surveys

QUESTIONS FOR STUDENTS:

1. RESPECT - I felt that my faculty partner respected my ideas and contributions (1-4)
2. RECIPROCITY - I felt that my faculty partner treated me as an equal. (1-4)
3. RESPONSIBILITY - I felt that my faculty partner viewed me as a co-creator of curriculum. (1-4)
4. RESPONSIBILITY - I felt that my faculty partner trusted me to complete my work on time. (1-4)
5. RESPONSIBILITY - I felt that my faculty partner trusted the quality of my work. (1-4)
6. COMMUNITY - I feel more connected to the GT BME community as a result of this experience. (1-4)
7. EMPATHY - I have a better understanding of what faculty do to design a course. (1-4)
8. How could these faculty- student partnerships be improved in the future?

QUESTIONS FOR FACULTY:

1. RESPECT - I respected my student partner's ideas and contributions (1-4)
2. RECIPROCITY - I treated my student partner as an equal. (1-4)
3. RESPONSIBILITY - I viewed my student partner as a co-creator of curriculum. (1-4)
4. RESPONSIBILITY - I trusted my student partner to complete their work on time. (1-4)
5. RESPONSIBILITY - I trusted the quality of my student partner's work. (1-4)
6. COMMUNITY - I feel more connected to the GT BME community as a result of this experience. (1-4)
7. EMPATHY - I have a better understanding of a student's perspective of my course. (1-4)
8. How could these faculty- student partnerships be improved in the future?

Appendix C: Summary of Results of Student Surveys (5 respondents)

Student Question	1 Strongly Disagree	2 Disagree	3 Agree	4 Strongly Agree
<u>RESPECT</u> - I felt that my faculty partner respected my ideas and contributions.	0	0	0	5
<u>RECIPROCITY</u> - I felt that my faculty partner treated me as an equal.	0	0	1	4
<u>RESPONSIBILITY</u> - I felt that my faculty partner viewed me as a co-creator of curriculum.	0	0	2	3
<u>RESPONSIBILITY</u> - I felt that my faculty partner trusted me to complete my work on time.	0	0	2	3
<u>RESPONSIBILITY</u> - I felt that my faculty partner trusted the quality of my work.	0	0	3	2
<u>COMMUNITY</u> - I feel more connected to the GT BME community as a result of this experience.	0	0	2	3
<u>EMPATHY</u> - I have a better understanding of what faculty do to design a course.	0	0	1	4

Individual student comments on the student-faculty partnership:

1. I've helped create more reflection and teamwork activities involving the three C's but I haven't done much to change the assignments already in place, so I don't feel like my partnership has been that meaningful to the course as a whole. I also only meet the faculty once a week so I can't strongly agree that our partnership is strong. However, working together and keeping in touch through emails has been useful.
2. (My faculty partner) was very helpful and supportive of my ideas. We had good communication and met set deadlines.
3. I very much enjoyed working with (my faculty partner). I learned a lot about how to be an effective teaching assistant, and what makes an efficient, helpful, and incredible prof!
4. I loved working with my professor on this project. I felt a large sense of ownership of the project, and really think I did something valuable. He or she trusted me with completing my work, really respected my ideas and opinions, and was very encouraging.

Individual student responses to the question: How could these faculty-student partnerships be improved in the future?

1. Students can be asked or required to be present in the class itself to observe the professors' lectures and assignments. Students can also be asked to be involved in all curriculum changes and not just those associated with the KEEN program or portfolio project.
2. Maybe a faculty-student lunch?
3. A clearer communication of responsibilities and goals from the beginning. Faculty can get really busy and then some weeks, I'm left hanging a little bit not really sure of where to proceed.

Appendix D: Summary of Results of Faculty Surveys (5 respondents)

Faculty Question	1 Strongly Disagree	2 Disagree	3 Agree	4 Strongly Agree
<u>RESPECT</u> - I respected my student partner's ideas and contributions	0	0	1	4
<u>RECIPROCITY</u> - I treated my student partner as an equal.	0	1	2	2
<u>RESPONSIBILITY</u> - I viewed my student partner as a co-creator of curriculum.	0	1	3	1
<u>RESPONSIBILITY</u> - I trusted my student partner to complete their work on time.	0	0	3	2
<u>RESPONSIBILITY</u> - I trusted the quality of my student partner's work.	0	0	2	3
<u>COMMUNITY</u> - I feel more connected to the GT BME community as a result of this experience.	0	1	4	0
<u>EMPATHY</u> - I have a better understanding of a student's perspective of my course.	0	1	1	3

Individual faculty comments on the student-faculty partnership:

1. We let the students execute the project, after the kickoff. We did period checks and answered questions, but personally I was not as involved as the other team members. I think it was as productive as it could be (sort of neutral on this). The reason I put disagree as meaningful is because it was an exploratory examination of core concepts and I did not get the results of the inventories. As a result, I have not been able to make and changes this semester. I think that it was a significant experience though and has potential to be meaningful. It was more of the "baseline" of how the students interpreted the core concepts of the class.
2. (My student partner) brought a student perspective to the planning process. Really invaluable.
3. I only wish that I had more time to connect with the student partners.
4. Gained some perspectives I would not have otherwise had. Also allowed us to accomplish more than I could alone.

Individual faculty responses to the question: How could these faculty-student partnerships be improved in the future?

1. I am not sure. Perhaps more guidance from experienced educational investigators. As a first semester though, I think we learned a lot.
2. This is uncharted territory for me. I looked at this semester as a learn as you go. I am not sure if that is the best approach, but it worked for us.
3. Honestly, I am not sure that much requires improvement. The structure of regular meetings was helpful, as were regular email updates.