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Board 7: WIP: Leaders or Co-leaders? How Shared Leadership Takes Place in an Undergraduate Biomedical Engineering Design Program

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WIP: Leaders or co-leaders? How shared leadership takes place in an undergraduate Biomedical Engineering Design Program

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ABSTRACT

This is a work in progress. To instruct design abilities in undergraduate engineering students, it is common for programs to engage in problem-based learning projects. In addition, project-based instruction is often done with students in teams and these teams have formal or informal leadership structures. In this context, the success of the student project is usually attributed to the mindset of the leader, management styles, team dynamics that are cultivated by the leader, as well as a clear team structure and goals. This vertically operating leadership model is manifested as an individual activity in opposition to the concept of shared leadership. The latter form of leadership talks about a distributed form of influence amongst a group of people. This article portrays a descriptive case study that looks to understand some of the traits and pitfalls behind leading and co-leading dynamics in a 12-to-18-month biomedical engineering design course. After the pandemic, we've seen an increasing interest in formally sharing decision-making amongst our teams of 5-8 undergraduate students. This has made us rethink the leadership model for our Design Teams in biomedical engineering course. Qualitative one-to-one interviews with co-leaders and solo leaders enable a more granular understanding of the traits that come with sharing leadership while solving an open-ended biomedical engineering health problem. Preliminary data suggest that whilst co-leading has certain drawbacks, it has benefits regarding the protection of mental health, the complementation of skills, and the division of course workload.

Keywords: co-leadership, biomedical engineering, engineering design, teams, shared leadership

1. INTRODUCTION

Undergraduate engineering students are traditionally taught design skills through senior capstones, problem-based learning studio-based courses, and cornerstone design experiences. Specifically, an individual leadership structure to conduct a team is usually implemented oftentimes due to the presumed superiority of a one leader mode. This vertical leadership structure, where the success of the team is attributed to the personal qualities of the leader or their management tactics, differs from the idea of shared leadership [1]. In shared leadership, influence is distributed among a group of individuals without having anyone act as the superior [2]. In the startup world, incubators often promote the idea of co-founders to balance leadership skillsets, bring new investments, and deal with the difficulties of a new venture [3]. This tactic would avoid the pitfall of having a single point of failure. We might add that, over the years, our undergraduate biomedical engineering design program has seen an increased interest for co-leading a team as opposed to having a sole leader. We have seen students naturally undertaking a co-leadership structure when the projects go beyond the two mandatory 2 semester courses into a third semester that required more work into packaging and do translational work regarding the technology developed. In addition, as the first Fall semester started, some of the selected solo-leaders thought that they couldn't deal with the amount of work that entailed being a single orchestrator in a team of peers while leading with their own coursework. Initially, these were some of the things that made us challenge the idea of a single team leader, adding this as an option for the last cohort of team leaders' recruitment process.

The following work in progress is a descriptive, qualitative naturalistic study at an R1 university where the undergraduate design program in biomedical engineering is widely recognized. After receiving anecdotal evidence from students interested in co-leading, our team decided to conduct a formal context-sensitive inquiry to understand the drawbacks and benefits of a shared leadership model for engineering-design teams working to solve a healthcare issue. The article showcases the preliminary data coming from qualitative one-to-one interviews.

2. THEORETICAL FRAMEWORK

2.1 Shared leadership versus individual leadership

As in many other theories, there are many flavors to shared leadership. Articles refer to it with terms such as collective leadership [4], shared leadership [5][2][1], and co-leadership [6]. The latter term has been used more prominently in areas like social work, or group therapy as a case that uses a mentor-protégé situation [5]. In business ventures, shared leadership is often seen when two people divide the vertical leadership role to function as co-founders in startups [7][8][9] or co-leaders in the corporate world [10]. Even though the common knowledge taught in business schools looks at leadership as a trait in singular [1], the main biomedical engineering design course in a top-ranked university has seen a sustained interest and the need to enable co-leadership among their students.

2.2 Shared leadership in business ventures

Along the same line, non-research articles such as the ones published by giant tech Atlassian [11] or Harvard Business Review [12] reveal the paradigm shift towards co-leading in industry. In a 2022 study, researchers found that even solo-founded successful ventures involve some model of shared leadership by

including what they call a board of cocreators to manage their organization [3]. Howell et al. challenge the idea of co-founding but reaffirm the idea of ventures using a model of shared leadership.

2.3 Shared leadership in engineering education

Wu et al. [13] used a social network analysis approach to define when and when not to use a shared leadership approach in engineering design teams. In their study, they try to understand when shared leadership can be positively related to team effectiveness. Most of the previous studies they review deal with shared leadership amongst the team members, but not with the formal establishment of a co-leader. An interesting outcome of their research is the implication of the need to have a shared leadership model that depends on the stage in the project cycle. This is something we tend to see in the leadership decisions that our undergraduate biomedical engineering design teams take.

3. METHODS

3.1 Research context: The biomedical engineering undergraduate program at The Johns Hopkins University is ranked #1in the US News and World Report for 2022-2023 [14]. The Biomedical Engineering Design Team Program at JHU is more than 25 years old [15], and it partners with clinicians and industry to develop solutions in the areas of healthcare. Students apply to become team leaders before they onboard 4 other students. The vertically integrated teams are composed of juniors, sophomores, and seniors for the Fall semester. Teams onboard 3 freshmen for the Spring semester. Each team has a BME faculty as an engineering design mentor and a clinical, industrial or community counterpart. Leaders attend core lectures with the rest of the teams, and they participate in desk reviews with their engineering design mentor and committee meetings with their clinical mentor and other specialists. In addition, students that apply and are selected to become leaders go through special courses on project management and leadership. As Table 1 shows, the cohort of leaders has ranged from 13 in 2016 to 20 leaders in 2023. For the academic year of 2023-2024, and after a first set of positive informal comments on co-leading from 2020-2022, we decided to open the option for students to indicate if a) they were open to a co-lead b) they wanted to co-lead and c) they wanted to solo-lead. Surprisingly, from a total of 36 applicants, 27 of them indicated that they would be open to working with a co-lead, 2 were not interested in having a co-lead (wanted to do solo-lead), and 7 absolutely wanted a co-lead. With these results, we interviewed leaders and, after selecting the total number of teams for the cohort (20) the teaching team decided to have 5 of the 20 teams co-lead and follow their performance for 2023-2024.

	2015	2016	2017	2018	2019	2020	2021	2022	2023
CO-LEADS	01	02	00	01	00	00	02	03	05
SOLOLEADS	13	11	13	13	17	14	16	15	15
TOTAL TEAMS	14	13	13	14	17	14	18	18	20

Table 1: Co-leads and solo leads from 2015 – 2023

3.2 Research strategy: After getting IRB approval (IDHIRB00014708) for studying the way co-leading takes place in our Design Team course, an independent researcher conducted one-to-one qualitative interviews [16] [17] [18] with team leaders that had co-led in different academic years. We have also involved interviews to team members and solo leaders to understand the naturally happening dynamics in

these two different team typologies. Participation was voluntary. Most of the interviews were conducted virtually and recorded on Zoom. Later, they were transcribed, anonymized, and coded by two different individuals in order to identify salient themes. Our preliminary data portrays a convenience sample of 6 and to date we have conducted 6 more interviews considering the input from reviewers for the first iteration of this work in progress.

4. RESULTS AND DISCUSSION

Interviews were transcribed and analyzed looking for salient teams. Some of the team leaders worked together during the pandemic, so their comments were subjected to the context of virtual instruction. Our preliminary data from these interviews shows that co-leading marked benefits in the areas of mental health, division of labor, and skill development. One co-leader emphasizes that shared leadership not only enhances the different skills brought to the team, but also protects leaders from burnout: "*Imagine if there was only one leader: that leader probably wouldn't have the diversity of skills [of two leaders]. Also, the leader would be extremely burned out on a psychological level*." With co-leadership, if one leader is having a particularly busy week, the other leader can step up to ease the workload of the other. Co-leadership allows for a level of flexibility as well as division of labor, both of which could positively impact mental health, collective team skillsets, and skill development. One co-leader asserts the efficacy of co-leadership on team outcomes based on "*the quality of what we were able to produce, just because we had two people behind it rather than the typical [singular leader]*." Preliminary data consistently shows that co-leaders feel confident in the quality of their work due to the increased bandwidth made possible by co-leadership.

One co-leader focused on the "technical side" of the project while his counterpart focused on the "big picture, business plan" side of the project. He says, "*co-leads make sense when your team is working on multiple fronts.*" Co-leaders are able to bring their respective strengths to the team *and* develop their skills in areas less familiar to them. One co-leader remarks that he and his co-lead "*... brought complimentary skills. I bring some of the academic experience with writing report and manuscripts, even citing references, as well as a business background*," while the other leader brought expertise in modeling, prototyping, and other engineering-specific skillsets. "*It was interesting to see that both of us also took a little bit of leadership and learned about the skill that the other leader was a little more adept at*." In comparison with a singular leader model, co-leadership is perceived to offer teams more skills and additional perspectives and backgrounds as well as the opportunity for co-leads to develop the skills of their counterpart. Ultimately, co-leadership operates best when leadership styles are complementary and when co-leaders are viewed by team members as "equals." Interviewees overwhelmingly expressed the importance of building a foundation of established expectations and communication styles in order to form successful partnerships. Lastly, and aligned with the literature reviewed for our theoretical framework, there is a connection between having a single lead or onboarding a co-lead depending on the stage of the design project (whether it has to do with prototyping, ideation, or translation).

5. CONCLUSION

This article showcased preliminary data that portrays a case study on undergraduate biomedical engineering design teams and discussed the perceived benefits from co-leaders in what shared leadership entails for undergraduate biomedical engineering student. Future work implies looking thoroughly at the whole dataset and probably collect more interviews from the recent cohorts. Future work implies to go deeper in understanding the trajectory for those who decide to be solo leaders and the tradeoffs in this particular context. Limitations of this study are connected to naturalistic inquiry in which the findings are not generalizable to a wider audience.

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