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Identifying a "Starting Point" for Diversity and Inclusion Initiatives

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Identifying a "Starting Point" for Diversity and Inclusion Initiatives: An Executive Summary from Findings in a Problem-Based Learning Team-Centric Course

Abstract: Teamwork in educational settings can improve learning and prepares students for what they will encounter in the workplace, especially within engineering positions. Team diversity can strongly influence its success, sometimes for better, sometimes for worse: diversity can improve the quality and creativity of a team's outcomes but can also increase the chances of interpersonal conflicts and process problems[3,10]. Given its significant impact on team outcomes, we wondered how and to what extent students are aware of, acknowledge, and actively capitalize on the diversity of their teammates. As part of a larger study of factors that influence collaborative success or failure within teams, we conducted an open-ended, end-of-course survey in a sophomore level problem-based learning (PBL) class. The survey asked students to describe their teams in a way designed to capture those characteristics that were most salient to the students. The survey did not mention diversity or any other factor that might influence a team's ability to function well. Despite this lack of prompting, diversity emerged as one of the characteristics students remembered most about their teams. Interestingly, most students mentioned the diversity of their team with respect to the wide range of relevant knowledge and skills they possessed rather than in terms race, gender, and culture. These results suggest that a new "starting point" may be needed for diversity initiatives in order to connect with today's students: one that considers the impact on team function of not only surface-level characteristics such as race and gender, but also of deep-level diversity characteristics such as technical competencies and prior experiences.

Introduction: The course at the center of this study is both a highly-technical and highly cooperative team-focused class. Structured as a Problem-Based Learning (PBL) course, students are assigned to work in 8-person teams and required to delve head-first into an ill-defined, ill-structured, authentic biomedical engineering design problem[6,7]. Teams are expected to define the problem, model their proposed solution conceptually and mathematically, build a proof-of-concept with microcontrollers and Arduinos, and finally conduct an experiment with their prototype to test and validate their conceptual and mathematical models. This intense but highly scaffolded learning experience provides the ideal environment to examine how students engage in the team experience and participate in cooperative learning[4,8,9].

Participating students are generally first or second semester sophomores. At the undergraduate level, the academic department participating in the study is overrepresented with women (55%) and has moderate underrepresented minority (URM) representation (7.3% Black, 9.3% Latinx, and 4.7% multiracial); nationally, these enrollment statistics surpass graduation rates for biomedical engineering in gendered diversity (53.6% women compared to the national graduation rate of 41.7%) and offers comparable racial and ethnic diversity (16.6% Black and Latinx compared to the national graduation rate of 12.1% of Black and Latinx students)[2].

The diversity of our student teams and the complex nature of the tasks they are taking on together, presents us with the opportunity to contribute to the growing literature that examines the impact of diversity on team satisfaction and performance. We are interested in helping our students develop into inclusive leaders who promote a positive relationship between diversity and performance. A critical first step is for our students to value diversity and to be aware of how variations in surface- and deep-level characteristics can shape a team's performance and how the quality of the experience for each person on the team. Therefore, in this study, we examined whether students valued the diversity of their group members and their varied contributions to their team's effectiveness by asking the following research questions:

RQ1 - How do students label their teams?

RQ2 - What did students view as valuable within their team or team members?

Methods: After receiving institutional IRB approval, students enrolled in the PBL course during the 2017-18 academic year were asked on their final exam to "List two to three words that best describe your team and explain why they are representative." This prompt was selected to elicit unguided student views of their teams, with the goal of emergent unprompted responses from the students. Responses were aggregated to calculate the frequency of each submitted descriptor. Researchers then used descriptive coding on students' explanations of their submitted descriptors to organize the words into larger categories and themes (Table 1). While many themes emerged through this exploratory method, for this proposal, the focus will be on one of the largest codes: *diverse*.

Group Dynamics		Group Process	
Climate	Composition	Operations	Task Management
Supportive	Diverse	Design Thinking	Communicative
Professional Relationships	Imbalanced	Hardworking	Effective/Efficient
Social Relationships		Resilient	Inefficient
Negative Climate		Risk-averse	

Table 1. Emergent coding structure of prompt results

Results: In total, 47 out of 479 student descriptors were coded into "diverse". The explanations that accompanied these descriptors almost exclusively described diversity in terms of traits that were perceived as being directly relevant to solving the problem; here are two examples:

> Well-rounded: *Our team was made up of a diverse group of people. We all had different skills, but that played well to us being successful in all aspects of the class. Some of us were better at speaking while others excelled in coding and circuits.*
>
> Different*: Everyone had different strengths - some people were good at details, and those were the ones handling more technical aspects of the device - building the circuit etc. Others were good at the big picture, and they handled conceptual models, presentations, etc.*

Among the 47 submitted descriptors—words such as "well-rounded," "complete," and "mixed"—coded into "diverse" only one student explained their word choice as being representative of ethnic diversity within their team, and three noted nationality when their team included international students. No students used *diverse* to describe gender diversity within their team. The student explanations of the labels assigned to their teams go against the conventional grain of defining diversity in terms of the various identities people hold. Instead, students focused largely on intellectual contributions, skill sets, and personal approach to work when describing a "diverse" team. For example, one student wrote:

> *No two people were alike. We had programmers and we had abstract visionaries, strong personalities and not so strong personalities, hard workers and lazy people, procrastinators and early birds, and I believe we did well at using diversity to our strength.*

The rare allusion to race, ethnicity, or cultural background, and the complete oversight of gender, in students' explanations of their chosen descriptors suggests that students in our context—which is relatively diverse particularly with respect to gender—are viewing diversity primarily in terms of deep-level attributes such as the knowledge contributions of their team members, rather than in terms of surface-level attributes which tends to be the focus of STEM diversity initiatives nationally[1].

Discussion: The results raise several interesting questions worthy of further investigation. Is it possible that students have internalized the normality of this department's racial, ethnic, gender, and cultural diversity? Or is it that rather than embracing this diversity to enhance their team work, they ignore it to the detriment of individual members and their team? Or is the topic of diversity and inclusion so charged that students are not comfortable or do not have the words to articulate how visible diversity (race, gender, disability, ethnicity etc.) impacted their team? Yet another possibility is that the context of the course shaped the kinds of diversity that were salient to the students[5]. In this case students were embedded in a PBL course that challenged them to solve, as a team, an ill-defined, ill-structured complex real-world problem for which there is currently no known solution. The results suggest that this particular course sets a context that makes certain deep-level characteristics that vary widely among the team members highly salient Perhaps in this context, knowledge and technical skills were so highly valued that intellectual diversity is what students most readily noticed and appreciated. In addition, given the fact that the significant majority of the descriptors students used with regard to diversity were positive, it appears that the course was scaffolded effectively in terms of helping students recognize, appreciate, and utilize these deep-level variations. However, because the results also show an almost complete blindness to surface-level diversity and its impact on team function and individual experiences, a deeper probe into surface level make-up of the teams would need to be evaluated. There is no mention of gender diversity among the team, even though the ratio to males and females is almost equal, and with 16% students of color, more than one mention of ethnic or racial diversity would be expected as well.

A critical skill for being an inclusive leader is to understand the impact that stereotypes and status cues can have on shaping an individual team member's experience and their willingness and ability to make meaningful contributions to the team. We wonder, given the results of this study, the extent to which our students understand this - that the experiences individuals have based on their visible diversity shapes their lens and contributions to the group. More investigation is needed to determine how engineering students experience diversity in their school and work environments, perhaps looking into how (or if) they connect visible diversity to complimentary to intellectual contributions to the team. Juxtaposing the results of this study with students interviews on diversity could provide a greater insight to *why* they are not noticing or commenting on the visible diversity of their teammates and its impact on the team process.

Implications beyond our departmental context extend to the accepted methods for educating and preparing Generation Z students for a modern workforce that embraces diversity. Our results suggest that college students may view a group of peers with diverse identities as more normal/expected than a group of peers with diverse academic and operational strengths. When educators begin from the assumption that interacting with diverse others is new or uncomfortable for students, the default orientation is to use what may prove to be antiquated methods on teaching interaction and diversity to today's college students.

A looming question that remains is whether this result can be replicated in engineering departments and classrooms with a less diverse student body composition. Our ruminations on the implications of our results are not to imply that diversity initiatives focused on increasing knowledge or comfort with interacting with diverse others have been rendered unnecessary. Rather, we believe that our students' views on diversity may be a factor of the diverse departmental environment and their pre-college experiences in an increasingly global world. Our results, then, support the idea that initiatives that increase the diversity of people entering the field of engineering are vital to the ability to continually replicate these results both in our department and in others.

Conclusion: Our data is evidence that may support a new starting point for diversity education within engineering classes of diverse composition, and provide an opportunity within this course for growth within the students as well. If engineering students in a diverse environment readily recognize cognitive and intellectual diversity as an asset, we see two options for how these students are interacting with the social diversity in their environment: either they view it as normal and expected, or they ignore it. The latter option might be prompted by a preference for cognitive and intellectual diversity. If the former is the case, however, and our students are truly viewing surface-level differences among peers as normal, we want to leverage this perspective in advancing our goal of creating truly inclusive learning environments where all students feel connected and respected for all that they bring, dominant and marginal identities, to the department. The results suggest the course does NOT make salient these surface-level diversity attributes and that students lack an understanding or appreciation of the impact these attributes can have on how individuals experience the team, or how this may impact overall team function.

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