Board 318: Inclusive Engineering Classrooms and Learning Communities: Reflections and Lessons Learned from Three Partner Universities in Year 2

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Abstract

Minoritized and underrepresented students have historically experienced prejudice and discrimination within and outside of their classrooms, negatively impacting their educational outcomes. Research has illustrated that student academic and social success can be improved through instructors creating inclusive classroom environments that facilitate a sense of belonging. The impact of creating more inclusive environments is well-studied, however, actionable guidance on how to do this, especially in more technical disciplines such as engineering, is lacking. This study aims to address this gap by developing an inclusive engineering classroom practices menu along with accompanying tools for faculty seeking to improve their classrooms.

The first year of this study, the 2021-2022 academic year, as detailed at ASEE's Annual Conference in June 2022, saw the development of the inclusive engineering classroom practices menu as well as the pilot of the inclusive learning communities for faculty across three partner institutions. The student and faculty assessment plans were surveys and short-format interviews for both groups. This poster will focus on the survey and interview data that has been collected thus far, and the website that has been developed to further engage faculty, institutions, and partners interested in the study. During the second year of this study, the 2022-2023 academic year, a pilot decision matrix will also be developed to aid faculty and instructors to further promote and support the implementation of inclusive practices in engineering classrooms. The continued refinement of the menu and creation of both the website and decision matrix are the next steps in the development of an inclusive classrooms toolkit that can be used across all engineering classrooms and curriculums.

Introduction and Background

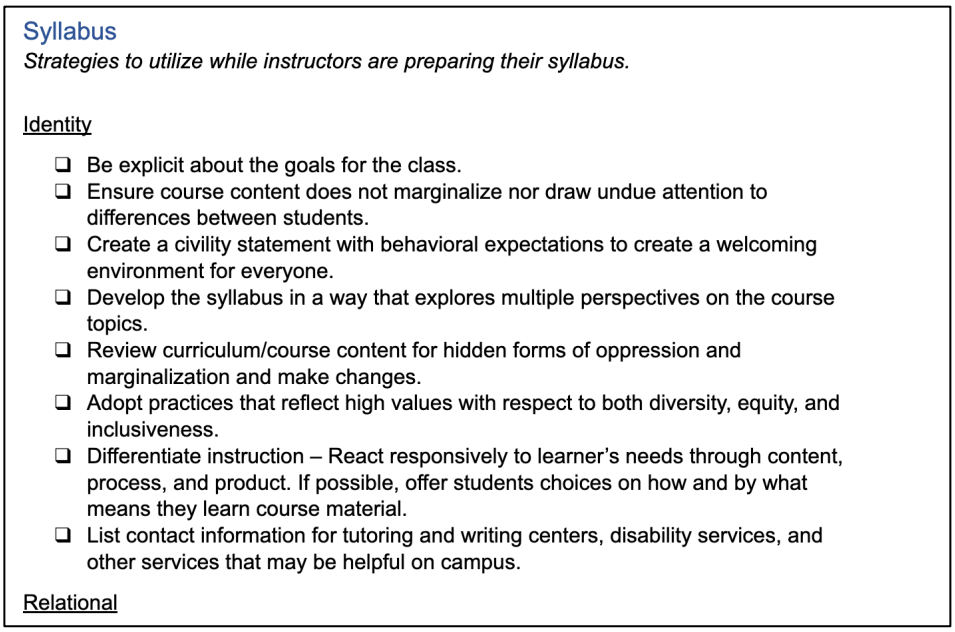
Minoritized and underrepresented students have historically experienced prejudice and discrimination within and outside of their classrooms, negatively impacting their educational outcomes. In 2018, the National Student Clearinghouse Research Center reports that in terms of college completion within six years in comparison with other races, Black students have the lowest completion rate (41 percent) and are more likely to discontinue enrollment or stop out than to complete a college credential [1]. Over time, these trends have largely remained the same when comparing Black and Latinx collegiate students with other majority races and it has caused some to ask the question: What are colleges and institutions doing to address this? One of the answers researchers have given is putting an institutional emphasis on inclusive teaching.

Research has illustrated that student academic and social success can be improved through instructors creating inclusive classroom environments that facilitate a sense of belonging [2], [3]. Though the impact of creating more inclusive environments is well-studied, actionable guidance on how to do this, especially in more technical disciplines such as engineering, is lacking. Faculty in engineering may find it particularly difficult, given that many of the tips for

an inclusive classroom suggest discussing race, gender, and other diversity attributes as they relate to the *technical content* of the class. If an instructor is teaching, for example, statics, it can be challenging to weave inclusivity topics into that content. This study aims to address this gap by developing an inclusive engineering classroom practices menu along with accompanying tools for faculty seeking to improve their classrooms.

First Year Outcomes

The first year, the 2021-2022 academic year, of this study saw the development of the inclusive engineering classroom practices menu as well as the pilot of the inclusive learning communities for faculty across three partner institutions. This study, particularly the development of the inclusive classroom strategies menu, is informed by and aligned with the Theory of Change Model developed by Henderson, Beach, and Finkelstein [4]. This model shows four quadrants of change strategies for higher education: disseminating curriculum and pedagogy, developing reflective teachers, enacting policy, and developing a shared vision among teachers and stakeholders. The inclusive strategies menu, which can be seen in part in **Error! Reference source not found.**, was developed through an extensive review of both peer-reviewed literature and university teaching and learning websites. Literature sources spanned the last five to ten years of research on successful inclusive strategies that have worked in classroom settings, particularly those in engineering classroom settings [5]–[8]. Teaching and learning center websites were also integral in creating the menu because they provided pedagogical advice along with inclusive strategies as they are considered the practicing experts on shaping and shifting classroom environments. Integrating relevant and culturally diverse examples into course material, ensuring a physically and technically accessible classroom, activating student voices throughout the entirety of the class, and interrupting blatantly racist and discriminatory behaviors were some of the strategies sourced from the literature and teaching and learning center resources for the menu [9]–[11].


Syllabus

Strategies to utilize while instructors are preparing their syllabus.

Identity

- ❑ Be explicit about the goals for the class.
- ❑ Ensure course content does not marginalize nor draw undue attention to differences between students.
- ❑ Create a civility statement with behavioral expectations to create a welcoming environment for everyone.
- ❑ Develop the syllabus in a way that explores multiple perspectives on the course topics.
- ❑ Review curriculum/course content for hidden forms of oppression and marginalization and make changes.
- ❑ Adopt practices that reflect high values with respect to both diversity, equity, and inclusiveness.
- ❑ Differentiate instruction – React responsively to learner's needs through content, process, and product. If possible, offer students choices on how and by what means they learn course material.
- ❑ List contact information for tutoring and writing centers, disability services, and other services that may be helpful on campus.

Relational

Figure 1. Portion of the Inclusive Strategies Menu (Link to Full Menu)

Also, while developing the menu, the inclusive practices were sorted in a way that was unique from other inclusive classroom resources. The practices were organized by the timing of the semester and categorized utilizing the Aspire Alliance's inclusive professional framework's three core domains: identity, intercultural, and relational [12]. Listing the practices according to the best timeframe to utilize them during the semester was unique, in comparison with other strategy tools, as it helps guide faculty through the semester. The categories used for the strategies menu were Pre-Semester, Syllabus, In-classroom Engagement, and Discussion Tools. In terms of the domains, identity focuses on mitigating bias in class design, content, grading and groupwork through developing an awareness of self and others' social and cultural identities. The intercultural domain focuses on supporting students' connections to content and encouraging them to be their authentic selves through developing an understanding of cultural differences and how those impact peer-to-peer interactions. The last domain, relational, focuses on building trusting relationships among peers and instructors, encouraging student belonging, and inclusive communication which all support interpersonal interactions [12], [13]. Through the inclusive classroom practices menu, instructors were able to choose the practices they wanted to focus on and implement in their classrooms during the semester. In the first year of the study, the menu was also transformed into a website in order to engage more faculty and to provide them a landing page for the menu. The website can be found at this link.

To help support participating faculty and to provide a platform for feedback, inclusive learning communities (ILCs) were convened at each partner institution in alignment with the goals of the study. The members of the ILCs consisted of faculty, staff, and/or teaching assistants who expressed interest in creating more inclusive classrooms and were committed to engaging with the ILCS for at least one semester. The ILCs employed the core ideas of a learning community (LC) from the Center for the Integration of Research, Teaching, and Learning (CIRTL). One of the core ideas the ILCs practice is creating and fostering functional connections among learners as well as connections with other related learning and life experiences. Another strength of the ILCs is while focusing on creating inclusive learning environments in classrooms, also recognizing the importance of fostering an inclusive learning environment within the LC [14]. Though the ILCs at each partner university were developed separately through an existing or newly created LC for the project, they were created with these same shared goals.

The student and faculty assessment plans were also curated in the first year and involved both a student and faculty survey as well as the opportunity for students and faculty to engage in short-format interviews. These surveys collected feedback on strategy implementation, the ILCs, and student experiences in classrooms where strategies were implemented. The student survey was developed by combining existing survey instruments that were used to assess the classroom and university environment as well as peer and instructor interactions [15]–[17]. Instead of focusing only on classroom and university climate, the faculty survey asked instructors about what strategies they implemented, their ease and needs for implementing these strategies, and their assessment of their participation in their institution's ILC.

Second-Year Results to Date

In the second year of the study, in comparison with the first year, there was a large increase in the number of student respondents (24 to 85) and there was representation from all three partner universities, as opposed to only one from the first year of the study. This increase in respondents was largely due to concerted efforts from the research team at each partner

institution, some of which efforts are explained in the "Lessons Learned" section. The majority of the respondents identified white as their race (45.9%), were in their first undergraduate year (55.3%) and had a self-reported grade point average greater than 3.0 (90.6%). Most of the student respondents identified as male (76.5%) and a majority reported their sexual orientation as heterosexual (89.4%).

The student survey results showed that most students felt that the people who have the largest impact on their success as an **engineering student were their peers and instructors as opposed to their departments and institutions.** Most students also felt encouraged to ask questions in class, experienced a connection between classroom material and societal problems or issues, and felt they could discuss gaps in their learning with their professor and peers (Table 1). Most students also agreed that they felt a spirit of community in their courses. On average, students also indicated a high quality of interaction with their instructors and peers at 6.07 and 5.16 out of 7, respectively.

Table 1. Fall 2022 Selected Student Survey Results

	Strongly Agree	*Agree*	*Neither*	*Disagree*	*Strongly Disagree*
Questions					
Feel encouraged to ask questions	38%	34%	11%	2%	0%
Feel a spirit of community in class	24%	34%	23%	3%	1%
Feel uneasy discussing gaps in learning	7%	11%	18%	34%	14%
	Very Often	*Often*	*Sometimes*	*Never*	
Diverse perspectives included in class material	39%	26%	16%	4%	
Connected learning to societal problems or issues	50%	28%	6%	1%	
	Peers	*Professor*			
Rate quality of interaction on a scale from 1-7 (1 being low to 7 being high)	5.16 (Mean)	6.07 (Mean)			

Overall, when considering all of the student survey results collected throughout the three semesters of this study, the trends of the data have remained largely the same, indicating that the implementation of the inclusive classroom practices menu has likely made a positive impact on classroom climate, but further data analysis will confirm conclusions about the menu. Another result is that on average across all semesters, students have indicated their interactions with their instructors are higher than that with their peers. This could be an area to explore further with the practices menu to provide faculty with strategies that help students positively contribute to the classroom environment. It is important to recognize that a large proportion of the students who took the survey were white, though the Fall 2022 semester introduced more diversity to the student respondent group. As found in the literature review for this study, historically minoritized and marginalized students tend to have a different experience in the classroom as opposed to their peers, so this gives reason to explore the data further and compare across identity groups. The Fall 2022 semester data collection also incorporated short-format interviews with some students in participating classrooms and this data is currently being analyzed.

In addition to receiving feedback from the students on their experiences in classrooms, feedback from the participating faculty was also collected. The faculty-centered assessment plan was two-fold, starting with collecting data about the experiences faculty had implementing the

strategies and also collecting data on the effectiveness of the support they received from their membership in the ILC. This feedback will also inform whether the ILCs are an efficient tool for initiating and sustaining efforts in creating more inclusive classroom environments within engineering departments and schools.

The faculty survey respondents (n=6) were instructors from both the first partner institution (67%) and the second partner institution (33%). It is important to note that the results in these tables are from one semester and some of the faculty teach more than one class and engage more students which, in part, can explain the lower number of responses. However, as the data from all semesters is combined for both faculty and student assessments, the data trends and statistics should continue to strengthen and diversify with time.

Table 2. Top 3 Most Utilized Inclusive Strategies Among Faculty During Fall 2022 Semester

	Strategy	*% Used*	*Strategy*	*% Used*	*Strategy*	*% Used*
Timeframe						
Pre-Semester	Build availability for students into your schedule[4]	100%	Examine assumptions about current and former students and re-commit to increasing your awareness[1]	83%	Ensuring classroom is physically accessible and usable by all students[1]	67%
Syllabus	Explicit course goals[1]	100%	List contact information for University resources[1]	100%	Promote empathy throughout[4]	83%
In-Classroom Engagement	Make interactions in class accessible to all participants[1]	100%	Employ interactive teaching techniques[4]	100%	Do not judge responses to questions[4]	83%
Discussion Tools	Model inclusive language[4]	100%	Do not judge responses[2]	100%	Acknowledge different ways of knowing[1]	83%

Aspire Alliance Domains Legend: [1]Mostly Identity, [2]Mostly Intercultural, [3]Relational and Intercultural, [4]Mostly Relational

The results from the faculty survey showed which strategies were most utilized by the participating faculty for each of the timeframes in the menu (Table 2). Different from the first-year results, there were a few strategies used by all of the faculty across all the categories. Some of the faculty also responded with strategies that they implemented that were not included in the inclusive practices menu but were aimed at improving inclusivity in their classrooms. One of these strategies was to bring in guest speakers and faculty to talk about their expertise and experiences in engineering and other related areas which allowed students to hear from other voices within their university communities. The survey also asked faculty for their feedback on the ILCs to help make them more impactful. Some of these suggestions include providing inclusive strategies aimed at improving student interactions during group work or projects as well as considering introducing the inclusive strategies menu to students as a way for them to help design the classroom environment they would thrive in. From all of the semesters of this study, the faculty also expressed interest in receiving circular feedback from the surveys, particularly from the students. So, during the first meeting of the Fall 2022 semester, the results were shared from the first year as a prelude to forming shared goals with ILCs for the upcoming year.

Lessons Learned

Over the past two years, the research team has learned a few lessons in regard to different aspects of the study. Some of these lessons learned were specific to each partner institution while others were similar across all of them.

One of the major lessons learned across all of the institutions was the structure of the ILC meetings. The initial thought process was to have the ILC meetings as standalone meetings so that the participating faculty could focus solely on discussing and sharing experiences with the inclusive strategies menu. However, the team realized that participants would be more likely to attend the ILC meetings if they coincided with another meeting already on their schedules with the same focus of inclusion, diversity, equity, and access (IDEA).

Though each institution engaged their ILCs this way, they still differed as the meetings have different purposes and were led from different levels or parts of the institutions. The ILC at the University of Pittsburgh (Pitt) is a portion of the IDEA committee meetings. The committee engages students, staff, and faculty in efforts to improve these areas in the Civil and Environmental Engineering department. The committee takes approximately 30 minutes to discuss experiences with the menu and strategies while the remainder of the meeting focuses on the committee's goals and tasks. In the second year, the IDEA committee utilized the book *Black, Brown, Bruised* by Dr. Ebony McGee to stay abreast of literature on inclusivity, but also to guide the committee's goals [18]. Since the ILC was embedded into the IDEA committee meetings, the participating faculty also used it as a resource in addition to the menu. Arizona State University's (ASU) ILC is affiliated with the Research in Inclusive Science and Engineering Education (RISE) Center on campus and is a part of the RISE Core Faculty monthly meetings. This ILC includes faculty from engineering, physical sciences, natural sciences, and education. Content relative to the menu of practices takes approximately 15 minutes of each meeting; during this time, faculty review what their experiences have been. The balance of the meeting focuses on ongoing RISE Center efforts, including other research on inclusive teaching and learning as well as working time on an article. In the first year of the study, the ILC at the Colorado School of Mines (Mines) was more similar to the other institutions' ILC formats, however, in the second year of the study they changed the format in order to engage more participants. The ILC began over the summer when a cohort (8-10 faculty), along with the institution's STEM Equity fellows, engaged in a two-week intense curriculum focused on broader topics of equity in addition to inclusive classroom practices. Once the Fall semester began, the cohort employed both an equity lens and the menu in their classrooms and attended workshops focused on topics that further encouraged the use of strategies and provided additional resources as well. Mines's ILC and this study are being led from their Diversity, Inclusion, and Access office which is directly under the president's office so they have been able to not only engage engineering faculty, but every department in at minimum reviewing the inclusive classroom practices menu. As mentioned earlier, the second year of this study engaged more faculty and students across all institutions which in large part is due to these concerted efforts and changes at each institution.

Another lesson learned was the success of employing incentives for the faculty to join the ILCs. At two of the partner institutions, incentives were used to recruit and retain faculty participation though they were met with some opposition initially. Since ASU's ILC was a part of their RISE Center, they incentivized faculty by offering recognition on the center's website and the opportunity to collaborate on an inclusive teaching journal paper. On the other hand, Mines's incentives included a stipend from a grant that they could use for their own research or teaching initiatives. Though these incentives improved participation at both of these institutions,

the team was initially met with opposition from the administration on the basis that inclusivity and equity should already be embedded into teaching "because it's a part of their job". However, the teams at both institutions showed that participants were asked to do work outside of their teaching jobs that included coming together in community for shared learning and knowledge rather than just being provided the inclusive practices menu as a resource. They also emphasized the importance of providing "protected" time for faculty to work on these efforts instead of compounding it on top of the work they already do.

A final lesson learned over the course of this study was the saturation of IDEA work and opportunities at institutions. Depending on the institution, there is a chance of oversaturation of IDEA-focused work which would give faculty a multitude of options. Also given the amount of time that faculty spend on these initiatives, it can lead them to participate less in these efforts. However, ILCs can help to work against this because the discussions in an LC can be individualized and experience-specific which can help to guide people in the direction they hope to focus on in their teaching. The ILCs also provide an opportunity to create a community for shared learning and knowledge that can not only be discipline-specific but also transformative at different levels of an institution (department, school, etc.). These lessons learned from the first two years of the study were the most prevalent among the research team's experiences and will continue to guide the future direction of this work.

Conclusion and Future Direction

Since its inception, this study has seen the development and pilot of the inclusive engineering classrooms strategies menu, the administration of both the student and faculty surveys for assessment, as well as some short-format interviews for assessment. With three semesters of data, the impact of the implementation of these strategies will continue to be analyzed and will aid in the continued refinement of the strategies menu. The authors also hope to engage more student and faculty participants in interviews about their experiences in the classroom and the ILCs to inform the survey data with more detail as well as elucidate details of personal experiences that the surveys were not able to capture. These interviews will also allow for thematic coding and analysis of participants' experiences which will allow for a deeper understanding of which strategies have the largest impact in the classroom. The research team also is planning in-classroom observations at all three partner universities to collect data on the implementation of the inclusive strategies menu.

This analysis will both strengthen the data collected as well as help to develop the decision matrix for instructors to use when determining what areas they want to improve in and what strategies align with those goals. Feedback will also aid in the refinement of the survey instruments we utilize during the study to make the results more powerful for both the participants and the research team. In addition to interviewing faculty and students, the research team will also be interviewed about their experiences facilitating their ILCs, especially since the partner Universities are regionally distinct and the communities the ILCs were formed from differ. Following additional refinement, the menu will also be launched at other institutions as well as across diversity, equity, and inclusion networks to serve as a tool for creating more inclusive classrooms.

In addition to menu refinement, a website was developed to create a more dynamic version of the strategies menu to increase engagement from faculty and instructor participants as well as to share the resources and project outcomes more easily with the public. The website can be found at this link. Updates to the website will aid in this distribution as it will include feedback from past

participants as well as examples of the survey instruments we have used. We recognize the need to fully develop a formal toolkit in which faculty can easily review and adopt practices into their teaching and this study represents the first step to that for use across all engineering classrooms and curriculums.

Acknowledgements

This work was funded through the IUSE (Improving Undergraduate STEM Education) Division of the NSF under Grant Nos. 2021204, 2021227, and 2021335.

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