Creating Inclusive Classrooms: Work Developed during the ASEE Year of Impact on Racial Equity (YIRE)

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Background

The ASEE Commission on Diversity, Equity, and Inclusion (CDEI) specified 2021–2022 as the Year of Impact on Racial Equity (YIRE). The inspiration and objectives for this work has been previously documented in ASEE Prism [1], which is quoted below.

> "ASEE President Sheryl Sorby's speech at the 2020 Annual Conference outlined a vision for both the organization and engineering education that reflects more diversity and equity. In light of this vision, as well as the societal momentum toward dismantling White supremacy and racism, ASEE has launched a Year of Impact on Racial Equity.
>
> Many aspects of engineering culture have origins and practices that center Whiteness and exclusivity. However, we are all caretakers of this culture and can either protect exclusionary traditions or strategically design models that better meet the diverse challenges and needs of our society.
>
> In order to improve the field's diversity, adaptability, and competitiveness, the Year of Impact on Racial Equity is focused on creating organizational change to address the culture, policies, and racial and ethnic representation within engineering student organizations, colleges of engineering, and pre-college outreach efforts. These 12 months will move us beyond action to focus on the impact of the actions we take.
>
> We expect that actions in these domains will result in three concrete forms of impact: (1) empowered engineering student organizations, which will make engineering education more inclusive at the level of peer-to-peer interactions; (2) actionable organizational policies and effective practices implemented in colleges of engineering that disrupt the status quo regarding who gets to participate in engineering education as students and faculty members; and (3) increased participation and comfort among Black and Brown K–12 students in pre-college engineering activities that signal to parents and young learners that an engineering career is an option for anyone. These outcomes map to three strategic pillars of the Year of Impact on Racial Equity."

Volunteers for the Year of Impact on Racial Equity were divided into three taskforces, each focusing on a distinct pillar: (1) student organizations at Colleges of Engineering and Engineering Technology, (2) faculty and administrators in Colleges of Engineering, and (3) guardians of K-12 students [2]. The second task group – the Faculty and Administrators Pillar – began with ten subcommittees that each focused on a unique approach to "actionable organizational policies and effective practices implemented in Colleges of Engineering [3]." The work presented in this paper is the resulting effort of one of these subcommittees: Creating Inclusive Classrooms.

Creating Inclusive Classrooms

This subcommittee focused on the goal to compile and share "effective practices implemented in colleges of engineering that disrupt the status quo regarding who gets to participate in engineering education as students [1]." To meet this goal, the group focused on providing resources for instructors to help them start and continue incorporating anti-racist teaching and practices.

Before describing these resources, it is important for the subcommittee to describe our commitments to this effort.

1. We understand that racial inequality exists, is commonplace, and is perpetuated in engineering education. The goal of this antiracist pedagogy is to acknowledge the imbalance of privilege and power, and to work to redistribute these more equitably.
2. The members of this group do not position ourselves as experts on antiracism. Throughout our involvement in this endeavor, we aim to learn and grow in our knowledge and implementation of antiracist pedagogy into our courses and curricula, and in how we teach.
3. We aim to amplify the work and voices of BIPOC scholars who are leading the effort on anti-racist pedagogies.
4. Additionally, for the white members of the subgroup, we acknowledge our positions of privilege and aim to use that privilege to confront white supremacy and racism and commit to taking action, speaking up and out against racism.
5. Our group wants to work towards an inclusive and equitable learning experience for all learners and to acknowledge and dismantle educational practices that create and reinforce disparities. However, we know that DEI efforts in engineering often focus on (white) women, and that is not sufficient or acceptable. It is crucial that this work centers the implementation of specifically antiracist pedagogy. While some resources could be generally inclusive, it is important to show the anti-racist pedagogical value.
6. We also want to acknowledge the demand on educators and that each educator's approach to antiracist pedagogy will be different based on their own positionality and privilege within their institutions. We aimed to bring more inclusive practices to faculty in easily accessible and applicable chunks.

As the deliverable for the work, this subcommittee has compiled inclusive and anti-racists practices and wrote reflection paragraphs about incorporating these strategies. These reflections provide insight on effectiveness and can help other instructors, as they look to implement new pedagogies. Many of the pedagogies promote general inclusiveness, but the focus of the reflections is on the anti-racist impact. Five reflections are included in this paper as examples of the work. The pedagogies documented in these reflections include: (1) Incorporating Health Disparities Content in the Classroom, (2) Hydraulics Hero Assignment, (3) Dialogue Sessions for Engineering Project Teams, (4) Transparent Assignments, and (5) "Getting to Know You" Assignment. While the pedagogies vary in scope and implementation, they all aim to create an inclusive classroom environment for engineering students, especially BIPOC students.

Collectively, the co-authors and members of the Creating Inclusive Classrooms subcommittee of the Year of Impact on Racial Equity Faculty and Administrators Pillar are a diverse group of engineering professionals with doctorates in civil engineering, chemical engineering (2 members), environmental engineering, and biomedical engineering. One co-author has experiences as a first-generation college student. Two members of this group are teaching faculty, two members are tenured associate professors, and one member is a STEM education assistant director. We are serving at private (60% of group) or public (40% of group) higher education institutions in the Rocky Mountain, northeastern, midwestern (2 members), and southern regions of the United States. The majority of the group identifies as white (80%), and 20% identify as African-American. Eighty percent of the co-authors and Creating Inclusive Classrooms group members self-identify as cisgender, heterosexual, females, and 20% identify as transmasculine and pansexual. All of the co-authors and group members are United States citizens, with about half of the group identifying as neuroatypical. As engineering educators and researchers, the Creating Inclusive Classrooms co-authors and group members acknowledge that our identities and intersectionality shape our positionality, experiences, and approach to engineering education, and we seek to learn and share knowledge about inclusive, anti-racist pedagogy through continued application, reflection, discussion, and life-long learning as demonstrated in the following reflections.

Inclusive Pedagogy and Reflection #1: Incorporating Health Disparities Content in the Classroom

Author: Shannon Barker

Background

Racial and ethnic disparities in healthcare are differences in health outcomes between majority and minority populations and are the results of complex sociologic, cultural, political, and economic factors. These disparities are well documented and are a major public health concern [4] – [5]. The Society of General Internal Medicine Health Disparities Task Force, in a set of guidelines for medical education in disparities in health and health care, advised that the ultimate aim of a curriculum on disparities is that learners understand and accept their role in eliminating racial and ethnic health care disparities [4]. This guideline pertains to all stakeholders, including the engineers who design, build, and administer technology used in health care. Exposing engineering undergraduate students to health care disparities through courses and other learning activities will raise the awareness of this future workforce and potentially lead to more innovative technological solutions that reduce these disparities [9].

The task force recommends the following topics related to the existence and prevalence of disparities be included in any curricula: a) US racial and ethnic demographic factors that impact health care; b) the magnitude of key health disparities in common disease categories; c) the history of segregation in US health care; d) the differences in access to care for different demographic groups; e) the disparities that exist amongst demographic groups to effective treatment; f) health

and biomedical workforce disparities; g) differences in patient perspectives on health care; and h) cultural norms and their effects on health care [4].

Several academic programs have attempted to incorporate healthcare disparities content into their undergraduate coursework, particularly at minority-serving institutions. For example, at City College of New York, a Hispanic-serving institution, undergraduate biomedical engineering students engage in healthcare disparities challenges through curricular modules, research initiatives and design projects [6] – [7]. Additionally, the HBCU University of D.C. uses a seminar series to integrate the physiological determinants of health and social determinants of health. At the University of Pittsburgh, educators have implemented healthcare disparities and social determinants of health into a cross-disciplinary course on drug-delivery systems [8].

Objective

For this work, I incorporated the topic of health disparities into a required 3rd year biomedical engineering physiology course using an infographic assignment [10].

Inequities and disparities in biomedical research/design and healthcare were threaded into the teaching of organ physiologies and pathophysiologies as the semester proceeded. Additionally, students were asked to work in teams to create a health disparity infographic on a topic of their choice. The purpose of this assignment was to provide an opportunity for students to dive deeper into a particular health disparity, research ways it has been or could be addressed, and to think about how to effectively educate biomedical researchers and clinicians on this topic. The effectiveness of this approach to teaching students about health disparities was assessed using a post-semester survey. The survey included 12 questions, including 7 Likert scale questions and 5 open-ended questions. Likert scale questions were designed to measure how well the infographic assignment familiarized students with health disparities and how students feel about these disparities and a biomedical engineer's role in addressing disparities. Open-ended questions focused on how well the assignment taught students about disparities and what improvements could be made.

Personal Reflection

A total of eleven teams completed the infographic assignment. Ten different medical topics were included, including maternal mortality, infant mortality, reproductive health prosthetics, chronic renal disease, ADHD, diabetes, asthma, and healthcare for native Americans. A large majority of the infographics focused on racial and ethnic disparities (9 of the 11).

Most survey participants felt that engineers should learn how their designs and technologies impact society (91%) and that engineers have a role in informing the public about the impact of their design and technologies on individuals and society (96%). An open-ended question asked participants why challenges in health disparities are important. A major theme that arose from the responses was that equal access to healthcare is a human right (35%), as was that biomedical research has a major impact on existing and potential health disparities (20%). Other themes that

emerged included the outsized impact biomedical research has on people's lives (15%), that addressing these disparities leads to more innovative and effective treatments overall (15%), and that working to eliminate disparities builds trust in research and healthcare, making it more accepted by all demographics (10%).

A majority of respondents agreed that the infographic assignment helped them to understand the inequities in the health care system (87%) and in the biomedical research enterprise (79%). Additionally, many respondents (83%) also agreed that the infographic assignment helped them understand how to apply information on disparities into their design or research process. When participants were asked what lessons were learned from completing the infographic assignment, three major themes emerged: 1) the magnitude and prevalence of health disparities (28%), 2) the role of biomedical engineers in addressing those disparities (28%), and 3) a better understanding of how specific disparities affect different demographics (21%).

I also asked what could be improved about the assignment and three major improvements were suggested: a) have a list of specific disparities or disparity types to choose from, b) have a more specific list of questions that must be answered in the process of completing the assignment, and c) have student teams present their infographic in class so students can learn from each other. Other improvements suggested included making the infographics available around research labs and clinical settings, expanding the conversation to include other kinds of disparities (such as BMI, age, geography, etc.), and provide resources on ways individual students can address disparities in their communities.

Overall, students responded very well to the assignment and showed great interest in learning more. For the next iteration, I am thinking of having a small expo where students can present their infographics to invited researchers and clinicians.

Inclusive Pedagogy and Reflection #2: Hydraulics Hero Assignment

Author: Kenya Crosson

Background

This Hydraulics Hero Assignment is the first assignment in a 300 level, third year fluid mechanics/hydraulics course offered in a Department of Civil and Environmental Engineering and Engineering. The hydraulics/fluid mechanics course is the engineering science foundational course that precedes design courses in water resources and environmental engineering water and wastewater treatment design courses. For many students taking this course, it is the first semester they are primarily enrolled in courses within their civil engineering major, and some may have completed summer and/or fall co-op work experiences. Thus, the students may not know each other very well yet, and they are beginning to take courses focused on their engineering discipline.

Objective

The objective of this inclusive pedagogy assignment was to assess students' understanding of fluid properties; learn more about aspects of students' identity, interests, and vocation; allow students to learn more about each other, and allow students to explore the links between engineering and social justice. Additionally, this assignment provided an opportunity for students to show creativity and demonstrate learning in multiple ways (e.g. visual, written, research, etc.). The student learning outcomes for this assignment are to:

- demonstrate and apply scientific and engineering understanding of fluid properties,
- share aspects of identity, interests, and vocation,
- explore social justice, and
- demonstrate artistic, creativity and branding skills.

Students create a superhero that has superpowers based on fluid properties. This is the first assignment for a fluid mechanics (hydraulics) course. The writing assignment requires students to create their superhero's name, logo/symbol, origin story, superpowers, the villain and injustices the superhero is motivated to fight against, and physical appearance, and character/personality traits. The superpowers must be based on fluid properties and align with the specific properties of the chosen fluid(s) the superhero uses or encounters.

A worksheet is provided with questions to help students with ideation and organization of ideas, storylines, and details. A grading rubric is also provided to help students understand assignment grading and expectations. The inspiration for this project was a chemical element superhero project, which required students to create a superhero with powers based on the characteristics and properties of a chemical element [11].

Personal Reflection

This is an inclusive pedagogy assignment that allows students to share aspects of their identity, values, interests, and vocation. This assignment incorporates the inclusive pedagogy principles of transparency (rubric, clear assignment expectations), sense of belonging (learning about students as individuals, allowing for diverse perspectives, acknowledgement of world experiences and views), and recognizing difference (providing different approaches to demonstrating knowledge, art, creative writing, etc.). This is a great way for me to get to know the students, have the students get to know each other, and for this problem-based lecture course, I can leverage these interests to create problems on topics of interest to the students.

This assignment could be expanded to focus more on anti-racist pedagogy by including a think pair share activity with the students about their assignments that involves reflection and discussion about the intersections of identity and the social injustices of importance highlighted by the students in their projects. Additionally, the themes and information shared in the assignment submissions could be incorporated to prepare and incorporate diverse and inclusive examples, problem statements, and projects in the course. This will further support a sense of belonging and vocational discernment for the students.

Inclusive Pedagogy and Reflection #3: Dialogue Sessions for Engineering Project Teams

Author: Kenya Crosson

Background

Project-based learning in engineering design courses requires team formation and development. A dialogue session pedagogical practice was used in a project-based, first-year, engineering design course, to discuss the importance of dialogue and the approaches for dialogue on teams. A facilitator from the university's Dialogue Zone that is trained in dialogic techniques visits class to interactively facilitate a session on dialogue, team interactions and teambuilding [12]. This is part of the team formation process for the course.

Objective

Initially, students complete the Dominant, Influencing, Steady, Cautious (DISC) self-assessment. The dialogue session is paired with the student DISC self-assessment to help students identify and learn about their personality styles and understand the personality styles of others. This dialogue activity focuses on understanding dialogue, how to use dialogue in teams to mitigate conflict and advance team goals and it also includes self-reflection, sharing and discussion, and preparation of a team agreement, which supports the forming and norming stages of group formation. The student learning outcomes for this course activity are to:

- understand what dialogue is and is not,
- understand when and how dialogue can be used,
- discuss how seeking understanding can help mitigate and manage conflict, and
- understand and value different perspectives.

Personal Reflection

This pedagogical practice relates to three principles of inclusive teaching—structured interactions, recognition of difference and transparency. The combination of a dialogue session with the DISC self-assessment provided students with more understanding and tools for structured project team interactions. The self-work and practice of dialogic methods helped student teams to actively practice inclusion, promoted an asset-based view of individuals and peers, and created a structured peer-peer interaction that valued all students. The project teams were also better able to manage conflict, and the development of team agreements helped establish transparency on group norms and, expectations that benefited all learners. Opportunities to advance this as anti-racist pedagogy include incorporating a dialogue on anti-racism, and having the students reflect on group norms and expectations outlined in their team agreement, and whether these team agreement norms and expectations promote anti-racism, equity, and inclusion.

Inclusive Pedagogy and Reflection #4: Transparent Assignments Design
Author: Victoria Goodrich

Objective

Transparent teaching helps students understand how and why they are learning content in your classrooms. While this practice benefits all students, it has shown greater benefits for students from historically excluded communities and first-generation students [13].

The simplest change for transparent teaching is to take an assignment that you already give, and convert it into three sections [14]:

1. Purpose – Why are you assigning this problem or problem set? What important skills will the students practice or how does this meet your course learning goals? When possible, link the assignment's relevance beyond just the course it's assigned in.
2. Task – This is typically what is already in an assignment. Directions on which problems to solve, how to turn in the work, etc. These are usually action verbs with guidelines and steps.
3. Criteria – Minimally, this should describe the characteristics of a good finished product. This may be a rubric with an outline of information, but would optimally also include several examples of work that students could use to better understand expectations.

Importantly, transparent teaching does not show students exactly what to do or how to do it. However, it clarifies what may be unspoken expectations that some students would understand and others would not.

Personal Reflection

I've brought more transparent assignments into my own classroom at different levels. While I do not always structure the assignments exactly with these 3 sections, I do make sure that the purpose, task, and criteria are clear in some form during class. For instance, the purpose may not be listed on each homework problem set, but at the start of the year I take time to explain the purpose of homework in their learning. This includes letting them know that I expect them to struggle on problems and to use office hours, tutorials, group work, and other provided resources to find solutions. In addition, many Learning Management Systems (Sakai, Blackboard, Canvas, etc.) have built in grading systems that will allow you to add a rubric or criteria for students, which can easily communicate your expectations to students. For smaller stakes, and more typical assignments, these changes can be done very easily and with little to no changes to overall course design.

I've used transparent assignment design for larger scale assignments as well. In my Chemical Engineering Lab course (often called Unit Operations at other schools), students are asked to complete a 3-week experiment and then write a group report on their findings. While the students are given a large manual about the report sections and expectations, I found that many groups struggled to parse that document into my expectations. Groups that did well, often asked me many

questions before turning in their work or had friends who had previously completed the experiment and could give them pointers. Therefore, it was clear there were some unspoken expectations that I wanted students to meet that I wasn't communicating well. I updated the assignment in the following ways:

- Provided students with a formatting checklist to use before turning in their assignments. While all of this had been stated in a lecture, this was a simpler way for the students to confirm that they did all the finishing steps.
- Outlined the purpose of each written section. I do not tell the students explicitly what to include in each section as determining what information is relevant and necessary is a learning goal for the course.
- Defined expected results that must be included. I do not tell them how to explicitly show those results. For example, Using the data obtained in your lab sessions, describe how operational decisions in the plate heat exchanger effect the overall heat transfer and connect those findings to theoretical expectations. Students then have to discern how to present and describe their data, but it's clear that I will be explicitly looking for this understanding.
- Provided a similar experimental write up with my feedback. I provided students with a previous year's assignment on an experiment that they would not be completing. Therefore, they could read it and understand what a report should look like and my responses to student writing.

One of the best outcomes of making a more transparent is that I was able to focus comments at a higher level instead of spending a lot of time providing feedback on formatting or overall section needs. Instead, I focused on, for example, how an example did or did not provide the context they intended. In the results section, I was able to focus more on their understanding and connection to theory rather than just taking off points because something wasn't included. In this way, I had greater insight into my student's learning and understanding of the technical problem, and I was able to provide feedback both on the technical communication skills AND the scientific understanding. Students also reported much less frustration with the write up because they did not have to guess at what I wanted to see.

Inclusive Pedagogy and Reflection #5: "Getting to Know You" Assignment

Author: Jordan Jarrett

Background

As the first assignment of the semester, I have the students fill out a "getting to know you" homework. Many of the questions are written to allow students to share about their identities, without explicitly requiring them to share information that they are uncomfortable with. This exercise helps build instructor-student rapport [15] and provides the opportunity for the students to share valuable information about themselves.

Some of the questions that include anti-racist pedagogy are:

- What is your preferred name, preferred pronouns, and how to pronounce your name?
- What is your favorite meal?
- Share a fun fact about yourself or a general fun fact.
- Is there any additional information to share with me?

Objective

As the semester begins, this assignment allows me to learn more about my students and any concerns they have going into the semester. Each question is included to make the students feel welcome and to give them an opportunity to share important information with me.

Asking the students their preferred name and how to pronounce it ensures that they are being addressed correctly. Having this information will support an inclusive classroom environment and help me avoid accidental microaggressions. This can be particularly impactful for students of color, international students, and non-binary and transgender students who may experience incorrect pronunciation of their names frequently.

For the next two questions asked (about the favorite meal and fun facts), students will often share information about their background with me. Food is an integral part of most cultures, and students regularly share stories about their families and hometowns in this response. Similarly, the fun fact that students share will often describe their interests, passions, and communities.

For the last question, I request any additional information. In their response to this open-ended question, students can tell me about any concerns they have for the course or the semester. Many students leave this blank, which helps me identify any students that could benefit from additional resources or communication.

Personal Reflection

I teach classes that typically have 70 – 100 students enrolled, and these assignments help me learn more about all my students, even in the larger classes. The information in these assignments can often be used as an icebreaker in office hours and other one-on-one or small group interactions. I often find myself re-reading these assignments regularly throughout the semester, as I start to pair the faces and the names. My hope is that that this assignment makes the students feel welcomed and recognize that I value them as individual learners, even in a large class.

Future Work

These teaching practices presented have specifically highlighted two main practices: clearly articulating the expectations in engineering classrooms and building a sense of belonging and community in courses. Expanding the sense of engineering identity and belonging are bedrock to inviting students into a learning community where they can thrive. The authors hope that these examples are just the beginning of the anti-racist pedagogy collection. We would like to include a call to action to the educators reading this paper. We ask that you reflect on your own teaching and

identify any pedagogical practices that are focused on inclusive, anti-racist environments. Once you identify these practices, we encourage you to share them so we can expand this collection and continue our work on "creating organizational change to address the culture, policies, and racial and ethnic representation within engineering student organizations, colleges of engineering, and pre-college outreach efforts " If you are interested in sharing your own anti-racist pedagogy and reflection with the collective ASEE, please contact Jordan Jarrett at jordan.jarrett@colostate.edu. The collection of reflections will be shared through ASEE for future reference and collaboration.

Conclusions

As ASEE and many other organizations have identified, engineering educators and practitioners need to make a concerted effort to create an anti-racist environment for all engineers. While many in engineering education have focused on creating inclusive classrooms, these practices are not explicitly created for anti-racist purposes and are rarely reflected on or measured for effectiveness as anti-racist pedagogy. Therefore, as part of the Year of Racial Equity, the authors and their peers developed resources for other instructors to help them start and continue incorporating anti-racist teaching and practices.

This paper shares five of these resources, which each document an example of an anti-racist pedagogy that can be incorporated into other engineering classes. Each resource includes a personal reflection to document the process and effectiveness of the resource and to share lessons learned. In each case, these types of inclusive practices can be found in many books, campus teaching centers, and professional workshops. As stated before, inclusive teaching is generally the larger goal, where the authors hope to connect explicitly to anti-racist pedagogy. We intend that the unique addition of reflections from practicing engineering educators will encourage more engineering professors to use and adapt these practices for engineering courses while actively considering anti-racist outcomes as part of their teaching. While this early work focuses more narrowly on inviting students into engineering courses through building belonging and community, the goal is to expand this collection to provide a robust and valuable resource for the engineering education community.

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