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# Reflective Teaching Practices for Equity-Minded Engineering Instructors

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## Abstract

Reflection is often cited as a critical component of effective teaching, but the term itself and its related practices often remain ambiguous. Reflecting on one's teaching is an important exercise to better understand the approaches to and success towards creating inclusive classrooms. Therefore, engineering educators must become aware of reflective practices to be able to employ them in their work. We explored essential elements of highly effective reflection practices for equity-minded educators in a workshop where faculty participants learned about three reflective practices: (i) personal reflection, (ii) reflective engagement with colleagues, and (iii) reflection with students. Through collaboration with others, attendees evaluated various reflection techniques, discussed case studies, and considered supports and barriers to how purposeful reflection can support equity-minded engineering practitioners. From this workshop, a Community of Practice of faculty was formed to analyze individual reflective practices, identify practices applicable to their classrooms, and work together to employ reflection in seven classrooms across our college. In this practice paper, we evaluate each of the above reflective practices and their utility in contextualizing more equitable curricula in a variety of course types. Additionally, we provide an engineering education framework for using reflection to understand the classroom environment educators create and its impact on equitable student learning. This practice paper presents reflections from the workshop and outcomes from the Community of Practice activities to inform equity-minded reflective instruction in engineering.


## Introduction

*"We do not learn from experience...we learn from reflecting on experience." ~John Dewey*

Inclusive pedagogies in STEM are necessary to improve classroom climate, enhance student persistence, and promote more positive and equitable outcomes [1], [2], [3]. A National Academies consensus report emphasizes that broad-based STEM education reforms, including curricular and pedagogical innovations, are needed for systemic and lasting effects. The American Association of Universities Undergraduate STEM Initiative outlines a framework for systemic change, highlighting the necessity of scaffolding and support for both faculty and students [4]. Faculty play a critical role in shaping educational environments and conditions for student success by establishing the context of learning through their classroom practices and pedagogical approaches [5], [6]. These practices can foster relationships and welcoming environments for students that mitigate the effects of discrimination and bias that they may experience [7]. Faculty development is essential for institutional transformation and sustainable diversity in STEM disciplines. Challenges to this type of faculty development include perceived resistance from peers or administration, concerns about class size and workload, wellbeing, lack of institutional support and community [8]. To address the need to provide education, resources, support, and a network for faculty to implement equitable and inclusive teaching practices, the

Grainger College of Engineering founded the Developing Equity-Minded Engineering Practitioners (DEEP) Center with support from the National Science Foundation.

The Developing Equity-Minded Engineering Practitioners (DEEP) Center leverages the Communities of Practice (CoPs) framework to foster equity-minded practitioners and a Diversity Equity and Inclusion-centered culture in our engineering education system [9]. CoPs facilitate mutual reflective engagement, shown to support sustainable change, and create a collaborative community to explore knowledge and develop practices [10]. This framework also promotes faculty buy-in and supports sustainable situated learning [9]. This paper describes the implementation of one CoP within the DEEP Center focused on Reflective Teaching to improve equitable practice among faculty participants. Goals of the DEEP Center for CoPs include (1) an instructor-focused approach to induce cultural change in engineering educators, (2) equipping faculty as "change agents", (3) improved educational experience and success of students measured by increased retention and persistence of students from diverse backgrounds, and more positive and equitable student outcomes. Here we describe how a Reflective Teaching CoP was established to meet these goals. Figure 1 displays the timeline of the Reflective Teaching events described in this paper.

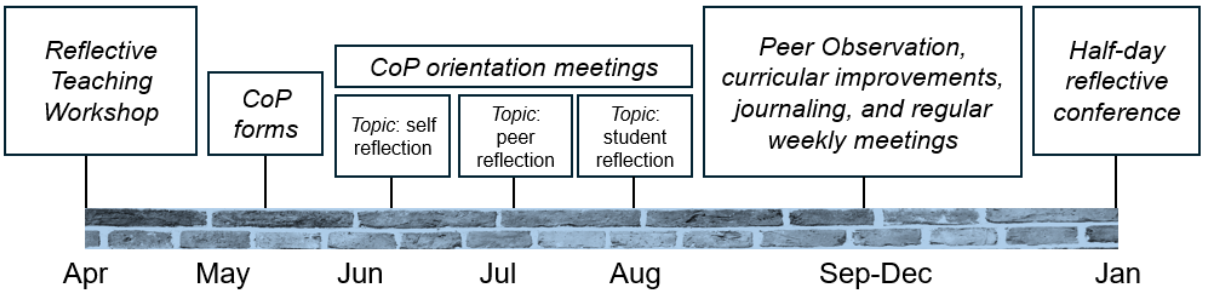


**Figure 1.** Timeline of DEEP Center Reflective Teaching workshop and community of practice (CoP).

## Equity Minded Reflective Teaching Workshop

The Reflective Teaching CoP was formed from interested faculty who attended a Reflective Teaching workshop sponsored by the DEEP Center. The initial invite to attend the workshop was sent to the whole faculty body (tenure-track and specialized faculty) by the center. A small stipend was provided to incentivize participation in the CoP. The workshop was conducted in an hour-long virtual format and presented strategies to build a reflective practice composed of three elements: (1) self-reflection, (2) reflection with colleagues, and (3) reflection with or by students (Figure 2).

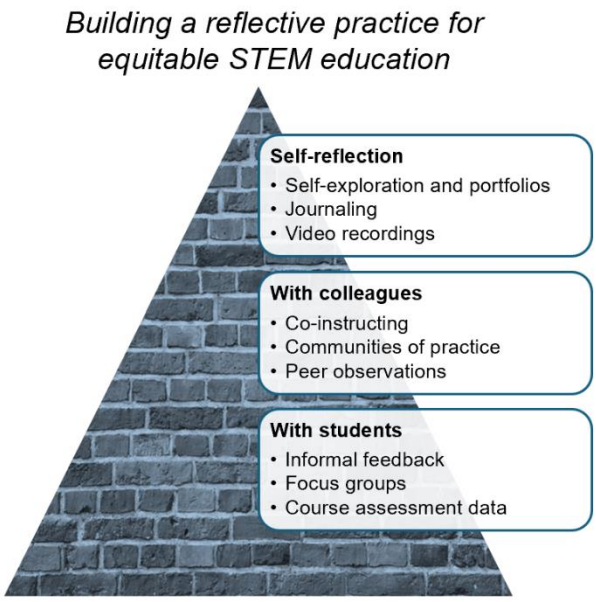


**Figure 2.** Reflective practice that benefits students builds from self-reflection and peer support of instructors.

*Equity-minded self-reflection*

The most effective educators have a sense of self and an awareness of how their identities and lived experiences inform both their interactions with students and the practices they enact in the classroom [11]. This self-awareness and resulting empathy are considered by some a prerequisite to pedagogical improvements [12]. As such, instructors who seek to foster an equitable learning environment can benefit from consistent and purposeful self-reflection. By examining oneself and one's practices, an equity-oriented educator becomes more cognizant and hopefully deliberate in facilitating educational experiences that meet the needs of all learners.

Self-reflection is an often-cited yet underutilized reflective practice. This is due, in large part, to the challenges inherent to making "reflection from within" a regular part of the teaching practice. For some, self-reflection is the first method to be abandoned when planning, instruction, and assessment tasks demand increasing time and effort to move the course forward. After all, the next lesson, activity, exam cannot be delayed while an instructor stops to think about their identity, goals, and interactions with students. But then again, can any of these experiences be fully realized as effective and impactful learning opportunities for all students in the absence self-reflection?

Another frequent concern regarding self-reflection is selecting a method or approach that can be consistently executed. For many of the same reasons as above, self-reflection practices that are too complex, too time-consuming, or less actionable in design are quick to be discarded when faculty find themselves unable to regularly complete them or to use them directly to impact their teaching.

During the one-hour reflective teaching workshop, facilitators shared self-reflection tools and practices that could deepen their sense of self to strengthen their equity-oriented teaching. First, the facilitators shared ways in which practitioners and educators could make reflection a routine element of teaching (e.g., formal journaling before and after instruction, making brief notes about what did and didn't work in class and a subsequent action plan to address elements that fell short, purposefully reading student evaluations, etc.) as well as sources of evidence (e.g., students' eyes, colleagues' perceptions, personal experience, theory and research, etc.) [13]. This was followed by a breakout activity in which participants discussed strategies for self-reflection that could be accomplished at various times (examples below), and ranked their top strategies and pros and cons to implementation.

- Before class: journaling (in anticipation of teaching), inquiry of lesson plans and materials (asking oneself, from design to implementation, what do you want to know?);
- During class: post-it notes of ideas and thoughts (that can be further organized afterwards), video recording of oneself teaching;
- After class: tracked changes and comments in lesson plans and materials, further organizing and/or journaling (in response to the ideas that arose during the teaching episode), reflection on the video recording (to reorganize order of topics or adding a new module); and
- Ongoing: compiling a teaching portfolio or opportunities for professional development.

*Equity-minded reflection with colleagues*

When does interaction with colleagues about one's teaching become reflection? Can meaningful reflection with fellow educators happen by chance informally? Are hallway celebrations or lamentations reflection? Is collaboratively discussing end-of-semester student evaluations enough? In short, the answer to each of these questions is likely no, and, for the equity-oriented instructor, meaningful reflection with colleagues benefits from much more intent, purpose, and regularity. Collaborative reflection is shown to support the previously discussed self-reflection [14]. Reflection with colleagues, or collaborative reflection, can occur informally (with conversations) or formally (for example, in a CoP). However, it is not easy, as there is a certain vulnerability that should be acknowledged, and norms of engagement should be mutually agreed upon by those who choose to reflect together. In addition, collegial reflection should allow for sustained interactions over time and opportunities to engage directly with classroom experiences (observation, artifact review, etc.). Because reflection should promote growth over time, the best reflective practices with colleagues allow for engagement throughout a course and not only at the end of a learning experience.

The facilitators of the reflective teaching workshop considered each of these factors when presenting strategies for reflection with colleagues that can support equity-oriented teaching. They began by informing on methods of reflecting with colleagues, such as co-instructing (e.g., joint lesson planning, common assessments, and interpreting student work together), CoPs (which lend themselves to dialogue, collaboration, and reflection), and peer observations (pre and post dialogue, and structured observation). Next, participants were introduced and encouraged to consider first steps in collaborative reflection:

- Starting small: sharing self-reflections and actions with a colleague in person or via email or chat;
- Leveraging ongoing efforts: joining a CoP around a topic of interest;
- Observing (of others, and by others): meeting before and after to discuss goals and observations (using qualitative or quantitative observation tools); and
- Making it sustainable: starting a CoP around a top of interest.

*Equity-minded reflection with or by students*

Perhaps the most powerful reflective practice, especially when focused on equity in the classroom, comes from direct reflection with and by students [15]. After all, any instructor's efforts to make learning accessible for all students can only truly be assessed effectively by the students who are the intended audience of these endeavors. Therefore, reflection with students can be viewed as the pinnacle of reflective practice and the final key to unlocking the power of reflection to foster a more equitable and impactful learning environment.

Reflection with students involves direct communication with students about their learning experiences and a willingness by faculty to engage students regularly in considering their academic and professional goals, instructional and personal needs, and the practices that might support their learning. For some faculty, sustained and significant reflection can be at odds with perceptions of "rigorous" engineering coursework. While formal feedback from students at a certain point in the semester is useful, it is insufficient to fully harness the potential of reflection in partnership with students. Instead, the goal of an equity-orientated instructor should be sustained interaction with students to promote timely and focused feedback loops.

Reflection by students requires less direct interaction by the instructor but considerably more time to analyze student responses. During the workshop, facilitators commented on the importance of students as sources of information during reflection. For example, data from students can help instructors to reflect on teaching practices. Bringing students into the reflection can also increase their agency in the classroom and teaching them how to reflect can be valuable during engineering training. Finally, breakout groups discussed methods to reflect with students, including:

- Informal early feedback;
- Student focus groups;
- Purposeful self-reflection by students; and
- Deep dives into test data (e.g., item analysis and coding of extended response and computational problems).

**Equity Minded Reflective Teaching Community of Practice**

After the workshop, interested faculty formed a CoP around the Reflective Teaching topic for deeper exploration, practice and support from one another. Table 1 provides demographic and teaching experience details of the CoP Participants. Furthermore, faculty motivations for joining the CoP are summarized in Table 2.

**Table 1.** Reflective Teaching CoP participant demographics.

| Individual's Pronouns | Individual's Race | Department | Position | Years taught at current instituiton (total years teaching) | Type of courses taught |
|---|---|---|---|---|---|
| She/her | White | Bioengineering | Teaching Assistant Professor | 5 (10) | Senior Design, technical elective |
| He/him | Asian | Aerospace Engineering | Teaching Assistant Professor | 7 (9) | Undergraduate core courses |
| He/him | Asian | Bioengineering | Teaching Assistant Professor | 2 (4) | Undergraduate core courses (All Levels) |
| He/him | White | Civil and Environmental Engineering | Assistant Professor | 4 (5) | Undergraduate elective and lab courses |
| He/him | White | Educational Administration / Curriculum and Instruction | Director / Lecturer | 15 (25) | Instructional methods / educational assessment |
| She/her | White | Bioengineering | Teaching Assistant Professor | 4 (4) | Undergraduate labs and core courses |

**Table 2.** Motivations for faculty to join a reflective teaching CoP.

| *Why did you agree to participate in a community of practice related to "reflection?"* | |
|---|---|
| Theme | Example quotes |
| "Reflection" aligned with personal goals or interests | • The "reflection" community of practice seemed to be a good fit because it was not just about learning specific teaching tools and learning activities but a framework to help be intentional about thinking through how what I do in the classroom fits in with my own teaching philosophy.<br>• I was looking for effective ways to improve my teaching by exploring my own teaching style.<br>• Since young adulthood, I have reflected through journaling (either on paper or in a digital document). It has been a helpful method for me to organize my thoughts, record important events, and process emotions. |
| Sought community and accountability | • .. this community of practice will provide inspiration, a sounding board for my reflection, and accountability for keeping up with these practices on a frequent basis.<br>• From my past experiences, it was hard to implement sustainable change without partnerships with others. Hence, I believe being part of a community of practice would be ideal for finding support and accountability. |

| | |
|---|---|
| | • I wanted to learn more about how other faculty reflect in a productive manner on multiple levels- from self-reflection, to peer reflection, to reflecting with your students in class. |
| Has reflected but missing one of the three types of reflection (self, peer, or student) | • I realized that although I've tried to discuss how designing a more equitable world plays a role in engineering in the courses that I teach, I had very limited opportunities within the courses that I teach for students to reflect.<br>• In my role as an instructor, I have often engaged in reflection with colleagues, but not as much with students or in self-reflection. |
| Feeling ready to add reflection into teaching practice | • I feel that my teaching career is at a place where I can begin to reflect and improve on the past few years.<br>• Reflection is very important as an educator to improve and learn from previous iterations of courses. |

The CoP met once per month for 3 months to review literature, complete self-assessments, and discuss prior experiences. Each session focused on one of the reflection modes: (1) self-reflection, (2) reflection with colleagues, and (3) reflection with or by students, but discussion crossed over. The group discussed the vulnerability of reflection and established norms for the group early on. The group committed to journaling about the experience to document change within themselves and further practice reflection. After this orientation period concluded, the group committed to continuing to meet weekly during the next semester.

*Journaling*

CoP members were encouraged to engage in journaling activities meant to capture thoughts and feelings throughout the process of learning about equity-minded reflective teaching, and how it affected them or their teaching. Journal entries were open-ended and allowed faculty to self-reflect about reflection. For some faculty members of the CoP, this was their first time journalling, and thus a new method of self-reflection. Other disciplines such as mental health use journaling extensively, as a way to commit intervention for patients, investigate implicit biases, and reflect upon their feelings [16]. Similarly, journaling is useful for self-reflection for instructors, as identifying implicit biases in teaching will help to create a more equitable teaching pedagogy as well as help to focus on the reasons behind certain pedagogical choices. Throughout the CoP, members were recommended to keep a copy and digitize these reflections such that they could be collected and then compiled for peer reflection if not publication.

*Orientation Sessions*

Session 1 – Before the first session, each CoP member individually completed several self-assessments on personal identity and teaching practices. This included identifying existing reflective practices that each CoP member has used in the past. These practices are detailed in Table 3. Despite CoP members recalling their own reflective practice, members cited "lack of sustained reflection" or "lack of accountability to stick with it," "difficulty following up on

reflections," and "lack of formal spaces for equity-oriented reflection" as barriers to seeing real change from these reflective exercises. During this session, each member of the CoP shared how their own upbringing and experiences, ranging from birth order to socioeconomic background, have influenced or shaped their teaching style and philosophy. The teaching inventories further facilitated the discussion by providing a reflection framework for teaching goal-setting and best practices. In light of personal discovery about implicit and explicit biases, the group discussed how equity-mindset can be incorporated into the individual classrooms of each member. Each member focused on practices that align with their teaching goals, and which teaching practices would be most effective in accomplishing these goals.

**Table 3.** Self-identified reflective teaching practices used by CoP members *before* joining.

| What experiences do you already have with reflection in your teaching? What challenges have limited your reflection in the past? | |
|---|---|
| *Themes* | *Examples* |
| Self-reflection | • When teaching the same material at different institutions<br>• Taking notes throughout the semester |
| Collaborative Reflection with peers | • Informally meeting with colleagues<br>• Infrequently with colleagues<br>• Inclusive instructors book club with peers |
| Student Reflection | • Informal Early Feedback surveys<br>• End-of-semester surveys<br>• Pre- and post-semester surveys for students to reflect on educational goals<br>• Post-semester focus groups to collect student feedback on lectures, assessments, active learning activities, and course policies. |

Session 2 – The second session focused on reflecting with colleagues. Before meeting, the CoP read an article about a reflective CoP formed at Cal Poly, San Luis Obispo [14] and reflected on the experience of the instructors in that group. The group also discussed the instructors' personal goals in terms of reflecting with colleagues, including the future of the CoP in the following semester and how each member had been reflecting with colleagues so far.

Session 3 – Prior to the third session, each instructor filled out the goal matrix shown in the "goal setting" section below. This session focused on reflecting with students, so the discussion centered around how to bring reflection with students into engineering courses taught by the CoP member for the upcoming semester. Ideas such as including surveys of students and examining data from scores as related to different self-identified identity groups within classrooms arose in the meeting. Finally, some instructors planned to utilize reflection-based questions into assessment instruments already being used in the classroom.

*Goal setting*

At the end of the summer orientation, each CoP member created a goals matrix for each type of reflection to guide new initiatives in the classroom (Figure 3). The emphasis was on goals that are measurable ensuring that success could be assessed by individuals at the end of the semester.

Equity Minded Reflective Teaching Goals for Fall 2024 NAME, Dept

| Reflection Type | Reflective Practice | How will this reflection support equity minded teaching practice? | Additional Details |
|---|---|---|---|
| Self Reflection | | | • Links<br>• Course, Semester |
| With Colleagues | | | |
| With Students | | | |

**Figure 3.** Goals matrix completed by CoP members for each type of reflection.

**Table 4.** Cited challenges to equity-minded reflective practice.

| Theme | Example |
|---|---|
| Perceived lack of expertise | • lack of expertise in equity-related issues<br>• desire to follow evidence-based best practices without being an expert in this field,<br>• often overwhelming to begin |
| Lack of examples | • Not sure what it should look like<br>• Hard to define |
| Difficulty collecting evidence from a diverse group | • Students who volunteer feedback may be from a narrow sample of the student population |
| A desire for more practice | • Has engaged, but there is always room for improvement<br>• Hadn't realized how impactful self-reflection may be |

*Reflecting with colleagues throughout the semester*

As a group, CoP members created a plan for collaborative observations and reflection during the upcoming semester. Each member identified an equity-minded update to be implemented in their respective courses. CoP members planned to observe classes taught by other members and specified by the instructor within that course, and to later discuss the successes and challenges of the implementation, the outcomes, and plans moving forward. Table 4 outlines perceived challenges to reflection of CoP members prior to joining the CoP. Sharing these challenges helped the group to identify specific ways they would support one another. This activity created an opportunity for each faculty member to learn from each other's new initiatives and provide feedback. This structured observation of reflecting with colleagues models the observation structure used by the Academy for Excellence in Engineering Education (AE3) within the Grainger College of Engineering at the University of Illinois Urbana Champaign. AE3 conducts peer evaluations with all new faculty in the Grainger College of Engineering. Each faculty member is familiar with the observation structure in a different context. Faculty observers used their journals to record activities, interactions, and notes during the observation. Each instructor

then led a reflection session during the next weekly planned meeting to share their experiences and seek feedback.

## Future Work and Conclusions

The work of an equity-oriented engineering faculty member is and should be ongoing. The efforts described above represent an earnest commitment to be routinely engaged practitioners who are dedicated to sustained reflective practices both independently and in collaboration with colleagues and with students. We fully recognize that the practices outlined are neither unique nor exhaustive of high-quality reflection for equity-oriented engineering educators; however, we hope that the framework by which we approached deepening our commitment to reflective practices and the vehicles described to promote and to sustain these approaches will encourage others to engage in these important processes.

Given the timing of the reflective teaching workshop and community of practice formation, much of the work we shared has been proactive and in preparation for engaging with students during the fall semester of 2024. While this has given the participants ample time to explore strategies and practices to promote reflection at all three (3) practices (self, colleagues, and students), the work of implementation and evaluation of these is still to come. As such, the community of practice will use our weekly meetings in the semester ahead to support one another in the execution of our Reflective Teaching Goals and to assess the effectiveness of the practices we are now able to apply in our teaching. It is our sincere hope that the community of practice, as an example of reflection with colleagues, will amply our efforts advance our reflective practices and strengthen our equity-oriented teaching.

## Author Contributions

During the project, Mann and Golecki conceived of, developed and delivered the workshop and co-facilitated the CoP. Hajj, Cvetkovic, Chang, and Ansari were CoP members and contributed to all CoP activities. Wright and Althaus are project co-PIs and conceived of and organized the overarching DEEP Center workshop and CoP structure. All authors contributed equally to the writing.

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