Snyder, K. (2019). *Inclusive Teaching in STEM at U-M: Survey of Best Practices and Challenges to Implementation.* (Inclusive Teaching @ UM White Paper). Ann Arbor, Michigan: University of Michigan.

Abstract
This paper provides an overview of inclusive teaching practices used by STEM faculty at the University of Michigan. Information is drawn from interviews with a dozen faculty and staff members who regularly engage in inclusive teaching and/or are involved in promoting an inclusive campus culture. Interviewees identified a variety of practices; however, inquiry-based learning, growth mindset-inspired approaches, and value affirmation activities were mentioned most frequently. Interviewees also reiterated the importance of well-known practices like learning and using students' names, encouraging students to attend office hours, and integrating supportive digital technologies into the course curriculum. Still, challenges to implementing these practices remain, including lack of time and knowledge of how to cultivate inclusivity. Some interviewees noted that these challenges might be overcome by implementing faculty mentorship opportunities, encouraging more participation in CRLT training, and offering incentives to reflect on one's teaching practices, goals, and outcomes.

Introduction
The University of Michigan (U-M) is moving into year four of an expansive Diversity, Equity, and Inclusion (DEI) five-year strategic plan. Many programs and projects are currently underway, including an inclusive teaching website aimed at helping faculty develop practices to make their classrooms welcoming and supportive to all students. The website was created by the Inclusive Pedagogies Subcommittee, which grew out of the LSA Campus Climate Collaborative (formerly the Undergraduate Education Climate Committee). The website provides classroom activities to promote inclusivity and resource pages that describe relevant teaching practices and concepts. Sample syllabi materials are also available to review and adapt, including suggestions for using inclusive language, providing trigger warnings, and addressing concerns about sexual assault. A collection of annotated research articles about inclusive teaching methods and other DEI topics is also included.

While content on the website is useful for all academic disciplines, the subcommittee recognized a need to develop more resources specific to STEM classes. During the summer of 2018, two research assistants collected materials and began to develop content for STEM faculty. As part of this project, they interviewed a dozen U-M STEM instructors who practice inclusive teaching to begin compiling a catalog of activities and strategies that have worked well. Interviews were conducted from June through August 2018 and included faculty from North and Central campus. All interviewees were provided anonymity. They responded to 8-11 prepared questions (depending on the nature of their teaching obligation and experience), and interview times ranged from 40 – 70 minutes. Example questions include the following:

- What does "inclusive teaching" mean to you?

- Describe inclusive teaching practices or strategies you use in the classroom.
- Discuss whether some strategies are more or less effective in small vs. large lecture courses.
- Describe any resources or technologies you use outside the classroom to support inclusive teaching.
- Have you drawn on specific research articles or trainings to develop inclusive teaching practices?

Faculty members were also asked about their background in teaching, their participation in current DEI initiatives at U-M, and their recommendations for other faculty members who might be interested in being interviewed. Notably, the research assistants received many more recommendations for faculty members to interview than they had time to complete. This may suggest that more faculty are using inclusive teaching practices in STEM fields than is currently recognized. Also, the range of responses indicates that faculty are sharing their teaching practices within and across disciplines.

Interviewees provided a variety of answers when asked to describe or discuss inclusive teaching. For example, one said that inclusive teaching was about promoting social justice. Another said it is about helping students feel comfortable and respected. Additional responses include the following:

- Using examples and open-ended questions.
- Using active listening in the classroom.
- Building trust by checking in with each student.
- Avoiding putting students “on the spot.”
- Including visuals of diverse social identities and experiences in lecture slide decks.
- Addressing microaggressions in class and on teams.
- Trying to engage or connect with every student in the class.
- Having an awareness of different learning styles and social identities.
- Having an attitude or a mentality oriented toward inclusivity.

- Honestly believing that every student in the class can succeed.

Taken in sum, two primary themes emerge: the first has to do with faculty mindset—believing that every student can be included, respected, and successful in the classroom. The second theme has to do with faculty behavior—faculty can use many teaching practices to create inclusivity. Notably, one faculty member explained that using inclusive teaching practices does not guarantee that the classroom "feels" inclusive to students. If the practice seems inauthentic or if the instructor does not seem invested in the practice, it may backfire. For this reason, a combination of inclusive mindset and practice is desirable. Also notable is that some faculty discussed inclusive teaching as part of a broader objective (social justice, for example, as noted above), while for others it was more local or immediate, aimed at meeting individual student needs. Again, a combination of both perspectives may be useful.

The next section includes a discussion of best practices and strategies most commonly mentioned during the interviews.

Best practices

A growing body of literature shows that inclusive teaching practices can be beneficial for STEM students, and the results are measurable. Some examples include Inquiry-based learning (IBL), growth mindset (Fink, Cahill, McDaniel, Hoffman, & Frey, 2018), and values affirmation. These practices have been widely identified as inclusive because they encourage learning and engagement from students who have historically been excluded or felt unwelcome in traditional college classes. STEM faculty at U-M have employed these practices to good effect.

Inquiry-based learning

IBL can be used to create student-centered math courses and has shown positive outcomes, especially for female students (Laursen, Hassi, Kogan, & Weston, 2014). With this approach, students are given "imperfect" problems to work through, often in groups. One interviewee explained it as a process that teaches students to "find the math," to see and read the "math story" instead of relying on textbook or instructor-generated approaches. The U-M Math Department hosts the Center for Inquiry-Based Learning, which offers workshops and provides training for postdocs and graduate students on how to use this method in their teaching. The interviewee noted that this approach to teaching improves classroom climate by making it easier to reach students who need additional support and that students seem less stressed or frustrated when working through difficult problems. In an IBL classroom, students work on problems in groups and the instructor(s) circulate around the room to check in with each team and answer questions. While working in groups can present challenges, it also provides opportunities for students to support, teach, and collaborate with one another.

Growth mindset

Growth mindset became widely known more than ten years ago when Harvard psychologist Carol Dweck (2007) published a book showcasing her research on this topic. Dweck shows that the way one thinks about learning has a meaningful impact on one's willingness to try and ability

to complete difficult tasks and to learn from mistakes instead of being defeated by them. Several faculty members mentioned the importance of teaching a growth mindset in their classes, and/or approaching their teaching with this framework.

Notably, growth mindset is one of the four pillars of success in the U-M Comprehensive Studies Program (CSP) and is integrated into CSP courses. One interviewee explained that this mindset is particularly beneficial in STEM classes because students are often caught off guard by content difficulty. Initial assignment grades may be quite low, and without a growth mindset, students may drop the course or leave the sciences altogether. Underrepresented minority and first-generation students are particularly at risk (Jordt, Eddy, Brazil, Lau, Mann, Brownell, King, & Freeman, 2017). Faculty who employ growth mindset in their teaching may also offer students opportunities to revise papers or projects or retake quizzes after meeting with the instructor to work through and learn from challenges they encountered the first time around.

Values affirmation and utility value writing

Values affirmation is a practice that some faculty members in the sciences have used successfully at U-M. This approach asks students to reflect on their core values, often in short writing assignments, one or more times during the semester. A prompt might provide students a list of concepts to reflect on like “independence,” (Jordt et al., 2017) or “relationships with friends,” (Miyake, Kost-Smith, Finkelstein, Pollock, Cohen, & Ito, 2010), and then ask them to choose two or three to write about and explain why these concepts are meaningful to them. Studies show that this reflection can help reduce students’ stress (Purdie-Vaughns, Cohen, Garcia, Sumner, Cook, & Apfel, 2009) and mitigate problems like stereotype threat and imposter syndrome. Consequently, it may also improve student motivation and engagement (Jordt et al., 2017).

Utility value writing is similar in scope and benefits. In this case, however, students are prompted to reflect on how the course content or current lesson applies to their personal experiences and goals (Harackiewicz, Canning, Tibbetts, Priniski, & Hyde, 2016). One interviewee said they have seen this approach give students incentive to push through challenging science courses because they start to see the relationship between course content and their own goals of becoming a doctor or researcher or simply completing their undergraduate degree.

Adding “appreciation” to peer evaluations

For instructors who teach team-based projects, peer evaluation forms are a useful way to check in with teams, identify problems, and offer targeted support. Several faculty members also said this practice helps them connect with individual students, especially in larger classes. Typically, peer evaluation forms include questions about balance of workload, team conflict, or ways that students can improve. One faculty member found good results by including an “appreciation” section on peer evaluation forms. By incorporating a question that asks students to show appreciation to and for their teammates, the team’s focus can shift from what might not be going

well to what has been successful. This shift can improve group dynamics by helping individual team members build confidence, stress less, and cultivate a sense of belonging.

Taking an integrated approach

Another interviewee recommendation was to integrate inclusive teaching and DEI topics into one's course rather than making these separate or add-on components. In some STEM fields, it can be challenging to include additional content or apply different teaching methods because classes are often already over-full of material. However, several faculty members found success by integrating inclusive practices or content in every class session – strategies could include those methods already mentioned above. In addition, an instructor might consider sharing a personal story relevant to course content, using "think-pair-share" to explore essential concepts, or small group problem-solving. These methods can make the classroom seem more welcoming to students who might feel overlooked in traditional lecture-style classes, and they create opportunities for students to build interpersonal relationships with each other and the instructor. These relationships may help students experience a sense of belonging in class and at the university more broadly.

Challenges

While inclusive teaching practices have proven effective in U-M STEM courses, some challenges remain. For example, one faculty member noted that a "heavy-handed" or inauthentic approach to creating an inclusive classroom can be problematic. In other words, faculty are advised to use teaching practices and topics they are comfortable with and they believe in so the approach seems genuine and not like they are trying to check off a box on an inclusive teaching checklist. The difficulty, of course, is that faculty typically need to learn about new practices and test them before becoming committed and adept. Several interviewees mentioned that trainings provided by the Center for Research on Teaching and Learning (CRLT) and the Program on Intergroup Relations (IGR) offer excellent introductions to inclusive teaching practices and other DEI topics. They expressed interest in attending more of these trainings and shared that they would encourage their colleagues to do the same.

Also, several interviewees mentioned that it was challenging to apply inclusive teaching practices in large courses. Depending on the size of the course, it can be very difficult to reach out to everyone, and many students voices can go unheard. An instructor's recommendation to attend office hours or meet with a study group can be ignored by students or not taken seriously. Moreover, even when faculty can reach out, some students may not engage because there is no time to establish a relationship.

Notably, the U-M's CRLT has resources available online to support instructors wanting to apply inclusive teaching practices in their classes. The CRLT website provides supporting research and strategies for teaching large classes effectively and for applying inclusive teaching practices across all disciplines. While they do not appear to have a resource page devoted to *inclusive teaching in large classes*, materials from each section can be applied to achieve that goal.

In addition, Graduate Student Instructors (GSIs) can be a valuable bridge for large course instructors. GSIs meet more regularly with students and often “have the pulse” on student issues. Intentional communication with GSIs about what they are hearing from students and how the course is going can lead to near immediate course corrections for more responsive teaching.

Many interviewees also found that digital teaching tools were useful in helping them connect with students in large classes. M-Write was mentioned by several instructors, along with ECoach and the newer Tandem e-coaching program meant for project teams. M-Write provides writing instruction in large courses where this kind of instruction may not be typical. This tool takes students through a writing, peer-review, and revision process that helps them improve their writing skills and learn key concepts from the course. Along with the digital components, M-Write Fellows (undergraduate students trained at the Sweetland Center for Writing) assist students through their writing tasks. Also developed at U-M, ECoach provides personalized feedback and data to support students as they proceed through a course. It is particularly useful in large courses that may offer less direct contact with an instructor. Tandem, a project supported by the U-M Center for Academic Innovation, is similar to ECoach except that it provides encouraging messages, data, and suggested readings for students working in teams. This can be valuable in engineering classes where students often work collaboratively but, just as often, run into trouble with team dynamics.

Another challenge that one interviewee noted is that inclusive teaching practices can sometimes put instructors in vulnerable positions. As noted above, instructors may be taking on new teaching methods or sharing personal stories related to course content. They may be inviting students to write or share similar stories but are uncertain of how to respond to what students have shared. These challenges can be addressed in several ways. One suggestion was that inclusive teaching could be considered in all tenure and lecturer review processes on student evaluations. Encouraging faculty to learn new pedagogical strategies and reflect on them in review processes signals the university’s commitment to inclusive teaching despite the perceived risk. Another suggestion was to establish mentorship programs where interested faculty can learn from peers who have been successful in using inclusive practices. Curiously, however, most of the interviewees were not comfortable with claiming expertise about inclusive teaching practices, even if they had been using them for many years. The interviewers did not pose the question of whether faculty would participate in a mentorship program to support inclusive teaching, but this may be a useful idea to pursue.

Finally, a couple of interviewees mentioned that, from their view, much of the work in creating inclusivity on campus is falling to administrators who are not working with students in classrooms. Administrators may create programs for faculty and students, but several interviewees felt that the programs were not widely used and/or the benefits of this work were not yet filtering down to the students. This was particularly noted by faculty who work with engineering students, several of whom felt that women and minority students would benefit from more support and continued efforts to improve inclusivity on campus. Following up on this

question, one suggestion to mitigate this problem was to do more to support student activism. The University of Michigan's DEI plan was motivated in part by student activism that has emerged over the past six years. Students can bring meaningful change to campus culture, given appropriate room and support.

Strategies to increase faculty engagement

While interviewees confirmed that many instructors are using inclusive teaching practices, they also noted that they still encounter disinterest or pushback from some of their colleagues. One way to increase faculty engagement in learning new inclusive teaching practices might be to provide an incentive for reflection. One faculty member, at the end of the interview, noted that it was useful for them to discuss and reflect on their teaching practices. They had made some choices to make the class feel more open and welcoming but had not reflected on how those practices were working or if they could be improved. Given this comment, one suggestion was that interested faculty members could keep inclusive teaching journals for a given period, then meet in small groups or teaching circles to discuss what they learned and apply new ideas to their courses. The mentorship component mentioned above could also be applied in this context.

Conclusion

Inclusive teaching is being used successfully in some U-M STEM classes, and students are benefitting from these practices. Many faculty members are interested in doing more to support their students and finding ways to help them accomplish their academic goals. As noted above, more work needs to be done to increase faculty participation. The Inclusive Teaching website is a useful resource for those who want to learn more and try out new practices. Practices mentioned in this article are described on the website. Faculty and staff are also welcome to share their inclusive teaching practices, activities, and assignments on the website via an interactive form. These shared ideas build our knowledge base and create a strong community devoted to making education accessible to everyone.

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