

Article

# Supporting Mathematics Instructors' Transition to Equity-Minded Active Instruction Using a Community of Practice Framework

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**Abstract:** With evidence mounting on the benefits of equity-minded and active mathematics instruction, increasing numbers of mathematics faculty members are seeking to transform their instruction. Yet, many lack the skills and/or confidence to make the transition. To support faculty in meaningful instructional improvement, the authors of this paper facilitate frequent and innovative professional development (PD) guided by a community of practice framework. PD is intentionally designed to be incremental and supportive. Using one-on-one interview data from ten faculty participants who participated in PD on equity-minded and active mathematics instruction, we report on three crucial characteristics of a community of practice: the domain, the community, and the practice. Findings have implications for mathematics departments that aspire to support instructors to transform their teaching. Incremental PD guided by a community of practice framework could support faculty through the challenges of instructional transformation.

**Keywords:** community of practice; professional development; undergraduate mathematics education; active learning; equity-minded instruction; departmental change



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## 1. Introduction

With increased publications pointing to the benefits of active learning over lecturing in mathematics and other science, technology, engineering, and mathematics (STEM) disciplines [1–7], as well as the importance of implementing equity-minded teaching practices [2,8–11], many mathematics faculty are motivated to improve their instruction [12–14]. An NSF-funded report on the state of instructional reforms across STEM disciplines stated:

It appears there is a growing consensus . . . that educational reform is needed in undergraduate mathematics. There is a call for more active classroom engagement that attends to the education research literature and acknowledges equity issues [15]. (p. 117)

The report found an increase in faculty requests for professional development (PD) [15]. However, being convinced it is time to change is not the same as being equipped with the skills to change [16]. The field has a pressing need for innovative PD to improve instruction [12].

The aforementioned NSF report indicated that faculty awareness and use of evidence-based instructional strategies has increased but there is not yet widespread implementation of the strategies [15]. STEM faculty receive varying degrees of teacher preparation [17] and many default to the lecture-based mode of instruction that they experienced as learners [2,9]. Pedagogical innovation is further stifled by institutions that value research productivity over effective teaching [9]. As a result, instructional transformation has been slow [5,18] and lecture remains the predominant mode of mathematics teaching [19].

Further, recent publications increasingly point to the importance of attending to diversity, equity, inclusion, and belonging in mathematics teaching [2,8–11,20]. Equity-minded instruction could be new territory for faculty who were educated under outdated and problematic notions of colorblindness in mathematics and lack the knowledge to be critically race-conscious instructors. Thus, faculty who desire to transform their instruction need support to make the transition [21]. As stated by Rasmussen et al. [14], “as the use of active-learning approaches increases, so does the need for professional development” (p. 107). When designing this PD, we must consider that decades of PD for instructors have not led to widespread change. We must innovate.

### 1.1. A Need to Focus on Equity-Minded Instruction

Initially, research pointed to active learning as a means to address longstanding opportunity gaps in mathematics and other STEM disciplines [1–7]. However, as researchers continued to investigate the impact of active learning on course outcomes across student demographic categories, it soon became clear that active learning alone is not sufficient [2,8–11].

Reinholz et al. [20], who compared performance outcomes and participation of different genders in inquiry-oriented and non-inquiry-oriented college mathematics classes, noted that gender inequities could actually be exacerbated if inquiry-oriented instruction is not implemented “with explicit attention to gender equity in student participation” (p. 1). These researchers did not advocate against inquiry-oriented instruction but instead cautioned against overstating the benefits of active learning in closing opportunity gaps. They noted that a way to address this is by offering instructors PD “with an *explicit* focus on equity” (p. 36, emphasis in original).

Research in science classrooms has yielded similar results. Dewsbury et al. [2] compared lecture-based introductory biology courses to those taught with inclusive and active pedagogies. Although their research revealed positive outcomes in the promise of active learning to close opportunity gaps, they cautioned that implementing learning-centered pedagogy “without appropriate consideration of context” may lead to harmful outcomes (p. 2). Harmful outcomes could include maintaining or widening opportunity gaps.

Schmid et al. [17] pushed us to think outside the walls of our classroom and to consider systemic barriers that contribute to opportunity gaps. Institutional barriers could include the overall campus climate around student diversity, faculty diversity, course size and access to the major, instructional approaches, and the types of academic support in place for students. From these past studies, we note that faculty must be supported to make positive changes for student success.

### 1.2. Equity-Focused Professional Development to Support Instructional Transformation

Researchers have found value in PD for supporting faculty to transform their instruction [12,14,18]. A paramount challenge faced by institutions today is addressing opportunity gaps that recognize that systemic injustices provide some students with greater opportunities than others. Ching and Roberts [8] argued that opportunity gaps will only close once we embrace race-conscious teaching. However, many faculty may not yet be aware of the need to explicitly address issues of inequity in mathematics [8].

Perhaps more concerning, opportunity gaps can still emerge even in classrooms where faculty are using research-based teaching approaches and express a commitment to equity; thus, it is important that faculty be taught to recognize and address biases, to reflect on issues of privilege, and to increase their multicultural knowledge [17,22]. Increasingly, institutions are implementing PD programs, particularly those that focus on equity-minded and inclusive teaching practices [8,17].

### 1.3. Faculty Experience in Equity-Focused Professional Development

Research on the experience of faculty members who aspire to change is sparse [16,18], making our site ripe for this investigation. Noted exceptions include Reinholz et al. [22]

and Schmid et al. [17]. Reinholz et al. [22] presented results from a learning community of three university mathematics instructors who used a classroom analytic tool to track participation patterns among their students and found that the supportive community was a crucial aspect of the faculty learning experience. Schmid et al. [17], who described Madison Teaching and Learning Excellence that supports early career tenure-track faculty to teach more effectively, found that PD on inclusive teaching raised instructor awareness and increased their use of inclusive teaching practices.

Since 2018, authors Marzocchi and Soto have facilitated a PD program focused on instructional improvement within our mathematics department at California State University, Fullerton (CSUF), a large, comprehensive public university with designations as a Hispanic-Serving Institution and an Asian American and Native American Pacific Islander-Serving Institution. Faculty members have been invited to participate in a variety of PD activities ranging from low stakes to high stakes [23,24].

Our model of PD is intentionally designed to be incremental and supportive. The original focus of our activities was on supporting faculty to transition to active learning. In 2021, we began to explicitly emphasize equity-minded instruction rather than assuming equity was an implicit consequence of active learning. Throughout the tenure of our project, we have engaged dozens of faculty members in PD offerings while offering small stipends as tokens of appreciation for their time. The overall goal of this work is to support faculty as they incorporate more equity-minded active learning into their pedagogical practices. With this in mind, we use the community of practice framework to answer the following research question: how do mathematics faculty describe the domain, the community, and the practice after participating in an incremental professional development on equity-minded active learning pedagogy guided by a community of practice framework?

## 2. Materials and Methods

### *Context*

The authors, who are faculty at CSUF, are the principal investigators of National Science Foundation-Funded META: Mathematics Equity through Teaching Actively Grant (Grant number 2142122), which strives to support faculty in the transition to equity-minded active mathematics instruction. The primary mechanism we use to support instructional transformation is faculty PD. Our PD offerings use innovative approaches to support incremental change. We strive to offer a variety of lower-stakes and higher-stakes PD options. Lower-stakes options generally involve less of a time commitment and/or less accountability. Higher-stakes options generally involve a greater time commitment and more accountability. The following PD options were offered to participants during the time of this research:

- Learning management system: Faculty joined a learning management system (Canvas) course to access resources, ask questions, and contribute to discussions related to the PD.
- Strategy of the month: Each month, a teaching practice was selected and shared with faculty through a department-wide email. The teaching practices included an explicit way to support equity-minded active instruction along with several strategies to enact the teaching practice in the classroom. As the year progressed, voluntary participants were elevated to leadership roles and tasked with selecting the subsequent strategy of the month.
- Brown bag lunches: Faculty attended monthly brown bag lunches to discuss targeted topics related to equity-minded active instruction. During a brown bag lunch, participants brought their own lunch and had informal but semistructured conversations around successes and challenges. Ideas were shared as participants learned in a supportive community environment. As the year progressed, voluntary participants were elevated to leadership roles and tasked with leading the brown bag lunches.
- Workshops: Participants were invited to attend a workshop each semester. The workshops were run actively so that the participants were themselves experiencing

the equity-minded active teaching practices that we encouraged them to implement in their classrooms. One workshop was led by our student researchers, allowing participants to learn from students about how to better support student learning.

The PD offerings are described in detail elsewhere [25].

To date, fifty mathematics faculty from our department have attended at least one of our PD offerings. Faculty participants represented every rank (teaching assistants, part-time lecturers, full-time lecturers, pretenure tenure-track faculty, and tenured faculty) and four mathematics subdisciplines (applied, pure, statistics, and teaching) in our department.

### 3. Participants and Data Collection

Ten faculty participants volunteered to participate in an end-of-semester interview, nine in spring 2022 and one in fall 2022. Among the ten interview participants, ranks included part-time lecturer, full-time lecturer, pretenure tenure-track faculty, and tenured faculty. Participants' mathematics subdisciplines included pure, statistics, and teaching. Participants' aggregated self-identified demographic characteristics included:

- Gender: women and men
- Race/ethnicity: Asian and white
- Nation of origin: foreign born and United States born
- Linguistic repertoire: multilingual and monolingual English speakers
- College lineage: first-generation college as well as those whose parents attended college.

Interviews were led by a principal investigator, lasted approximately an hour, and were audio recorded and transcribed. Interview questions included questions about the participant's background experience in mathematics, identity components, conceptualization of and experience with equity-minded instruction, conceptualization of and experience with active instruction, and experiences with PD within and outside of META.

#### *Community of Practice Framework and Data Analysis*

We apply a community of practice [26,27] framework to our PD design and qualitative research methods. Wenger-Trayner and Wenger-Trayner [27] describe communities of practice as "groups of people who share a concern or a passion for something they do and learn how to do it better as they interact regularly" (p. 2). The learning that occurs in a community of practice is authentic and informal. We employ qualitative research methodologies using interview transcripts as the primary data sources and a community of practice framework for data analysis.

Communities of practice have three crucial characteristics: (1) the domain, (2) the community, and (3) the practice [27]. The three crucial characteristics served as the primary sorting categories in our data analysis, as described below. The *domain* is the shared interest of the community members. Members have a shared competence and shared commitment to the domain. The *community* includes the members, their relationships with each other, and their engagement in joint activities and discussions. Members learn from each other and care about each other's learning. The *practice* refers to the learning products that emerge within the community such as the "experiences, stories, tools, [and] ways of addressing recurring problems" (p. 2). The repertoire of resources emerges from the experiences and expertise within the community. Members can have diverse experience levels and knowledge; this diversity can enhance the group dynamic and provide learning opportunities. Overall, a community of practice gives members the collective responsibility for "managing the knowledge they need, [and] recognizing that, given the proper structure, they are in the best position to do this" (p. 5).

Oliver and Olkin [28] reported success using a community of practice model to shift department instruction toward active learning. In fact, after just one semester of launching their PD work, they saw opportunity gaps close in targeted courses. The community of practice model also helped to shift department culture from individual preparation to one that involved regular sharing of ideas about pedagogy, content, and active learning. Schmid et al. [17] also used a community of practice model to ground their work in the

Madison Teaching and Learning Excellence Program, which supports early career tenure-track faculty to teach more effectively. Under their model, participants are encouraged to use the experiences of others in their cohort, as well as peer feedback, to inform their own teaching practice.

In our qualitative analysis, we used the three characteristics of a community of practice (the domain, the community, and the practice) to parse interview transcript data. Relevant excerpts were sorted into one or more of these primary characteristics. A fourth sorting category was included for nonexamples. Nonexamples captured interview excerpts that did not align with the crucial characteristics of communities of practice. After the primary sort, sorted excerpts were analyzed within crucial characteristics for themes and exemplars. We present our findings in the following section.

#### 4. Results

As described above, Wenger-Trayner and Wenger-Trayner [27] indicate three crucial characteristics of a community of practice: the domain, the community, and the practice. We use interview data to exemplify the three characteristics in the context of mathematics faculty members working together, during incremental and supportive PD, to learn and support each other as they transform their instruction to be more equity minded and active. For each characteristic, we describe the characteristic in our setting, then report examples and nonexamples (when applicable) of how participants did or did not experience the characteristic.

##### 4.1. The Domain

According to Wenger-Trayner and Wenger-Trayner [27], the domain is the shared interest of the community members. In the case of our META PD, faculty participants were interested in shifting their instruction to become more equity minded and active. Participants expressed motivation to join the community because they believed that equity-minded instruction was important and thought META would provide time, space, and support for them to explore this interest. Participants said things like, “I know [equity is] the big hot topic right now, which it should be”, “[equity-minded instruction] was definitely something I wanted to have conversations about and felt like I was not at a level that I wanted to be”, or “[equity] is something that the entire university is figuring out right now”.

However, some participants felt that university-level initiatives “don’t feel like something I can use in the classroom”. Instead, several commented that META is “the only space where I feel like [equity] has been a focus” or that META “is specific, and it’s colleagues, and I can do this in calculus, I can do this in a statistics class, I can do this in my classroom”. Essentially, participants reported a shared interest in equity-minded instruction and felt that the university and discipline were encouraging a shift to more equity-minded instruction; several reported that META provided the space to explore this domain.

##### 4.2. Examples

Although participants reported a shared interest in increased implementation of equity-minded instruction, their specific motivations varied. One participant, who has been teaching for several decades, reported that they “need to know more” because when they were going through their education “a long time ago, a lot of these conversations [about equity] weren’t taking place”. They appreciated the META events for providing the opportunity to learn from “people who are a little younger and maybe had more exposure [to conversations around equity]”. Another participant, who identifies as having several historically dominant identities, noted that “[equity] is something where I do feel ill-equipped” and that they appreciated learning from “the experiences from other people in our department who have different backgrounds and different experiences”. They particularly appreciated the opportunity to recognize when to “check [their] privilege”. Yet another participant reported that they attended META PD because they “wanted to get

better at teaching” due to their unfavorable student evaluations of teaching. They feel that their teaching is a bit more “old school” and that META can provide the support for them to shift to more active teaching. Finally, another participant, who has been participating in META since its inception, reported:

I don’t mean to brag, but I feel like I’m okay with active learning now . . . but when I see the word equitable, then it’s like, ‘pause’, what the heck was that? Is there even such a thing? So I wanted to learn in that aspect.

This participant felt that their teaching practice was strong in terms of active learning but that they could improve to be more equity minded. The participants quoted above are in different stages of their careers and have varying levels of skills and confidence to implement equity-minded active instruction. By this, we mean that some of our participants have been learning about and implementing classroom strategies for equity-minded active instruction for many years, whereas others are only just beginning to engage with these ideas. Thus, some participants arrive to our workshops with a greater foundation of knowledge and greater confidence than others. Yet, they participate in META PD because of a shared commitment to the domain.

#### 4.3. Nonexamples

As a nonexample to the domain described above of commitment to improving instruction to be more equity minded and active, one participant reported that they were not committed to the domain. They stated:

it would take more work to convince somebody like me that these things are, number one important in the classroom, and number two doable in the classroom . . . I don’t have that lived experience and I don’t feel like I have necessarily the credibility to pull off [equity-minded teaching].

Interestingly, this participant continued their involvement in META events, even though event participation was voluntary. An analysis of the next crucial characteristic, the community, reveals the rationale for this participant’s continued involvement. They explained that “the social ties that I’ve had with [the leaders] and the other META participants, even though this isn’t something I’m passionate about, makes it easier to get the motivation to show up”. The benefits this participant reported from the community outweighed their lack of commitment to the domain. The next section will share how the other participants reflected on the community characteristic.

#### 4.4. The Community

According to Wenger-Trayner and Wenger-Trayner [27], the community includes the members, their relationships with each other, and their engagement in joint activities and discussions. In the case of our META PD, participants represent every faculty rank and four mathematics subdisciplines. As described above, they also possess varying levels of skills and confidence to implement equity-minded active instruction. META provides time, space, and support for faculty to learn from each other through participation in a variety of incremental PD activities. One participant described the community as a “kind of grassroots support” that involves “just having good colleagues”. Another described the value of the shared expertise in the room, stating “the people in that room are impressive to me, they’re good role models . . . and it slowly changes your view on teaching and what your goal should be in the classroom”.

Other participants noted value in META’s approach, which invites participants to candidly discuss both their successes and their challenges. One participant reported that they benefit from “having my colleagues around where I feel like it’s safe to share my struggles especially . . . and it’s just great to be in the same room with the people who are willing to try new things and are not afraid of failing”. Similarly, another participant shared that “it is nice to have the chance to talk with other instructors who are trying the same things” and to know that “other people are trying and it’s not smooth sailing for everybody

as well". They describe this in contrast to going "to a workshop to sit there and listen to different strategies". In the case of META, a community is formed for faculty to learn from each other, as opposed to a top-down workshop approach.

An additional reported benefit of the community-centered approach is that learning extends informally, beyond the scheduled PD activities. One participant shared that:

just talking to other instructors that I know are in the META group has been very helpful . . . even just popping by . . . there were a couple times that I would just run by [a META leader's] office . . . we were all very supportive of one another, I never felt like my ideas were stupid, and we were all able to listen to one another.

Once the community was established, participants knew they had a set of colleagues, united under a shared domain, whom they could consult when issues and questions arose.

#### 4.5. Examples

Participants described a variety of ways that the community supported their learning. One of these ways was through healthy peer pressure. A participant shared, "there is, in fact, some pressure . . . just having colleagues raise the bar in terms of teaching leads me to raise my own bar a little bit". Another participant felt that their peers helped to increase their confidence and skills. They shared:

I think that if you want to talk about active learning, engaging with other people is a really important aspect of that and that's part of what META is all about, that community that you're building . . . and the more I learn the more confident I feel, the more I think I can do it, the more support I feel.

This stands in contrast to the historical culture of university teaching behind a closed door, with little opportunity to consult with colleagues.

Another participant, who has been a longtime participant in META PD, noted the value of growing into leadership roles in the community. They shared:

all of my past experiences with META have been so positive that I knew I would . . . continue to develop as an instructor and, also, I knew I could contribute as well, because . . . [from] the start . . . I did a lot of the activities and professional development . . . So I knew I could learn more as well as contribute. I've been a part of [META from the beginning], so it's like, 'Hey I can help too.'

In this case, a participant with advanced skills and confidence, through their years-long participation in our project and years of implementing the teaching strategies we encourage, was able to participate in the community nonetheless by taking on leadership roles.

Finally, we are compelled to report that two of the participants who were part-time lecturers reported on the value of being invited to the community. One shared:

to be invited [to META events] was pretty cool. I think as a part-time faculty member we're a little bit isolated sometimes, there's a lot of stuff like this that goes on that we're not always invited to, so it's just nice to feel included.

They went on to explain that:

as a part-time faculty member . . . sometimes it feels like there's not a lot of incentive to do your job better and the ways to defeat that are interactions and speaking with [colleagues] around you and realizing these people are doing a lot and going out of their way to really try and improve their classes and I think I should be doing the same thing.

Another participant who was a part-time faculty member explained, "I was forever grateful when [a META leader] reached out to me when I was just a part-time lecturer". This participant shared that several years ago they:

actually suggested that [META leadership] needs to reach out to the part-time faculty because they work at multiple campuses and they have more experi-

ence learning a little bit from here, from there, and they have richer experience compared to us full-timers where we just work at one school.

This participant reported that now they “appreciate the diversity of the faculty members this time around because now, I started seeing more part-timers getting on board”. The above examples show how the community characteristic of a community of practice supports faculty by providing healthy social pressure, building confidence, providing leadership opportunities, and increasing a sense of belonging for part-time faculty members.

Our dataset did not include a nonexample for the community characteristic.

#### 4.6. *The Practice*

According to Wenger-Trayner and Wenger-Trayner [27], the practice refers to the learning products that emerge within the community. In the case of our META PD, we focus on incremental improvement where faculty set their own goals and reflect on their own instruction after actively experiencing active learning themselves within their communities. Incremental improvement means that faculty have the agency to select something that allows them to grow but also feels manageable for their classroom, implementing their selection, and continuously reflecting and tinkering for continuous growth in their teaching practice. Faculty come together to discuss successes and challenges. One participant noted the benefit of gradual improvement in a low-stakes environment, stating:

I can go to a [META] workshop and increase my teaching effectiveness by epsilon . . . I’m not going to go and turn my class upside down but I’m going to go and make these small changes that little by little add to my toolkit and that’s less intimidating, but I also feel benefit coming from it . . . just knowing that that something is going to be relevant to me and often something I can put into practice pretty quickly.

Another participant noted the metalearning that occurs in META by explaining, “you share the ideas [at META PD], but we also ourselves do the ideas, so you use the teaching strategy to teach us the teaching strategy”.

#### 4.7. *Examples*

In terms of specific products emerging from the community, participants reported that they incorporated numerous new equity-minded and/or active teaching practices. These included board work, interest surveys, group work, grouping strategies, jigsaw, notice and wonder, think-pair-share, wait time, and worksheets in disguise. For example, one participant noted how their strategy for creating student groups changed after participation in META. They stated that after a META PD event, “I was encouraging the students to get into groups and then work with each other, whereas before, I kind of hoped that they would naturally form”. As another example, a participant noted the effectiveness of the notice and wonder strategy in their classroom, stating:

the notice and wonder was my very first time doing it and I was very pleased . . . [I used it with a notoriously challenging class and] they surprised me . . . they gave me really, really insightful answers . . . and they asked very powerful questions . . . And I didn’t have to tell them anything, they just figured it out by themselves . . . So I like that method a lot, like a lot.

The notice and wonder strategy was shared by one community member during a META workshop and was quickly implemented by many other community members who were delighted by the results.

In addition to naming new teaching practices they learned, participants were also able to name strategies they planned to try in the future which, for some participants, included notice and wonder, Padlet, or worksheets in disguise. This points to the community’s culture of continuous improvement.



Not only did participants report learning new teaching practices but some also reported philosophical shifts after participation in the community. One participant described a powerful shift in how they thought about equity in their classroom:

The realization that I've had about equity in more recent years is that you need to assume that it does not exist when you enter your classroom. I think I used to just take the approach of treating all my students the same and that'll be fair. Until you really think about it, and some students have had a lot of advantages and everything's worked out well for them. And other students may have had terrible high school teachers or they might be the first one in their family [to go to college], all kinds of disadvantages that you can have. So just being more mindful of what you're saying and what you're doing to try and help as many students as possible. Make sure that the way that you're running your classroom is working for as many students as possible and not just the students who already had everything work out for them. I think if everyone does that hopefully we can fill in some of those equity gaps and bring everyone a little bit closer together, without dropping a lot of people as well. Just raise more people up.

This participant provides an exemplar of a faculty member transitioning from the pervasive colorblind approach of mathematics teaching to an approach that is more equity minded by attending to individual students

Other participants discussed philosophical shifts in how they cultivated their classroom learning community. One participant explained:

Something that I've learned is that creating the community so that students want to engage with each other is really important, it's almost more important than what I do in the classroom. And this is something that's definitely different from when I was a student is how to develop that community amongst the students and also develop that relationship with the students that's different than just a lecturer-lecturee role.

Another participant who experienced a similar philosophical shift around the classroom community explained that:

I started coming up with a question of the day . . . just kind of looking for ways to build a little bit more community. I think in the past stuff like this, I viewed as not important or not part of the mathematical content, kind of not my job. But I think I've been convinced more that it's worth it, it's only a couple minutes at the beginning of class and if you can get more people interested . . . or enjoying it, I think that's worth it and you're going to get more benefits than what you lose for wasting those three minutes.

The above examples show that participants' teaching practices were expanded through classroom strategies and philosophical shifts.

#### 4.8. Nonexamples

As a nonexample to the above participants who benefited from the learning products that emerged from the community, one participant reported feeling that the learning within the community was not advanced enough for them. They reported:

I've tried most if not all the techniques. [So I made a suggestion to META leadership that] maybe in the future the META team could organize a different type of workshop for people who have done it many many times . . . For me, personally, I was looking for more . . . If it's possible to have a different type of workshop for advanced [strategies], I think it would work out a lot more.

This participant did not feel that they benefitted as much from the practice of the community as they could have if a more advanced community existed.

## 5. Discussion

PD is an important mechanism to support the increasing number of mathematics faculty members who aspire to transform their instruction [12–14]. The findings above exemplify the benefit of guiding PD with a community of practice framework. Under this model, PD facilitators provide time, space, and support to faculty. From there, as evidenced above, faculty can learn from each other's expertise. The community of practice framework includes the crucial characteristics of the domain, the community, and the practice. Our findings revealed that participants shared a domain of commitment to increased use of equity-minded instruction. Participants described a supportive community to reflect on their own learning together, including both successes and challenges. The resulting practice was a toolkit of new strategies as well as new conceptualizations of the classroom learning environment.

META was designed to support faculty who desire to transform their instruction to be more equity minded and active. Oliver and Olkin [28] used a community of practice model to increase faculty implementation of active learning. They found that “the strength of the community of practice, paired with a consistent message of support, has resulted in instructors who are increasingly less afraid to try out a new activity in their classes” and that “no coercion or heavy-handed coordination of curricular material has been necessary to increase active learning in the classroom” (p. 266). According to Reinholz et al. [20], this support is even more crucial when faculty aspire to use equity-minded teaching practices. They claim that “unless instructors receive sustained, ongoing PD of this type [that explicitly addresses inequities], we imagine that it will be difficult for most instructors to address the surmountable inequities in mathematics education” [20] (p. 36).

Yet, despite PD participants collaborating under a community of practice model, our incremental approach to PD allowed them to individually engage in a way that aligned with their own skills, confidence, and goals. We offer an incremental approach both in the PD offerings of META as well as in the equity-minded active strategies we explore with participants. With a variety of low-stakes to high-stakes PD opportunities to choose from, faculty are given multiple opportunities to engage in incremental improvement of their teaching practice. Similarly, at the classroom level, each participant could set their own goals from a variety of teaching strategies, allowing them to incrementally improve their instruction to be more equity minded and active. For instance, a participant who largely teaches through lecture could opt for a simpler strategy that keeps the lecture intact but swaps out the questions they ask of their students. A more experienced participant who regularly engages their students in collaborative learning could opt for a more complex strategy that changes the way students interact with each other. Even when working in a community together, each individual faculty participant had the autonomy to incrementally improve their instruction at their own pace.

As is often true with PD initiatives, time is a limiting factor. Despite our efforts to provide time and space for faculty to learn together in a community, two participants reported feeling that there was not adequate time allocated for collaboration. One stated that sometimes they felt the conversations “were a little rushed . . . some of the conversations had to be cut short because we're all trying to cram so much stuff in there . . . [If there was more time], I could have had some really rich discussions with other faculty”. A second participant noted an issue with limited time, stating:

it's just a matter of having the time to have those discussions with colleagues [to ask things like], 'how did you fit this in' or 'how did you work this out'. I think that is probably a challenge for all of us, finding the time.

Despite these time constraints, as evidenced above, faculty were able to unite under a shared domain to support each other in a community as they worked to improve their practice.

At a time when there is a pressing need for faculty to shift to equity-minded and active mathematics instruction, our META PD provides a case for using a community of

practice model to support faculty in carrying out the challenging work of transforming their instruction. The findings reported above indicate that faculty can come together under a common goal and draw from the expertise of the community to work toward incremental but meaningful instructional improvement. Participants of varying academic rank, from varying mathematics subdisciplines, and with varying confidence and skills around equity-minded active instruction were able to support each other in carrying out the difficult work of instructional transformation.

### 5.1. Limitations

Participation in META PD was voluntary. Thus, the participants of this research represent a sample of mathematics faculty who were aspiring to improve their instruction and are willing to devote time to this endeavor. The results of our research may not generalize to a context where PD participation is obligatory.

We also note that we were able to provide small participation stipends to participants. When replicating our project, other institutions should consider compensating participants. If compensation is not possible, other institutions should consider whether this will impact participation.

### 5.2. Future Research

The next phase of our research will investigate the scalability of our project to different contexts. We will collaborate with a mathematics department at a different institution type as well as a science department in our institution. This will allow us to research the affordances and limitations of our PD model outside of our department. An opportunity that could arise from this research is an improved PD model that can broadly benefit STEM departments of varying disciplines and institution types. An anticipated challenge is building our knowledge base on how best to support the needs of departments outside our own, with varying disciplines and institution types. We will use the results of this research to refine and strengthen our model to benefit other departments broadly.

### 5.3. Conclusions

Many participants reported ways in which the META PD aligned with crucial characteristics of communities of practice: the domain, the community, and the practice. Although there were some nonexamples, participants' interview responses paint an overall picture of a community of faculty motivated by a common interest who learned from each other's expertise to create products to improve their teaching. The community of practice model may be enticing to departments; rather than a costly high-stakes venture, effective PD can be local and grown by the faculty members themselves.

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