

NOTICING FOR EQUITY IN WRITTEN WORK: EXPLORING ONE TEACHER'S STUDENT WORK ANALYSIS PRACTICES

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Attending to students' thinking and using it to inform instruction has been shown to be an effective teaching practice. Although research on teacher noticing has explored how teachers attend to and interpret thinking in the moment and through video, less is known about the ways in which teachers notice students' thinking in written work, as well as the cultural dimensions that shape noticing. While work on "noticing for equity" has begun to explore the latter, it focuses on noticing of participation. This qualitative case study asks if equitable noticing extends to students' work. Analysis of one equity-oriented math teacher's student work analysis practices revealed that she a.) attended to the details of students' strategies with a learner stance, b.) contextualized their understandings, c.) interpreted their understandings through a strengths-based lens, and d.) planned to respond by identifying aspects of work to share with the class.

Keywords: Teacher Noticing; Equity, Inclusion, and Diversity

Introduction

Research has shown that when teachers attend closely to their students' mathematical thinking, they can use it to inform instruction, leading to gains in achievement (Carpenter et al., 1989). When teachers deeply understand students' thought processes, they can build on their prior knowledge and leverage student-generated strategies for class learning. Studies on "teacher noticing" of thinking and of classroom activity have explored what teachers attend to and how they interpret it (Jacobs et al., 2010; Sherin & van Es, 2005). Although teacher noticing has been studied primarily in the midst of teaching or in video, teachers can also attend to students' thinking by examining their written work (Kazemi & Franke, 2004). Less is known about what and how teachers notice thinking in work, as well as the ways in which that noticing is shaped by teachers' pedagogical commitments (Erickson, 2011), dispositions (Hand, 2012), and immersion in dominant discourses about mathematics (Louie, 2018). While work on "noticing for equity" has begun to explore these cultural dimensions of noticing, it focuses on noticing of participation (van Es et al., 2017; Wager, 2014). This study asks if equitable noticing might extend beyond participation—as noticed in-the-moment or on video—to students' written work. Given that student work is accessible and can be looked at outside of instruction, it is an untapped resource for making sense of thinking. Understanding equitable ways of noticing thinking in written work may support teachers in their practice, teacher educators training novice teachers, and researchers documenting equitable math pedagogies. While noticing of thinking and noticing for equity have been theorized separately, illuminating connections between the two may support future study of their intersections. This qualitative case study uses think-aloud protocols to explore one equity-oriented math teacher's student work analysis process, investigating the following questions:

1. What and how does an equity-oriented teacher notice when examining their students' written work?
2. In what ways do a teacher's pedagogical commitments and dispositions inform their noticing when examining their students' written work?

Conceptual Framework

This study draws on three bodies of literature to examine the ways in which an equity-oriented teacher's pedagogical commitments and dispositions shape what and how they notice when looking at work (figure 1). The teacher noticing literature has included several studies involving student work analysis related to the construct of noticing children's mathematical thinking. Scholars have recently extended the noticing literature towards theories of equitable mathematics pedagogy, utilizing "noticing for equity" to document equity-oriented teachers' noticing of participation. In these studies, scholars argue that teachers' commitments to equitable pedagogy shape their equitable noticing of participation. In exploring noticing for equity in written work, this study suggests pedagogical commitments also shape noticing of thinking.

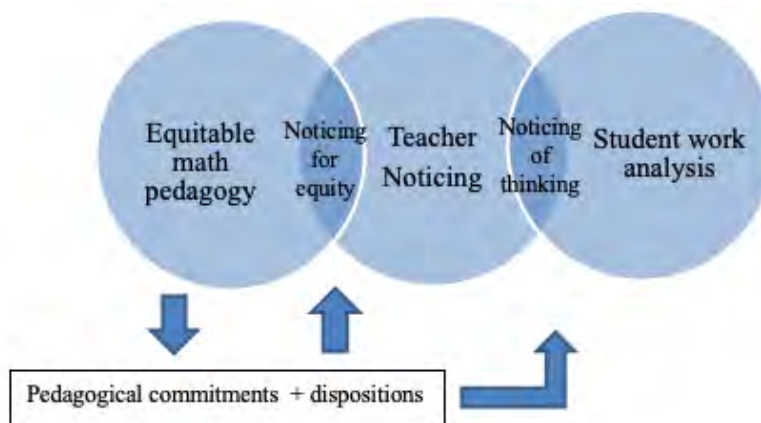


Figure 1: Conceptual Framework

Teacher Noticing

The teacher noticing literature builds on Goodwin's (1994) concept of "professional vision," defined as "ways of seeing and understanding events" that are distinct to a social or professional group (p. 606). In their study of noticing mathematical thinking, Jacobs and colleagues (2010) conceptualized noticing as three interrelated cognitive processes: attending to details of students' strategies, interpreting students' understandings, and planning to respond based on those understandings. The authors found that teachers improved their noticing through professional development in which they analyzed video and written work from their own students and anonymous students. The teachers attended to more details of a student's thinking and used robust evidence to interpret their understanding and to plan to respond (Jacobs et al., 2010). Similarly, Sherin and van Es (2005) found that teacher participants in video clubs shifted from an evaluative to an interpretive stance. Goldsmith and Seago (2011) found that teachers engaging in professional learning with video or work attended more deeply to mathematical details, used evidence from artifacts to support claims, and noticed more potential in students' thinking.

Student Work Analysis & Noticing of Children's Thinking

Other researchers have examined the affordances of student work analysis without using the noticing construct. In their study of a workgroup in which teachers collectively analyzed their own students' work, Kazemi and Franke (2004) found that teachers learned to attend more closely to their students' thinking, becoming more detailed in their descriptions of students' strategies, developing an appreciation for students' unique mathematical ideas, and finding ways to elicit and build on students' thinking. Additionally, researchers have found that student work

can serve as a resource to deepen teachers' knowledge around student thinking and to strengthen instruction (Ball & Cohen, 1999). Despite these affordances, researchers have identified constraints in looking at student work. Goldsmith and Seago (2011) found that when looking at anonymous work, teachers attended closely to students' reasoning and remained open to multiple possible interpretations, but they focused more on lesson details rather than the specifics of thinking when looking at their own students' work. Accordingly, researchers advocate for an inquiry-based approach to looking at work to support teachers to focus on the details of thinking and to carefully draw on their knowledge of students and context (Little et al, 2003).

Equitable Mathematics Pedagogy & Noticing for Equity

The teacher noticing literature has focused on noticing as a cognitive process; however, Louie (2018) argues that scholars ignored two aspects of Goodwin's professional vision: noticing is culturally situated and is not politically neutral. Erickson (2011) identifies a teacher's "pedagogical commitments" as the tacit and explicit ontological assumptions about teaching and learning that shape noticing. Hand (2012) posits that what teachers notice is informed by their "dispositions," which are the perspectives they have developed through both their teaching experiences and life experiences. Building on Hand, Louie (2018) argues that teachers' immersion in dominant ideologies shapes what and how they notice. The dominant mode of instruction in math classrooms is knowledge transmission from teacher to student (Boaler, 2016), which corresponds to similarly narrow definitions of ability (Louie, 2017). Narrow notions of ability are not applied equally, as racialized discourses that position white and Asian students above Black and Latinx students persist in and beyond classrooms (Shah, 2017). Teachers, particularly white teachers, are immersed in these ideologies, which may shape their noticing.

Emerging work on "noticing for equity" considers these cultural dimensions of noticing. R. Gutiérrez (2007) argues that achieving equity means no longer being able to predict, based on group membership, students' achievement, participation, and ability to mathematically critique the world. One line of inquiry on equitable pedagogy works to expand conceptions of mathematical activity and ability (Louie, 2017) through practices like Complex Instruction—a form of groupwork that combines multi-dimensional content with attention to status (Cohen & Lotan, 2014), including teachers noticing students' strengths (Jilk, 2016). Building on this work, van Es and colleagues (2017) define "noticing for equity": "How mathematics teachers notice aspects of classroom activity that have consequences for whether or not particular groups of students feel more or less empowered to take up these practices [i.e. engagement in mathematical reasoning]" (p. 252). In their study, the authors found that teachers' equitable instructional practices were connected to particular forms of "noticing for equity" around participation, such as attending to issues of status and positioning, attending to individual students' histories to inform interactions, and attending to the energy and flow of the class (van Es et al., 2017). Similarly, Wager (2014) found that teachers' positionality toward equitable pedagogy was connected to noticing of participation. These studies examined noticing of participation in-the-moment or in video; less is known about equitable noticing of thinking in students' work.

Methods

Study Context & Participant

I identified Ms. D¹ as "equity-oriented" due to her pedagogical commitments (Erickson, 2011), her implementation of equitable math pedagogies, and her dispositions (Hand, 2012) toward pushing back on dominant discourses about mathematics for Black and Latinx students. Ms. D, who identifies as a white woman, is National Board Certified and has taught at public and

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charter schools in California for the past 23 years. Originally trained as a science educator, she became fascinated with her students' thinking when she began teaching middle school mathematics 20 years ago and has since engaged in significant professional learning around listening to and learning from students' thinking. While Ms. D is not representative of the broader teaching force, she does represent, as Shulman (1983) writes, "images of the possible."

Ms. D's fascination with students' thinking and commitment to equity are integrated into her teaching philosophy. She believes it is her responsibility to "create the conditions that promote equity," defining equity as all students having access to multiple approaches to mathematical content, different ways of participating, a supportive relationship with their teacher, and collaborative relationships with classmates (Interview 1). This resonates with Ms. D's philosophies: 1.) mathematics consists of different ways of thinking; 2.) people learn through participation and interaction, and 3.) building relationships with and among students helps establish a learning community in which students' identities within and beyond the classroom are acknowledged. Relatedly, Ms. D aims to address power in her classroom, implementing Complex Instruction (CI) and working to center her Black and Latinx students' voices.

Data Collection

I used a case study design (Yin, 2009) and grounded theory analysis (Strauss & Corbin, 1994) to illustrate one teacher's practice of looking at student work. Data was collected during the 2019-2020 school year, which was Ms. D's first year at a public middle school, where she teaches sixth grade mathematics. The district in which she teaches is 8% Asian, 24% African American, 32% White, 21% Latinx, and 15% multi-ethnic/other. As a result of COVID-19 and the shift to remote learning, the majority of data collection took place over Zoom. Because this study centers around student work analysis, the primary data source consisted of three think-alouds, in which Ms. D made sense of her students' work, each followed by a short interview protocol. Students' work samples consisted of individually completed "Cool Downs" (i.e. exit tickets), which prompted students to represent their thinking in multiple ways. For the first think-aloud, which was video recorded in person, work samples came from the 20 students who were present and whose families had consented. For the second and third think-alouds, which were recorded via Zoom, work samples came from 19 (think-aloud 2) and 16 (think-aloud 3) of the 20.

Secondary data sources were used to contextualize Ms. D's noticing, given that teachers' philosophies and dispositions may shape their noticing (Erickson, 2011; Hand, 2012). Prior to the think-alouds, a semi-structured interview (Glesne, 2005) was conducted to gather information about Ms. D's context, philosophies, conceptions of equity, and experience with equitable pedagogies. The original design involved observing Ms. D's class the day of each think-aloud. One observation was conducted on the day of think aloud 1, during which fieldnotes were generated (Emerson et al., 2011). Due to the shift to online learning, no additional observations were feasible. Instead, Ms. D's weekly digital materials were consulted as artifacts.

Data Analysis

In the first phase of analysis, I identified Ms. D's pedagogical commitments. I engaged in line-by-line open coding of the interview transcript, from which bottom-up codes of Ms. D's pedagogical commitments and conceptions of equity emerged (Emerson et al., 2011). I refined these codes through visual diagramming and coding of observation fieldnotes, constructing a pedagogical commitments codebook which I then used to focus code the transcript.

In the second phase, I analyzed how Ms. D made sense of work in the think-alouds. I constructed time-indexed content logs (Derry et al., 2007) of the recordings and transcribed dialogue and movement of work. I broke the transcript into idea segments—separated by a

change in an idea or turn—which served as the unit of analysis for three rounds of coding: open coding; a priori coding using Jacobs and colleagues' (2010) noticing framework; and focused coding for connections to equitable math pedagogy literature. I constructed a codebook based on commonalities across the rounds and used it for a fourth round of coding. To generate themes, I wrote analytic memos and constructed diagrams of Ms. D's think-aloud process and relationships among codes. I then mapped each theme back to its related codes and excerpts, confirming that each theme was supported by evidence from at least two think-alouds. Finally, I looked for counterexamples of themes, expanding one theme to account for its complexity.

Findings

My analysis showed that Ms. D noticed students' mathematical thinking in ways that potentially promote equity. Although she engaged in the three cognitive processes of the Jacobs et al. (2010) framework, she did so through the lens of her pedagogical commitments. As she attended to the details of students' strategies, she maintained a learner stance, acknowledging her uncertainty with their thinking. As she interpreted understanding, she contextualized it within the learning environment, drawing on her knowledge of students and critically reflecting on the opportunities to learn that she had provided. These noticings supported Ms. D to engage in a strengths-based interpretation of students' understandings, recognizing strengths and partial understandings. Finally, her expansive definition of mathematical understanding supported Ms. D to notice aspects of students' work to share with the class as part of her plans to respond.

As has been found in studies of noticing thinking, Ms. D engaged in three intertwined cognitive processes as she looked at students' work: she attended to the details of students' strategies, interpreted their understanding, and made plans to respond (Jacobs et al., 2010). She engaged in these three processes in all think-alouds and in at least two of the three for every piece of work. For example, when looking at student G's work in think-aloud 1, Ms. D described G's thinking in detail, noting how she broke the 12 apart, recognizing her expression as equivalent, and wondering if she meant 16 instead of 12 (figure 2). As she attended to these details, Ms. D interspersed interpretations of G's understanding, determining that she understands how to write an expression with parenthesis and how an expression connects to a rectangle's area. Finally, Ms. D identified areas of growth (e.g. understanding partial shading of a rectangle). This example reflects a pattern across think-alouds: Ms. D attended to the details of a student's work, moved between interpreting and attending, and then made a plan to respond.

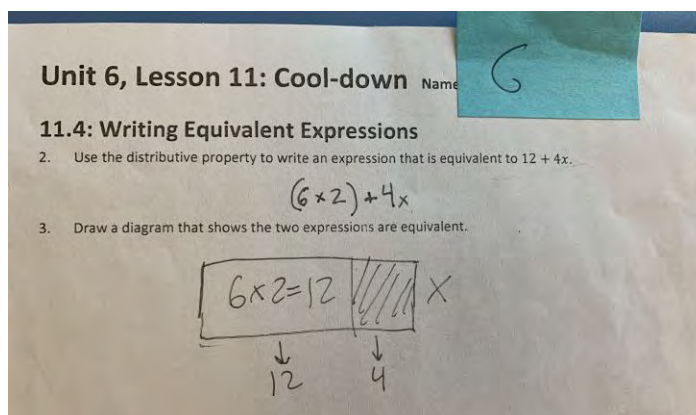


Figure 2: Photo of G's work

Attending to students' strategies: Maintaining a learner stance

As Ms. D attended to the details of students' strategies, she did so with a learner stance, in which she attempted to deeply understand students' thinking, expressed fascination with it, and acknowledged her uncertainty around the particulars of students' strategies. In the third think-aloud, Ms. D spent four minutes attempting to decipher how one student may have found the area of a parallelogram, testing out multiple possible strategies. She was fascinated by his work regardless of its accuracy, which was a trend throughout the think-alouds and which aligned with her assumption that all work showcased deep thinking and was worth paying attention to. It was common for Ms. D to comment that a student was "thinking about something," even if she wasn't clear on what that something was. This comfort with uncertainty, rather than seeking resolution, shaped Ms. D's process of attending to thinking. She consistently acknowledged her own uncertainty around a student's strategy, sometimes phrasing it as a question she planned to ask the student, such as, "but what does she mean by height and base?" (Think-aloud 3). Ms. D interacted with the work as a learner, naming uncertainties and framing them as wonderings.

Attending & interpreting: Contextualizing students' thinking

As Ms. D moved from (and between) attending to the details of students' strategies and interpreting which aspects of the concept they understood, she contextualized students' thinking in two ways. To make sense of their thinking and interpret their progress, she drew on her knowledge of her students as people and as mathematical thinkers. At times, she referenced a student's prior mathematical thinking, such as their facility with mathematical vocabulary or their mastery of particular strategies. For example, in think-aloud 1, Ms. D drew on her knowledge of student J's strengths (i.e. mastery of using tape diagrams to represent equations) and her areas of growth (i.e. area) to interpret her understanding. Additionally, Ms. D drew on her knowledge of students as people to understand their progress. In think-alouds 2 and 3, Ms. D spoke about J's challenges with distance learning—feeling overwhelmed by technology and missing interaction—and celebrated her completion and understanding amidst these struggles.

Importantly, Ms. D drew not only on her knowledge of students to interpret their work but also on her role in shaping their opportunities to learn. When noticing a student's partial understanding, Ms. D critically reflected on the extent to which she had provided that student access to the learning opportunities necessary to develop that understanding. In think-aloud 2, for example, Ms. D noted that students' struggles with language precision were likely related to lack of discussion during distance learning. Rather than attributing these struggles to individual students, Ms. D situated them within the learning environment and her role as an educator. Additionally, Ms. D referred back to the directions she had written for each problem as she processed students' work. For example, she acknowledged that the term "diagram" is vague, that there doesn't have to be a question in a student's word problem, and that describing a strategy doesn't require a numerical answer. In all three cases, Ms. D's critique of her directions widened the space of understanding, allowing for different kinds of representations and strategies.

Interpreting understanding: Applying a strengths-based lens

Ms. D's learner stance on and contextualization of thinking comprised an expansive notion of mathematical understanding, supporting her to interpret students' understanding through a strengths-based lens. For each problem on the cool down, Ms. D attended to each student's work and sorted them into two piles: understanding and partial understanding. Although she sorted along this binary, the piles were fluid and did not correlate with categories of "right" or "wrong." Instead, Ms. D sought out evidence that students understood the concepts—even if they had a computational error—and sometimes moved students across piles based on evidence from a later

problem. This fluid and conceptual sorting enabled Ms. D to recognize partial understandings of the learning objective in each piece of work, articulating what that student understood and what they did not understand yet. Additionally, Ms. D recognized strengths outside of the objective, such as writing an equivalent expression (even if doesn't use the distributive property), writing a numerical expression (even if it doesn't have a variable), and drawing a tape diagram (rather than a rectangular diagram). For this last strength, Ms. D's critical reflection on the directions supported her to recognize this student's tape diagram as a strength. Ms. D's recognition of partial understandings and strengths thus enabled her to notice a range of aspects of work.

Plan to respond: Identifying aspects of work to share with the class

Although Ms. D's plans to respond included many typical of formative assessment (e.g. feedback and small-group instruction), a portion of her plans involved using students' work as a tool for learning. As Ms. D recognized different ways of thinking and partial understandings, she identified aspects of students' work to share with the class. Her practice of noticing work to share took on two forms: highlighting exemplars and leveraging mistakes for class learning.

In think-aloud 3, Ms. D commented on many aspects of student thinking that she planned to "highlight" in class the following week. For example, Ms. D noticed and planned to share K's use of units and A's use of mathematical vocabulary. Both noticings were supported by Ms. D's contextualization of students' thinking. For K, Ms. D recognized his precision with units, even though that wasn't part of the objective. For A, Ms. D critically reflected on her directions, noting that A did not need an exact answer. Additionally, Ms. D noticed and planned to highlight different ways of thinking. For example, Ms. D recognized two students' creative ways of finding a parallelogram's area: T cut a parallelogram in half and Si chose a base from which to draw a height. In planning to highlight T's and Si's work, Ms. D affirmed the use of approaches that differed from most of the class. Ms. D's practice of highlighting student work was observed prior to school closure. During the observation, eight students shared aspects of their cool down, ranging from using arrows to communicate thinking, substituting to test out possibilities, and incorporating vocabulary. When selecting work to highlight, Ms. D not only considered students' approaches, but also their identities within and beyond the classroom. In interviews, Ms. D expressed a desire to "elevate students' status" in the classroom, particularly her female students of color and her quieter students, as she was aware that students' identities may relate to their perceived status. The eight students who shared their work, for example, came from a range of identities. In recognizing her students as multi-layered people with different personalities and backgrounds, Ms. D worked to elevate those who may have less power in class or in the world.

In addition to noticing aspects of work to highlight, Ms. D also planned to leverage student work as a learning opportunity for the class. While highlighting involved students sharing exemplar aspects of their work, leveraging involved Ms. D organizing an instructional activity around student work that showed partial understanding. In think-aloud 2, for example, Ms. D planned to respond to students' word problems by repurposing them for the class's learning, saying: "Already as I'm reading these, I'm excited to use these as an assignment for next week, which ones make sense, which ones don't, and have the kids try to see if they can come up with an expression [for each]" (Think-aloud 2). Ms. D aimed to leverage students' work as a tool for learning, positioning them as mathematical thinkers whose ideas are worthy of discussion.

Taken together, Ms. D's approach to looking at work with a learner stance, a critical lens on context, and a strengths-based interpretation supported her to identify aspects of work to plan to share with the class (figure 3). This plan to respond by leveraging and highlighting students' work has the potential to expand students' ideas about mathematics and about each other.

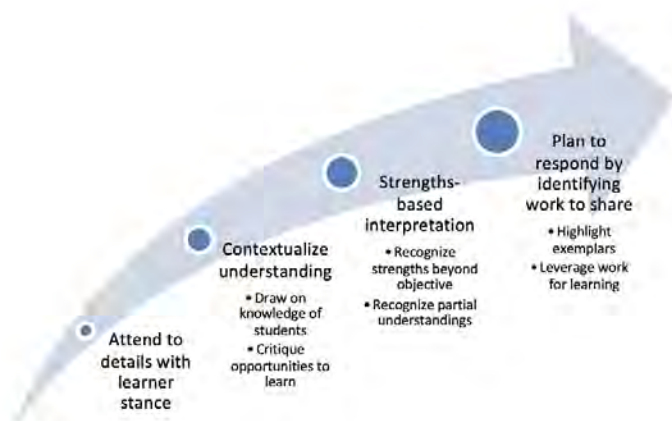


Figure 3: Visual representation of the major features of Ms. D's noticing process

Discussion and Implications

Ms. D's case illustrates that there are ways of attending, interpreting, and planning to respond to work that potentially promote equity. This case also shows that pedagogical commitments shape noticing, as Ms. D simultaneously utilized her expansive notions of mathematical understanding, as well as her ideas about status and positioning. This intertwining of multiple commitments supported her to a.) notice a range of thinking and b.) plan to highlight the work of students who may have been perceived as low-status in the classroom, the world, or both.

Ms. D's learner stance, her critical lens on context, and her commitments to expansive notions of mathematics supported her to notice a range of ways of thinking. Ms. D's inquiry lens resonates with studies showing this approach yields deep understanding of thinking, which can inform instruction and contribute to teacher learning (Kazemi & Franke, 2004). Despite being immersed in deficit discourses about students (Louie, 2018), Ms. D's commitments and her professional learning may have supported her to notice diverse strengths. The widening of understanding is important to equitable pedagogy, as math is accessible to more students when it is represented in multiple forms and different ways of thinking are valued (Boaler, 2016).

Noticing a range of thinking enabled Ms. D to plan to highlight multiple work samples, potentially expanding who is seen as competent. Ms. D's highlighting practice resonates with the CI routine of "assigning competence" (Cohen & Lotan, 2014), in which teachers position low-status students as competent. Importantly, Ms. D also attended to students' race and gender identities, which she believed may intersect with their perceived status. Put another way, Ms. D saw students' "social identities" in the world as potentially connected to the "practice-linked identities" they developed in the classroom (Esmonde & Langer-Osuna, 2013, p. 1). This practice of positioning students with attention to status and identity suggests teachers can "notice for equity" when looking at work, which resonates with van Es and colleagues' (2017) findings that attending to status and positioning was embedded in equitable noticing of participation.

This study has implications for practice and research. Teachers may take up these ways of attending and interpreting when looking at work to expand students' ideas about math and each other. Teacher educators may support novice teachers with attending to and selecting work outside of class as an entry point to implementing Smith and Stein's (2011) five practices. Future professional learning may support teachers to consider students' mathematical ideas and their statuses/identities when selecting their students' work. Finally, future research on student

thinking might theorize the ways in which equity-oriented teachers simultaneously take into account the mathematical significance of students' ideas and students' statuses and identities.

Note

¹ All teacher and student names are pseudonyms.

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