Culturally and Linguistically Responsive Noticing and Wondering: An Equity-Inducing yet Accessible Teaching Practice

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Many facilitators in educational contexts have employed phrases such as *I notice . . .* and *I wonder . . .* (often in combination with a third element) as frames for students' discussion or writing. These phrases are so intuitive that they likely appear spontaneously in the practice of many educators across many disciplines. What we believe is new and noteworthy in U.S. K-12 education is the systematic use of these two scaffolds for thinking or discourse as a pedagogy in and of itself. We conceptualize *Noticing and Wondering* as referring to instructional approaches that center these phrases on a consistent basis. We applaud incidental or occasional use of prompts that include terms like *notice* and *wonder*, but the claims we make here are based on more committed, long-term uses of Noticing and Wondering to drive instruction.

We argue that Noticing and Wondering is an innovation pedagogy with documented effectiveness in math education and with promise for other fields' embrace of an access to discourse and practices paradigm of learning. We also argue that it holds extra promise for multilingual learners who are still acquiring the language of instruction. Teacher educators in all fields may find relevance in our conceptualization of what we are calling *culturally and linguistically responsive Noticing and Wondering* because it can help teachers respond effectively to the proficiencies and needs of all students.

The Paradigm Shift

State curricula in the US are finally beginning to embrace an *access to discourse and practices* (ADP) paradigm of learning that allows the goals of K-12 education to better match our students' identities and their lives after graduation. In Table 1, we outline the concepts that have emerged over time in the field of education that define what we see as a shift from a traditional paradigm, narrowly focused on *teaching of information and skills,* to a broadened paradigm of ADP.

Table 1. *An outline of the differences between paradigms.*

Theme	Narrowed Paradigm: Teaching of Information and Skills	Broadened Paradigm: Access to Discourse and Practices
Theoretical grounding		
Basic metaphors	Acquisition of static knowledge (Sfard, 1998)	Participation in a more open-ended process of acquisition (Sfard, 1998)
	Compensation for perceived student deficits (Flores, 2005)	Enrichment of student assets with even more knowledge (Johnson, 2000)
Theories of learning and knowledge	Knowledge as skills and information (Hull & Moje, 2012)	Knowledge as practices and discourse (Hull & Moje, 2012)
		Social constructivism, collective meaning making in community (Lave & Wenger, 1991; Vygotsky, 1978)
	Behaviorism and individualistic constructivism	
	Freire's (2018/1968) banking model: Learner as primarily a recipient or reproducer of knowledge from experts	Freire's (2018/1968) problem-posing model: Learner as empowered producer and recipient of knowledge given access to the processes of the experts
Types of knowledge most valued	Teacher-centered, often scripted (Milner, 2013)	Student-centered and responsive to context and identity (Nieto, 1992)
	Content knowledge	Conceptual understanding of content paired with language development
	Facts, right answers, and procedures	
	Produced by dominant cultures (Nieto, 1992)	Big ideas, inquiry, and dialogue
		Multicultural (Nieto, 1992)
Enactment at the classroom level (mathematics as an example)		
Classroom tasks in mathematics	Applying learned procedural knowledge to "pseudo contexts"	Solving authentic problems and engaging in disciplinary practices (e.g. mathematical practices (CCSSM))
	A series of similar small tasks or worksheets with spaces for the answers.	An inquiry project.
Lesson structure in mathematics	Lecture then practice via "I do, we do, you do..."	Making sense of authentic problems, solving those problems in groups, and sharing and critiquing solution strategies across groups (NCTM, 2018).
	Focused on learning procedures for particular types of problems and reproducing those procedures when presented with a problem in that type.	
Classroom discourse structure	Initiate-Evaluate-Respond as the core discourse structure, where teacher elicits an individual's answer and immediately praises or critiques it.	Scaffolds to support discussion, analysis, reflection, etc.
		Student-to-student academic conversations with periodic teacher intervention through revoicing, questioning and summarizing as the core discourse structure (Zhang, Lundeberg, & Eberhardt, 2011)
Assessment	Summative that focuses on products and sometimes the sorting out the "less worthy"	Formative (Black & Wiliam, 1998) that equalizes opportunity to succeed on summative assessments, in part, by focusing on the process

Though not the initiators of ADP nor fully faithful to it, Common Core and the Next Generation Science Standards (NGSS) have been able to catalyze teachers in shifting towards the ADP paradigm we describe by their focus on naming and centering the discourses and practices of each content area. Though these standards have been in place since the early 2010s, researchers continue to find that professional development efforts struggle to convert teachers' practices, especially in institutional contexts where these shifts are not the norm

(Allen & Penuel, 2015; Cobb, McClain, de Silva Lamberg, & Dean, 2003).

Perhaps most essentially, the ADP paradigm entails process-focused curricula that are about learners participating in experiences that model a knowledge community's ways of communicating and acting, which stands in contradiction to the prior paradigm's answer-focused curricula that emphasize acquiring specific information or reproducing mechanistic procedures. In the ADP paradigm, all students learn each discipline's big ideas and the literacies through which to find more details about the big ideas if and when they need to later in life. For the same reasons that students are able to find it more relevant and engaging to take on the discourses and practices that are the big ideas of each discipline, these same big ideas are more worthwhile objectives than the detailed minutiae, because they are more generalizable beyond the K-12 classroom. The ADP paradigm empowers students to be shapers and reshapers of knowledge rather than its passive consumers. The ADP paradigm is also more equitable than its predecessor because (a) it discourages sorting students into categories based on whether they are "college material," (b) it tends not to be biased toward a Eurocentric, middle-class perspective, and (c) students are seen as able to join in on learning with age peers, despite any prior gaps in educational access.

Paradigm Shift Benefits
for Multilingual Learners

The ADP paradigm shift has had seismic implications for the field's conceptualization of multilingual learners' engagement with curriculum. The teaching of information and skills paradigm led educators to think of students classified as English learners as primarily in need of (a) preparation for content or access to content rather than ownership of content, (b) protection from being overwhelmed by grade-level language, hence needing supposedly empowering breaks from language demands in classes like physical education and math, (c) content instruction premised on simplification of text, and (d) an approach to language objectives dominated by vocabulary lists. The ADP paradigm has led to a rethinking of these assumptions such that multilingual learners now are seen as needing (a) inclusion in the mainstream classroom as soon as possible so as not to miss out on content instruction and the opportunity of apprenticing themselves to proficient speakers; (b) teachers in all content areas to think and talk explicitly about the language demands within the discourses and practices they teach (simultaneously making their curriculum more language-rich and discourse-centered); (c) *amplification* rather than simplification (Zwiers et al., 2017) of content and grade-level texts and academic tasks by creating multiple means of access to all levels of language through explicit scaffolding; and (d) a more deeply contextualized view of vocabulary as best acquired by scaffolding student-to-student academic talk and hence language objectives focused on extended uses of language (National Academies, 2018).

The goal of academic language proficiency is a space where the overarching paradigm shift toward access to discourse and practices and the shift specific to English language development find common ground. The supposed disjuncture between the needs of different student groups (such as multilingual learners and English-dominant students) gave many overwhelmed teachers the sense they could never realistically achieve the differentiation being asked of them, which sometimes left them with little motivation to attempt it. We argue

that Noticing and Wondering is a mechanism for keeping classrooms language-rich without overwhelming teachers who are still less comfortable with language development per se. Teachers' experiences of success with Noticing and Wondering may then open the door to a deeper commitment to the linguistically responsive instruction just described.

Introducing Noticing and Wondering

Noticing and Wondering is a pervasive pedagogy (Fukawa-Connelly, Klein, Silverman, & Shumar, 2018; Hogan & Alejandre, 2010; Shumar & Klein, 2016) developed by The Math Forum, a leading community in the field of mathematics education for more than two decades. At its core, Noticing and Wondering functions as an ever-available scaffold for engaging in evidence-based reasoning about (1) mathematics and (2) student mathematical thinking. In math education, Noticing and Wondering could be described as a math language routine, that is, "a structured but adaptable format for amplifying, assessing, and developing students' language" (Zwiers et al., 2017, p. 9) during content instruction. Research in the math context indicates that Noticing and Wondering has supported mathematics teachers in beginning to make the shift from facilitating the rehearsal of procedures to facilitating student-centered and discourse-rich learning environments (Klein, Matranga, & Silverman, 2019; Shumar & Klein, 2016).

To provide the reader a sense of what Noticing and Wondering in a classroom might include, we briefly summarize an example application of Noticing and Wondering to introduce a problem scenario and support students in making sense of a rich, open-ended mathematics task, documented in Hogan and Alejandre (2010). The teacher began the class by projecting on

the board a problem scenario (a mathematics task that does not include a question) about an Oracle who is prompted to make a decision about equal sharing of cost for bread. The teacher read the problem aloud to the entire class and asked the students to share what they noticed and wondered. When prompted to share ideas, the students responded and said, for example, "I notice there are 12 bread rolls"; "I notice they each ate four rolls"; "I wonder how they will split the bread to be equal." Following this open discussion, the teacher asked the students to reflect on their conversation and write down everything they remember. For homework, the students were given the question associated with the problem scenario and asked to draft an initial solution (Hogan & Alejandre, 2010). The authors also reported that the teacher adopted Noticing and Wondering to respond to student ideas and press students to think more deeply about a problem. For example, the authors reported:

> I now respond to the solutions students submit by using Noticing and Wondering, as modeled by Suzanne. I use "I notice" to acknowledge and value something the student has written, and then I use "I wonder" to pose a question that may further the student's thinking or understanding of the problem. (p. 33)

More generally, preliminary analysis of teachers engaging with the pedagogy of Noticing and Wondering indicates using it as a strategy to support students in making sense of a problem, in ways similar to what was just described, is one entry point into adopting the pedagogy of Noticing and Wondering for more holistic use (Klein et al., 2019).

Six Reasons to Make the Shift

Reflecting Table 1's outlining of aspects of the paradigm shift toward ADP, we offer six areas we see as important for showing Noticing and Wondering as a means for making the shift to the ADP paradigm. The following six reasons draw from research on Noticing and Wondering in mathematics education to discuss how Noticing and Wondering can address key issues that pull teachers back to teaching information and skills as well as the role Noticing and Wondering can have in helping teachers differentiate the language supports needed by English Learners (ELs) in a discourse-rich mathematics classroom.

Fosters Equal Access for All Students

Many teachers currently have not fully adopted the new paradigm simply out of the inertia of local institutional norms where they currently teach (Allen & Penuel, 2015; Cobb et al., 2003). Noticing and Wondering may be an entry point for such teachers to see the new paradigm as more accessible for them because of how quickly and easily Noticing and Wondering tends to increase the presence of student voice in the classroom (Klein et al., 2019)). For example, one teacher testified, "My students use noticing so well now that I no longer have to wait for them to raise their hands to respond; I can simply call on any student" (Hogan & Alejandre, 2010, p. 31). We argue that Noticing and Wondering has the potential to engender a democratic learning environment where all students have the opportunity to participate and learn. Even in cases where students may feel like they are not as smart as others in the class, it is never too late to start Noticing and Wondering and engage in disciplinary thinking, as well as the language demands of such thinking. Noticing and Wondering's accessibility immediately and inherently orients teachers and students toward equalized access for *all* students to sophisticated reasoning and language use.

Multilingual learners are more likely to do well when their linguistic and cultural assets and background knowledge are used as a foundation for classroom learning (National Academies of Sciences, Engineering, and Medicine, 2018). A key theme of preparing teachers to effectively teach multilingual learners has consistently been changing practitioners' mindsets toward seeing what ELs bring as assets (Lucas & Villegas, 2013). By its nature, Noticing and Wondering creates a conduit for cultural relevance in the classroom and the recognition of prior knowledge and current assets because students' noticings and wonderings will be expressions of what they find personally and culturally important. As teachers invite students to notice and wonder, students' culture and familiar discourses have a place in the classroom community. Even before the teacher responds or recognizes what students contribute, the act of asking students to showcase what they already know or think about a topic is a powerful catalyst for asset-based thinking by teachers and for relevance and engagement by students.

Creates Appropriate Challenges

One challenge associated with teachers shifting to the ADP paradigm is that teachers may not have experiences within discourse-rich learning environments that can continually remind them of their students' strengths and avoid the trap of deficit thinking about what their historically marginalized students are capable of doing. Given that Noticing and Wondering increases the presence of student voice in the classrooms, frequent opportunities

emerge for formative assessment that allow teachers to fine tune the challenge of a task by building on what students know rather than filling in what they do not know. Vygotsky (1978) theorized that effective learning occurred when experts were able to present instructional activities immediately (but not excessively) beyond students' current competence, what Vygotsky termed the *zone of proximal development*. Similarly, Hattie (2008) theorized from metastudies of instructional strategies that effective teaching is not about *making things easy to learn* but *making learning appropriately hard,* creating challenges into which students will put effort. Noticing and Wondering has the advantage of being accessible to all learners but resulting in highly challenging engagement with curricular concepts. We argue that Noticing and Wondering could provide for teachers in all disciplines the opportunity to make student thinking public, learn about student thinking, and adjust the difficulty of a task through questioning/follow up tasks that are specific to the students' current understanding.

Multilingual learners have historically often received either unscaffolded instruction designed for English-dominant students that is overchallenging for them or underchallenging instruction that has been simplified rather than amplified (Crawford, 2004). Their zones of proximal development lie somewhere in between these two extremes, and Noticing and Wondering gives teachers a tangible framework for discovering precisely where the sweet spot lies by amplifying opportunities for negotiation of meaning around grade-level content. Noticing and Wondering scaffolds teachers in allowing and encouraging ELs to produce language at their proficiency level yet hear meaningful language that repositions (Silva et al., 2012) their thinking in more academic, discipline-specific

language as teachers and classmates respond to their noticings and wonderings.

Prompts Evidence-based Feedback and Deep Collaboration

Many teachers may currently struggle to teach within the new paradigm because they have minimal experience with strategies to deal with the plethora of student ideas present in a student-centered classroom environment. Noticing and Wondering is a framework for beginning mathematical conversations with students, yet it includes the process of teachers' own Noticing and Wondering in those conversations; noticing the details of student thinking and then wondering about what that thinking says about students' mathematical understanding gets teachers to begin asking questions that get students talking (Shumar, 2017). Research shows that Noticing and Wondering supports teachers in developing feedback on student work that is evidence-based, specific (Matranga, 2017), and often with the purpose of probing student thinking (Fukawa-Connelly et al., 2018)—key components of effective feedback (Heritage, Kim, Vendlinski, & Herman, 2009) that can get students to share additional thinking. Thus, Noticing and Wondering can function as both a tool for making student thinking public and a scaffold for developing feedback that leverages this thinking for learning.

When multilingual learners notice and wonder, their ideas are made public, providing teachers the opportunity to give feedback on student content knowledge *and* language development. For example, Silva and colleagues' (2012) 5Rs model conceptualizes that as teachers and peers give feedback to ELs, they *replace* conversational with academic language, *reveal* new academic language that more precisely articulates content, and *repeat*

academic language in ways that solidify long-term memory. Noticing and Wondering's built-in negotiation of meaning builds language proficiency and complexity in tandem with conceptual complexity (Walqui & Heritage, 2012).

Builds Classroom Communities

Teachers' anxiety about classroom management may also contribute to their slow embrace of the new paradigm because of the perception that joyful and loud student talk signals disruptive behavior rather than productive collaboration that moves in and out of focus throughout a typical lesson. Wenger (1998) defines a community as a group of people who share common goals and tools and who engage in a common set of practices. Important factors for the emergence of successful learning communities include norms that engender collective reflection, critical examination of day-to-day problems of practice, and development of trust (van Es, 2012). In a study of teachers' online collaborative mathematical activity where Noticing and Wondering was used as the guiding practice for math, it effectively scaffolded teachers in considering, taking up, and responding to colleagues' ideas (Matranga, 2017). In addition, teachers reported that application of Noticing and Wondering in their school classrooms supported more frequent student-to-student interactions (Klein et al., 2019). We argue that the research just described suggests Noticing and Wondering has potential to scaffold classroom norms that increase student engagement and contribute to community development processes in school classrooms by providing a common practice to engage with classroom content. Building classroom community has implications for resolving classroom management issues that many teachers and in particular new teachers experience.

Multilingual learners are more likely to take productive, academic risks when they feel part of a positive, supportive community (Cline & Necochea, 2003) with "norms, values and routines that are understood and shared" (Walqui & Heritage, 2012, p. 97). Accessible and transparent routines like Noticing and Wondering can be particularly effective in increasing multilingual learners' confidence because there is likely a better collective understanding of acceptable ways to contribute to the classroom dialogue.

Promotes Evidence-Based Dispositions

Even teachers embracing the new paradigm may struggle to find mechanisms for sustaining consistent evidence-based thinking in their classroom. One of the core applications of Noticing and Wondering is for engaging in mathematical practices, reflection and mathematical discourse, and problem solving (Hogan & Alejandre, 2010; Powell & Alqahtani, 2015; Ray-Reik, 2013). Ray-Reik (2013) presented Noticing and Wondering as a scaffold for supporting students' engagement in the Common Core Standards for Mathematical Practices (NGA Center and CCSSO, 2010), in particular to "make sense of problems and persevere in solving them" (p. 6). Noticing and Wondering, along with the prompt *What does this mean?* has been effective in promoting student reflection on mathematical activity as a starting point for engaging productive mathematical discourse with peers (Powell & Alqahtani, 2015). Noticing and Wondering is also effective in supporting learners to engage with a mathematical scenario by noticing important aspects of the scenario and wondering about the underlying mathematics of the scenario (Hogan & Alejandre, 2010). We argue that many students typically disengage in mathematics classes because of boredom or

the common "I'm bad at this subject" mantra. Noticing and Wondering creates an easy access point for engaging with mathematics because everyone can notice and wonder, and teachers' use of Noticing and Wondering in instruction signifies a valuing of all students as mathematically competent.

By creating a routine in which even emergent multilingual learners are invited to look for evidence, pose questions, and construct arguments or explanations, Noticing and Wondering embodies the new paradigm's call to open access to academic processes simultaneously with English language development and avoiding the old paradigm's separation of these. Multilingual learners are empowered as much as any other student to begin immediately to work toward the generativity and autonomy of thinking at the heart of the academic disposition (Walqui & Heritage, 2012).

Moves Teachers Toward New Paradigm

Considering the complexity and pressures of the job of teaching, it is tempting even for teachers partial to the ADP paradigm to revert to a coverage mentality from the traditional paradigm and quickly move through a lengthy list of topics with lack of depth. Noticing and Wondering is empathically approachable for teachers, yet it productively disrupts typical practices in mathematics instruction that focus on supporting students in completing problems and getting correct answers (Shumar & Klein, 2016). Noticing and Wondering slows down the process of teaching and learning and engenders dialoguing with students about their thinking in deeper and more meaningful ways (Shumar & Klein, 2016). In addition, research shows that after a 6-week professional development course centered on the pedagogy of Noticing and Wondering, teachers' perceptions of the uses of Noticing and Wondering expanded from a tool for increasing engagement to a tool for problem solving, formative assessment, and promoting student-to-student collaboration (Klein et al., 2019). Thus, there is emerging evidence that, even in short periods of time, Noticing and Wondering begins to scaffold teachers in shifting towards classrooms that value thinking and talking about mathematics.

Multilingual learners have historically been shortchanged by conceptions of sheltered instruction or integrated English language development that were perceived by teachers as too complex to implement. Given the potential benefits of Noticing and Wondering for multilingual learners discussed above and teachers' perceived accessibility of Noticing and Wondering, we argue that Noticing and Wondering can create more equitable opportunities for ELs as mathematics classrooms become more discourse-rich learning environments. Noticing and Wondering on its own is not a sufficient form of differentiation for multilingual learners, but it can open a gateway to the new paradigm of English language development for many teachers.

Conclusion: Noticing and Wondering Across Content Areas

For the reasons just detailed, Noticing and Wondering is a promising framework for teaching and learning in the new paradigm, with clear benefits for multilingual learners. Noticing and Wondering may evolve as it enters fields beyond math, but what makes it recognizable is its consistent rather than occasional use as a structuring element of classroom discourse. That said, it seems to have taken root outside the classroom as well. Outdoor education is increasingly embracing a three-prompt framework of "I notice . . ., I wonder . . ., it reminds me of . .

.,” *not just as an occasional activity but as a driving mechanism of how teachers can approach their practice and frame learning for students*. Scholars at the Lawrence Hall of Science (2015), housed at the University of California Berkeley, frame this manifestation of Noticing and Wondering as an "essential routine" (p. 2) that "many instructors say . . . is their most effective tool" (p. 2) for scaffolding careful observation. The authors even suggest that one might add a fourth prompt —"Could it be . . . " (p. 11)— to move students from careful observation to the construction of potential explanations. This model could be broadly applied to science in all its forms and could benefit from empirical study of its impact.

We call other fields' attention to the potential of linguistically responsive Noticing and Wondering to support shifts to the new paradigm. Fruitful areas of research may include examining how application of Noticing and Wondering in the ways discussed above can support (1) teachers in shifting to and remaining within the new paradigm, and (2) ELs' development of disciplinary understandings and academic language.

We also call current teachers both within and beyond mathematics education to begin integrating Noticing and Wondering into their practice for the benefit of multilingual learners in particular. Our past work has shown that potential productive pathways to success with Noticing and Wondering might include initially integrating Noticing and Wondering as a way to support students' engagement with new content, establishing as a classroom social norm students' use of Noticing and Wondering to respond to classmates' ideas, and using Noticing and Wondering as a frame to guide the development of feedback to students (Klein et al., 2019). We also encourage teachers and teacher educators to participate in the ongoing Twitter conversation related to Noticing and Wondering at #noticewonder to engage in dialogue with others about experiences implementing Noticing and Wondering. Our hope is that this discussion may spark a more unified effort in teacher education towards understanding how linguistically-responsive Noticing and Wondering can make students' educational experiences more effective, equitable, and empowering.

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Appendix

Table 1. *An outline of the differences between paradigms.*

Theme	Narrowed Paradigm: Teaching of Information and Skills	Broadened Paradigm: Access to Discourse and Practices
Theoretical grounding		
Basic metaphors	Acquisition of static knowledge (Sfard, 1998) Compensation for perceived student deficits (Flores, 2005)	Participation in a more open-ended process of acquisition (Sfard, 1998) Enrichment of student assets with even more knowledge (Johnson, 2000)
Theories of learning and knowledge	Knowledge as skills and information (Hull & Moje, 2012) Behaviorism and individualistic constructivism Freire's (2018/1968) banking model: Learner as primarily a recipient or reproducer of knowledge from experts	Knowledge as practices and discourse (Hull & Moje, 2012) Social constructivism, collective meaning making in community (Lave & Wenger, 1991; Vygotsky, 1978) Freire's (2018/1968) problem-posing model: Learner as an empowered producer and recipient of knowledge given access to the processes of the experts
Types of knowledge most valued	Teacher-centered, often scripted (Milner, 2013) Content knowledge Facts, right answers, and procedures Produced by dominant cultures (Nieto, 1992)	Student-centered and responsive to context and identity (Nieto, 1992) Conceptual understanding of content paired with language development Big ideas, inquiry, and dialogue Multicultural (Nieto, 1992)
Enactment at the classroom level (mathematics as an example)		
Classroom tasks in mathematics	Applying learned procedural knowledge to "pseudo contexts" A series of similar small tasks or worksheets with spaces for the answers.	Solving authentic problems and engaging in disciplinary practices (e.g. mathematical practices; CCSSM)) An inquiry project.
Lesson structure in mathematics	Lecture then practice via "I do, we do, you do..." Focused on learning procedures for particular types of problems and reproducing those procedures when presented with a problem in that type.	Making sense of authentic problems, solving those problems in groups, and sharing and critiquing solution strategies across groups (NCTM, 2018).
Classroom discourse structure	Initiate-Evaluate-Respond as the core discourse structure, where teacher elicits an individual's answer and immediately praises or critiques it.	Scaffolds to support discussion, analysis, reflection, etc. Student-to-student academic conversations with periodic teacher intervention through revoicing, questioning and summarizing as the core discourse structure (Zhang, Lundeberg, & Eberhardt, 2011)
Assessment	Summative that focuses on products and sometimes the sorting out the "less worthy"	Formative (Black & Wiliam, 1998) that equalizes opportunity to succeed on summative assessments, in part, by focusing on the process