Differing notions of responsive teaching across mathematics and science: Does the discipline matter?

Andrew Elby, Jennifer Richards, Janet Walkoe, Ayush Gupta, U. of Maryland, TLPL, College Park, MD 20742
elby@umd.edu, jrich@umd.edu, jwalkoe@umd.edu, ayush@umd.edu
Rosemary Russ, University of Wisconsin–Madison, Dept. of C&I, Madison, WI 53706, rruss@wisc.edu
Melissa Luna, West Virginia University, Dept. of C&I, Morgantown, WV 26506, melissa.luna@mail.wvu.edu
Amy Robertson, Seattle Pacific University, Dept. of Physics, Seattle, WA 98119, robertsona2@spu.edu
Janet Coffey, Moore Foundation, 1661 Page Mill Road, Palo Alto, CA 94304, janet.coffey@moore.org
Ann Edwards, Carnegie Foundation, 51 Vista Ln., Stanford, CA 94305, ann.edwards@carnegie.org
Miriam Sherin, Northwestern University, SESP, Evanston, IL 60208, msherin@northwestern.edu
Beth van Es, University of California – Irvine, School of Education, Irvine, CA 92697, evanes@uci.edu

Abstract: Research in science and mathematics education suggests that the pedagogical practice of responsive teaching—teaching that notices, attends and responds to the substance (not merely the correctness) of students' thinking—supports student engagement in disciplinary practices. However, researchers in science education and researchers in mathematics education have tended to conceptualize "teacher responsiveness" differently. This structured poster session brings together researchers of teacher responsiveness in mathematics and science to begin hashing out, with each other and with attendees, the reasons for these differences. Do the different notions of responsiveness stem from epistemological differences between mathematics and science? From differences in the knowledge bases about student thinking in science vs. mathematics? This session will frame and initiate ongoing discussions of these issues, which are central to work on teacher cognition and practices in the context of teacher professional development—the focus of a growing number of learning scientists.

A. Overview: Focus of the symposium

Science and mathematics education researchers agree that effective instruction involves noticing, attending to, and responding to students' ideas (NCTM, 2000; NRC, 2012). So, researchers have studied teacher noticing, attention, and responsiveness in classroom and professional development settings (e.g., Ainley & Luntley, 2007; Ball, 1993; Brodie, 2011; Carpenter, Fennema, Peterson, Chiang, & Loef, 1989; Carpenter, Fennema, Franke, Levi, & Empson, 2000; Coffey, Hammer, Levin, & Grant, 2011; Crespo, 2000; Davis, 1997; Empson & Jacobs, 2008; Fennema et al., 1996; Franke, Carpenter, Fennema, Ansell, & Behrend, 1998; Franke, Carpenter, Levi, & Fennema, 2001; Gallas, 1995; Hammer, 1997; Hammer, Goldberg, & Fargason, 2012; Hammer & Schifter, 2001; Jacobs, Lamb, & Philipp, 2010; Kazemi & Franke, 2004; Lampert et al., 2013; Lau, 2010; Levin, 2008; Levin, Hammer, & Coffey, 2009; Levin & Richards, 2011; Lineback, 2012; Luna, 2013; Maskiewicz & Winters, 2012; Pierson, 2008; Richards, 2013; Rosebery & Puttick, 1998; Rosebery & Warren, 1998; Russ & Luna, 2013; Schifter, 2011; Sherin & Han, 2004; Sherin, Jacobs, & Philipp, 2011; Sherin & van Es, 2009; Star & Strickland, 2008; van Es & Sherin, 2008, 2010; van Zee & Minstrell, 1997; Walkoe, 2013; Windschitl, Thompson, Braaten, & Stroupe, 2012). However, explicit and tacit disagreements about what counts as noticing or responsiveness have arisen in the literature (e.g., Carpenter et al., 1989; Hammer, Goldberg, & Fargason, 2012; Pierson, 2008; Sherin, Jacobs, & Philipp, 2011; Sherin & Star, 2011). At first glance, some of the differences seem to fall along disciplinary lines, mathematics vs. science. Our session explores questions arising from this apparent divide: Is there a real split between mathematics and science education researchers about what responsiveness looks like and what counts as "progress" toward greater responsiveness? If so, from where does it stem, and why does it matter? Should the discipline matter in defining and assessing responsive teaching, or are discipline-independent conceptions more productive for guiding research and professional development? By gathering researchers of responsive teaching in both mathematics and science in the same room to discuss these issues, we hope to help different researchers understand each other's perspectives and clarify points of agreement, disagreement, and continuing discussion. Only through this type of dialogue among the perspectives can we develop robust characterizations of the practice of responsive teaching and subsequently use those characterizations to guide our research and our work with teachers.

Specifically, this session will feature six posters on teacher noticing and responsiveness, representing a range of institutions and perspectives. Five posters will focus on data from both pre-service and practicing teachers, gathered from both professional development and from classroom settings. **Session chair Andrew Elby** will take 5 minutes at the beginning to introduce the purpose of the session (as described above) and to quickly introduce those five posters and their presenters. (The slides from this introductory talk will constitute the sixth poster in the session.) Then, for the next 50 minutes, attendees will visit the posters to engage in

discussion with the presenters and with each other. Finally, during the last 35 minutes, **discussant Beth van Es** will synthesize the posters, offer her own perspectives from working in both mathematics and science teacher PD, and lead a discussion about the central issues of this session.

This session is of interest to learning scientists for several reasons. Given the proliferating approaches to teacher education and professional development that incorporate some notion of responsive teaching (ambitious teaching, high-leverage practices, etc.), it is essential that researchers either reach consensus about the nature of this construct or else understand the differences among various versions of the construct, and the advantages and disadvantages of those different versions for guiding research and professional development. That way, researchers can more effectively build on each other's work. With separate volumes published or soon-to-be-published on responsive teaching in mathematics (Sherin, Jacobs, and Philipp, 2011) and science (Hammer, Robertson, and Scherr, forthcoming), the time is ripe for bringing mathematics and science educators together to continue hashing out these issues.

B. Major issues addressed

In this section, we first present a brief overview of the major issues spanned by the five posters. Then, we present extended abstracts of the five posters.

The major issues addressed in this symposium include the following:

- *What does responsive teaching look like?* Work in mathematics and science education that explores teacher attention often takes a unidimensional perspective; it focuses on defining to what extent a teacher's practice is or isn't responsive to student ideas. The posters in this session push to flesh out the notion of responsiveness by exploring whether and how contextual features change what constitutes responsiveness. Walkoe and Sherin's poster explores how the specific domain (or subdiscipline) of teaching influences what counts as teacher responsiveness; they document changes in noticing that arise out of participation in a video club focused specifically on *algebraic* (as opposed to general mathematical) thinking. In contrast, Luna explores how responsiveness looks different depending on whether the teacher framed the classroom activity as sharing information or making sense of ideas. Finally, Coffey and Edwards document that pre-service elementary school teachers displayed different types of responsiveness when teaching mathematics vs. science. A thread connecting these posters is the role of context in defining and explaining teachers' responsiveness. The symposium seeks to shift the focus away from the unidimensional and toward multi-faceted characterizations of responsiveness situated in the particulars of context (whether it be disciplinary domains, types of classroom activities, or school subjects).
- *What does progress toward responsiveness look like?* We are interested in characterizing responsive teaching so that we can come to understand both (1) how teachers come to practice responsiveness and (2) how we can support teachers in enacting that practice. So, a second theme of the symposium is the exploration of what constitutes progress, or productive change, in responsiveness. This focus flows out of the first: the field has to date taken progress toward "greater teacher responsiveness" to be greater attention and responsiveness to the detailed substance of students' reasoning. Such a definition of progress is a necessary side effect of unidimensional descriptions of what constitutes responsiveness. These posters suggest, however, that as our images of responsiveness become more complex and nuanced, so can our conceptualizations of progress. Building on prior work (e.g., Jacobs, Franke, Carpenter, Levi, & Battey, 2007), Walkoe and Sherin's poster described above shows that, at a fine-grained level, "greater responsiveness" might look different in different areas of mathematics (e.g., geometry vs. algebra). Richards, Gupta, and Elby, analyzing video of the same science lesson taught by the same science teacher in two different years, argue that progress toward greater responsiveness can consist not just of greater attention to substance, but rather, greater attention to certain discipline-specific *facets* of the substance of student reasoning. Stepping back from particular cases of progress, Russ et al. argue that what constitutes progress in responsiveness is driven by teacher and researcher assumptions about student cognition and the state of education research. Specifically, they argue that an educator's sense of what constitutes "good" vs. "less good" responsiveness depends on the extent to which the educator (i) assumes student learning consists of moving through a hierarchy of progressively more sophisticated ideas, and (ii) understands education research as having fully mapped the terrain of student thinking about that topic.

Together these two issues add complexity to our understanding of the practice of responsive teaching. The addition of that complexity provides us with a range of theoretical and empirical machinery to explore the question of the disciplinarity of responsiveness. In other words, when taken together, these posters allow us to address the question, *Should conceptualizations of responsive teaching be (sub)discipline-dependent?* Our

sense from these posters is that, in some ways, disciplinary divides may actually obscure the very complexity and substance of issues surrounding responsive teaching, issues that warrant deeper examination.

Given this overview of the most important issues addressed by our session, we now present the five posters.

Poster #1: Characterizing a New Form of Productive Change in Teacher Responsiveness

Jennifer Richards, Andrew Elby, and Ayush Gupta

A growing body of work examines how teachers' attention and responsiveness to student thinking changes over time. This work considers the specificity with which teachers attend to students' ideas (e.g., van Es, 2011), the stance teachers take toward students' ideas (e.g., Crespo, 2000), and/or the types of follow-up moves teachers make (e.g., Pierson, 2008). While these foci foreground how teachers treat students' ideas, they do not clearly address how teachers link students' ideas to disciplinary ideas and practices. Our aim is to bring discipline-specific considerations into the discussion of changes in teachers' responsiveness.

Our perspective aligns with work emphasizing the "twin imperatives of responsiveness and responsibility" (Ball, 1993, p. 374) – grounding instruction in students' ideas while helping them learn important disciplinary ideas and practices. By looking for the beginnings of science in what students are saying and doing (Hammer & van Zee, 2006), teachers can help students see their contributions as productive in the doing of science and can help students refine their scientific thinking and content understandings.

We report on a comparative case study of two class discussions from Mr. S's seventh-grade science class. These discussions feature the same experienced teacher teaching the "same" lesson in consecutive years, attending and responding to students' ideas about the same physical scenario. We drew on a range of discursive markers to characterize his responsiveness in each case – how he revoiced students' ideas (e.g., O'Connor & Michaels, 1993), how and when he pressed on students' ideas (e.g., Brodie, 2011), and when he made bids to close the conversation (e.g., Schegloff & Sacks, 1999). We also examined video of teacher meetings and one-on-one interviews to probe Mr. S's perspective on these classroom discussions.

In the year 1 discussion, Mr. S foregrounded students' identification of the causal *factors*, the entities responsible for the motion they predicted. In general, if the factor causing the motion was not apparent in a student's explanation, Mr. S pressed the student to articulate it; if the factor was apparent, Mr. S accepted the student's response. In contrast, in the year 2 discussion, Mr. S foregrounded students' articulation of causal *stories*—mechanistic explanations—of what they thought would happen. This foregrounding involved his continued pursuit of different stories and details that fleshed out *how* the factors students identified resulted in the posited outcomes. Our poster will also examine influences on Mr. S's responsiveness in each case.

This work adds a disciplinary lens to the ongoing discussion of change in teachers' attention and responsiveness to students' ideas. Doing so raises important questions about what should count as—and where we might look for—progress in teachers' changing practices over time, and whether discipline-independent notions of responsive teaching are sufficient to capture a teacher's progress toward greater responsiveness.

Poster #2: The Subdiscipline Matters – Teacher Noticing of Student Algebraic Thinking

Janet Walkoe and Miriam Sherin

The work on teacher noticing in mathematics primarily looks at teacher noticing of students' mathematical thinking in general without focusing on particular mathematical domains. However, exploring teacher noticing in specific domains may be important: paying attention to specific content areas can matter in professional development (e.g., Garet, Porter, & Desimone, 2001; Kennedy, 1998), and PD programs that are specific to the content teachers teach have more positive outcomes in terms of student achievement and student conceptual understanding (e.g., Kennedy, 1998). Therefore, exploring teachers' attention and responses to students' thinking in a specific content domain is likely to inform PD efforts to support the teaching and learning of that domain.

Following Schoenfeld (1988, 1998), we take the perspective that teachers' beliefs about what counts as knowing the discipline and about what students need to know to succeed influences what they attend to respond to in the moment. In the algebra classroom, attending to productive student thinking can be difficult for reasons that may be particular to algebra. Historically, algebra instruction focuses on symbol manipulation and procedures, often at the expense of a more conceptual understanding (e.g. Chazan, 1996, 2000; Kieran, 1992). As a result, many students end up manipulating symbols by rote (Kieran, 1992). We believe teacher attention may play an important role: many teachers tend to focus on symbol manipulation above more conceptual forms of algebraic thinking (Stephens, 2008; Walkoe, 2010). If teachers believe algebraic thinking is synonymous with manipulating symbols and carrying out procedures, they may fail to attend to aspects of students' reasoning that

could serve as a foundation for helping students understand the content on a more conceptual level. In this poster, we describe a study that addresses this issue head-on.

Thirteen pre-service mathematics teachers in a large Midwestern city participated in the study. All thirteen teachers were asked to complete a pre and post task as well as six weekly tagging assignments using an online tagging tool that prompted teachers to watch a video and tag and discuss compelling moments of students' algebraic thinking. However, seven of the thirteen were asked to participate in a video club that focused on algebra classes.

We analyzed what moments the teachers tagged and what they wrote about those moments. Bottom-up categorization of the teachers' tagged commentaries, followed by quantitative analysis of changes in depth of various types of categories, enabled us to explore differences in noticing of algebraic thinking among members of the video club group and non-video club group.

Compared to the non-video club group, the video club group showed more change over time in the type of algebraic thinking they noticed and the depth with which they discussed student thinking. In addition, certain types of student algebraic thinking (e.g., reasoning about representations) appeared to prompt more in-depth analysis by the teachers than did other types (e.g., symbol manipulation).

This study illustrates that researchers and teacher educators can gain insights into improving PD by attending to sub-disciplinary aspects of students' thinking, such as algebra-specific types of symbol manipulations and use of representations. It also illustrates that conceptualizations of teacher responsiveness may need to be subdiscipline dependent, in focusing on the particular "distractors"—such as algebra students' rote manipulation of symbols—that tend to compete with attention to the substance of student thinking in the subdiscipline.

Poster #3: Framing the Task – Variation in One Teacher's Attention to Students' Ideas Expressed While Engaged in Disciplinary Practices

Melissa J. Luna

This study focuses on an elementary teacher's noticing and responding to his students' ideas as they engage in science disciplinary practices. I show that what the teacher counts as "noticing student ideas" can vary according to the type of activity in which the students are engaged.

What teachers notice in student thinking, and even what counts as noticing student thinking, is context-dependent and particularly sensitive to the teacher's epistemological framing of the activity—his sense of what counts as knowledge and learning in a given moment. Thus, two bodies of prior research inform this work: (1) teacher noticing (Sherin, Jacobs, & Philipp, 2011) and, (2) teacher epistemological framing (Levin, Hammer, & Coffey, 2009). Specifically, this work examines a teacher's epistemological framing of the very specific activity of noticing students' science ideas.

To accomplish this, I equipped the teacher with a wearable camera that continuously records what the teacher is seeing and hearing; but it only saves the 60 seconds of footage that occurred immediately *before* the teacher pushes a button. The camera can save several hours of these 60-second snippets, thereby capturing events the teacher noticed immediately after the fact.

The teacher wore this camera on thirteen occasions while teaching and was instructed to "capture students' science ideas." After each lesson, I reviewed each captured moment with the teacher to clarify the student's idea and why it was chosen. Data consist of 411 video clips each with a corresponding reflection. The analysis presented in this paper uses a similar analytical approach to Russ & Luna (2013), using bottom-up coding to classify different types of captured moments, to identify patterns in those moments, and to infer from these patterns the different frames the teacher draws on when attending to students' ideas.

Across the 13 tapings, the teacher captures many different kinds of moments, from students sharing examples, to guessing outcomes, to describing instances. However, he captures three specific kinds of moments more often than others: (1) factual statements offered by students while telling information, (2) descriptions offered by students while constructing meaning, and (3) explanations offered by students while drawing conclusions. Category (1) "captures" occurred primarily during classroom activities the teacher identified as information sharing; category (2) captures primarily occurred during activities the teacher identified as sense-making; and category (3) captures occurred when the activity was drawing conclusions. This paper discusses his noticing patterns and the connection to disciplinary practices in more detail.

This research contributes to our understanding of how teachers frame the nature of "responsiveness," especially the noticing of student ideas. Responding to students' science ideas involves more than the presence of ideas and the ability to notice those ideas. It also involves a teacher's in-the-moment understanding of what counts as note-worthy ideas. This study shows that a teacher's sense of note-worthy ideas depends on the disciplinary practices in which he perceives the students to be engaged, motivating future research to investigate this connection in more detail.

Poster #4: The Subject Matters for Teachers' Perceptions of Responsive Teaching

Janet E. Coffey and Ann R. Edwards

This paper argues that the subject matters for what teachers consider to be responsible, responsive teaching. Analysis focuses on establishing patterns of responsive teaching in science and mathematics, and understanding how the discipline influences how teachers respond to student ideas and reasoning. We argue that understanding these dynamics is important for teacher educators working with elementary teachers, who generally teach across disciplines and who often do not have strong backgrounds in mathematics or science.

We situate this work within efforts to establish more empirically-grounded and practice-based accounts of pedagogical content knowledge (Ball & Bass 2003; Kazemi et al, 2009; Putman & Borko, 2000). We align with work that seeks to better understand and support teachers' learning of "high leverage" practices within disciplinary areas (Franke & Chan, 2006). We consider the ways in which content knowledge and backgrounds become consequential as teachers interact with students in different disciplines.

Primary data come from a semester-long course within a STEM certificate program for practicing elementary teachers. Data include (i) video records of course meetings and (ii) course assignments such as written reflections and activities involving analyses of students' scientific and mathematical thinking, field-based assignments involving instructional design and implementation, observations of teaching, and written assignments probing the teachers' own mathematical and scientific thinking.

Analyses sought to examine the nature of differences and similarities across subject areas. Iterative coding yielded categories and revealed patterns of variation. Several cases were chosen for closer analysis that either represented typical patterns or that contrasted to prevailing patterns. Categories were then used to structure a closer comparative analysis of parallel assignments and participation in course activities for selected cases.

We build on a previous study of mathematics and science methods pre-service coursework that revealed that the same prospective teachers often attended differently to student thinking and participation across subjects, due to their orientation towards and relationship with the disciplines of mathematics and science (Coffey & Edwards, in revision). This paper focuses on data from a professional development setting. Contrasts in what participants noticed in videos of math and science teaching suggest the extent to which school standards and school curricula shape teachers' ideas of the nature of the discipline, constraining their sense of what counts as "responsiveness." The teachers in the professional development course responded critically to interactions in Deborah Ball's classroom (the "Sean's numbers" video) where an elementary classroom argued about whether 5 was an even or odd number. They were critical of Ball's choice to encourage the argument, particularly when one boy, Sean, took the position that 5 was both an even and odd number. They were unanimously concerned that Sean's idea was incorrect and that allowing the idea to persist would undermine students' understanding of even and odd. By contrast, the same group of teachers had a very different reaction to a video of students at the same grade level discussing whether air is matter or not matter. When in the video a student offered that air could be both matter and not matter and the student's teacher encouraged other students to respond to this idea, teachers in the professional development expressed excitement about the nature of the student reasoning and were supportive of the teacher's moves facilitating the discussion. The parallel nature of the examples and differing reactions highlight how teachers' perceptions of math and science as school subjects, in addition to as disciplines, shape their responsiveness.

This work contributes to teacher education literature that shifts the focus of pedagogical content knowledge from requisite teacher knowledge to practices through which that knowledge is employed, importantly in interaction with and in response to students' ideas and reasoning (Kazemi et al, 2009). We highlight the capacity of teacher education and professional development to help teachers establish practices of disciplinary attending that contribute to more robust notions of disciplinary learning and understanding and deeper conceptual understandings - for teachers and their students. We argue for the importance of supporting teachers' navigation across subject areas - including across the nature of the discipline and the disciplines as represented in school and text. We also intend this work to inform the debate on the discipline-specificity of "teacher responsiveness" by illustrating how variations in teacher responsiveness across school subjects might not align with variations in experts' responsiveness across different authentic disciplinary practices.

Poster #5: Is the Discipline Really the Issue? – Why Mathematics and Science Educators Sometimes Disagree about What Counts as "Responsiveness"

Rosemary Russ, Andrew Elby, Jennifer Richards, Janet Walkoe, Amy Robertson, and Melissa Luna

A variety of professional development (PD) has been designed to support teachers in enacting the practices of responsive teaching (e.g. Fennema et al., 1996; Hammer & van Zee, 2006; Sherin, Jacobs, & Philipp, 2011; Windschitl, Thompson, & Braaten, 2011). Examination of these PD efforts reveals differences in how PD designers conceptualize responsive teaching and its development in teachers. In this work we propose a

framework for characterizing and helping to explain the differences in the (sometimes tacit) conceptualizations of responsive teaching evident in these diverse research and professional development efforts. We suggest that this framework allows us to see through seemingly disciplinary differences among professional development efforts to the assumptions that underlie those efforts.

Our framework arises out of the perspective that an educator's conceptualization of responsive teaching reflects her (tacit or explicit) views about (i) the nature of student learning, and (ii) the ways in which research about students' learning of a given domain can and should inform teaching in that domain. Therefore, articulating researchers' tacit or explicit understandings of student cognition (e.g. Hammer, 1996) and their views about the role of research in teaching is essential for making sense of differing conceptualizations of responsive teaching.

To explore conceptualizations of responsive teaching, we conducted secondary analyses of published work on professional development (PD) and research targeting responsive teaching. We looked for patterns connecting the conceptualization of responsive teaching enacted in the PD or operationalized in the research, the researchers' assumptions about students' cognition and learning, and their views about the role of research in PD and teaching.

We argue that the differences between conceptualizations of responsive teaching can be characterized and explained largely by the educators' views about the extent to which (1) education research has fully mapped the terrain of student thinking in that domain, and (2) student learning in a given domain consists of moving through a hierarchy of progressively more sophisticated stages of thinking.

Some of the work on responsive teaching in mathematics (tacitly or explicitly) assumes what we call a Covering Model, according to which student thinking has been mapped in sufficient detail to specify a hierarchy of ways of thinking through which students typically progress. A paradigmatic example of a Covering Model drives PD in *Cognitively Guided Instruction* (CGI) (Fennema et al., 1996; Franke et al., 2001). CGI PD builds on the extensive, fine-grained body of research about early elementary students' thinking in arithmetic. The PD teaches teachers about the common stages of reasoning (set of strategies) students use and how to help students build on their current strategies to reach the next stage. So, CGI and other Covering Model-based PD assumes that the terrain of students thinking in the domain is quite well mapped and that student learning—with proper instructional support—generally progresses through predictable stages. Therefore, expert responsive teaching in the CGI paradigm consists largely of (a) recognizing which previously-documented strategies a student is using and (b) choosing problems and instructional moves designed to help students reach the next level of thinking—though of course, teachers should be ready to "hear," interpret, and improvisationally respond to unexpected reasoning.

By contrast, PD in the *Learning Progressions in Scientific Inquiry* project (Hammer, Goldberg, & Fargason, 2012) proceeds from the assumptions that (i) there is substantial variability and unpredictability about how students will reason about a given scenario relating to a topic such as energy, and (ii) learning is highly individualized, involving a complex interplay of evolving conceptual understandings, habits of mind, epistemic stances, and emotions. Therefore, PD in this project focuses largely on helping teachers to interpret the substance of student reasoning and to improvise next steps in response to various facets of that thinking (conceptual, epistemic, etc.). In this paradigm, expert responsive teaching consists largely of "hearing" and improvisationally nurturing the seeds of productive conceptual understandings and scientific practices in the substance of students' reasoning—though of course teachers should draw on research and their own experiences to recognize and plan for common patterns of reasoning.

To be clear, we do not think either of these two models of PD is "better" than the other, nor do we make claims about the validity of the assumptions underlying either model. Additionally, our short summaries of these models likely overemphasizes the differences between them, differences we view more as points on a continuum than as a dichotomy. Our purposes in doing so are to demonstrate and explicate how:

1. Differences in conceptualizations of good responsive teaching, and corresponding differences in PD regimens and assessment tools, stem in part from researchers' different assumptions about (a) how well-mapped student reasoning is in the targeted domain (b) the degree to which student learning can be characterized as progress through progressively more sophisticated stages of thinking.
2. In mathematics and science education, some of the seemingly intra- and inter-disciplinary differences in conceptualizations of responsive teaching stem from point (1) instead of from actual differences in (sub)disciplinary epistemologies.

C. Potential Significance of the Contributions

Historically, work in the learning sciences has focused more on student cognition and on learning environments than it has on teacher cognition and teacher interactions with students. This is starting to change, with a growing number of learning scientists doing research on teacher thinking and practices. A focal point for much of this research has been the construct—or really, a cluster of related constructs—of teacher

noticing/attention/responsiveness, with work done by the contributors to this symposium and by others. What has been missing is sustained cross-talk between work on science teacher responsiveness and work on mathematics teacher responsiveness. In our view, the major contribution of this symposium is bringing together LS-oriented researchers of teacher responsiveness, including both participants and attendees, to begin discussions and (we hope) collaborations that will continue for years.

Of course, simply bringing people together isn't enough. In section B above, while describing the individual posters and also the broader themes cutting across the posters, we made the case that this symposium pushes the field forward by helping to frame and initiate discussions about cutting-edge, contested central issues in conceptualizing, operationally defining, and assessing teacher noticing/attention/responsiveness. In doing so, we hope to refine and accelerate the contributions of LS-oriented researchers to understanding teacher cognition and practice. A deeper understanding of teacher cognition and practice in general, and teacher noticing/attention/responsiveness in particular, can contribute not only to theory-building about cognition and interaction, but also to teacher education and professional development efforts aimed at helping teachers foster deeper conceptual learning and productive disciplinary engagement (Engle & Conant, 2002) in their students.

D. How the presentations fit together

As just discussed, the point of this session is to bring together—and we hope, enlarge—the LS subcommunity focused on teacher responsiveness, in order to frame and initiate discussion and collaboration among researchers focused on mathematics teachers and those focused on science teachers.

The posters form a coherent whole. As discussed at the beginning of Section B, the posters individually and collectively address the following cluster of tightly related issues:

- *What does responsive teaching look like* in light of contextual factors such as those leading the teacher to frame of the classroom activity in particular ways, the teacher's views about and experiences with the subject being taught, and competing foci of attention associated with particular (sub)disciplines (e.g., students' rote symbolic manipulation in algebra)?
- *What does progress toward responsiveness look like* in light of (sub)discipline-specific foci of attention associated with productive disciplinary engagement and the researcher's assumptions about the nature of "good teaching" based on their reading of the research on student learning?
- *Should conceptualizations of responsive teaching be (sub)discipline-dependent*, and if so, in what ways? The answer, of course, is bound up with the first and second issue.

In brief, the posters all address the contested issue of how best to conceptualize "teacher responsiveness," and the Session Chair's introduction will focus on highlighting that coherence.

E. Relevance to conference theme

We end with a brief speculation about how research that builds on this session might relate to the conference theme. Conversations among the contributors to this symposium have revealed a shared experience in working with teachers who became significantly more responsive: Becoming "more responsive" in various technical senses was bound up with the teachers' changing visions of themselves as teachers, and with their "professional vision" (Sherin, 2001). Yet, this notion of becoming a certain kind of teacher has received minimal attention in the teacher noticing/attention/responsiveness literature. We acknowledge that our own work has generally backgrounded issues of identity and becoming. Interestingly, however, work in progress by some of the participants has begun to foreground these issues.

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