Accounting for How Practitioners Frame a Common Problem of Practice – Students’ Struggle in Mathematics

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Abstract

A central goal of ambitious teaching is to support all students to participate in rigorous mathematical activity. However, in any instructional regime, at least some students are bound to struggle at particular times (e.g., with specific content, with participating in mathematical practices). Prior research suggests that how teachers frame the problem of student struggle in mathematics impacts instructional decisions. In this paper, we argue that being able to support all students to participate in rigorous mathematical activity entails developing productive framing regarding students’ struggle in mathematics. We describe the development of an interview-based assessment of how practitioners frame students’ struggle, and we argue that assessing this is important when both trying to design for and account for instructional improvement aimed at rigorous learning goals for students. One dimension of framing is diagnostic, or the nature of how a practitioner explains, or frames, student success or failure in mathematics. A second dimension is prognostic, or how a practitioner describes the nature of supports s/he provides to struggling students. In addition, we provide descriptive statistics of the use of this assessment in a large-scale study investigating instructional reform in middle-grades mathematics. A team of coders used a coding scheme to code 936 interviews with teachers, coaches, and school leaders across five years. Initial findings suggest that participants’ framing generally remained static over the course of the study. School leaders’ and coaches’ frames were generally more productive than those of the teachers. This snapshot illustrates that a significant challenge in mathematics education reform efforts entails supporting the reorganization of how practitioners frame the problem of students’ struggle in mathematics.
Accounting for How Practitioners Frame a Common Problem of Practice – Students’ Struggle in Mathematics

The adoption of the Common Core State Standards in Mathematics by a majority of U.S. states, accompanied by the promise of conceptually-oriented state assessments, represents a particular moment in the history of mathematics education reform. It appears possible that what U.S. teachers will be held accountable for teaching may reflect what decades of research on mathematics learning and teaching suggests supports students to develop robust, enduring understandings of mathematics. However, the task of actually achieving the vision suggested in the Common Core is enormous, given what we know about most U.S. teachers’ current practices (Stigler & Hiebert, 1999) and what we know about the demands for teacher learning inherent in developing the forms of knowledge and practice necessary to achieve the goals outlined in the Common Core State Standards (Cobb & Jackson, 2011a).

For example, mathematics education research suggests that if students are to develop sophisticated understandings of mathematics, mathematical reasoning, and the ability to communicate effectively about mathematical ideas, they need to regularly engage in solving challenging, non-routine tasks that can be solved in multiple ways and with multiple representations (Stein, Grover, & Henningsen, 1996). Research also suggests that students need regular opportunities to justify, prove, and debate the accuracy of solutions and to compare solutions in an effort to identify mathematical connections between them (e.g., Franke, Kazemi, & Battey, 2007; Stein, Smith, Henningsen, & Silver, 2000). These goals for student learning and forms of instructional practice are often called ambitious because they are complex to support and develop, for both teachers and students (Lampert, Beasley, Ghousseini, Kazemi, & Franke, 2010). Development of ambitious forms of instructional practice requires considerable learning
on the part of practicing teachers, especially because most teachers have not had opportunities to learn mathematics in ways that are commensurate with the nature of opportunities to learn they are expected to provide their students (Stein, Smith, & Silver, 1999).

In addition to develop demanding forms of instructional practice, mathematics education research suggests the importance of teachers’ development of sophisticated mathematical knowledge for teaching, if they are to teach towards ambitious goals for students’ learning (Hill, Ball, & Schilling, 2008; Hill, Blunk, et al., 2008). Mathematical knowledge for teaching entails, for example, understanding the conceptual underpinnings of big mathematical ideas; understanding how, in general, children tend to develop important mathematical ideas over time, including the strategies they use, what they find challenging, and why; knowing how to use mathematical representations to model relationships in problems and to model students’ thinking; and being able to interpret specific students’ thinking, both in written and in oral forms, in order to assess and build on students’ current understandings to achieve a mathematical agenda.

In addition, teaching towards ambitious learning goals requires fundamentally different practices on the part of students than are typical in most math classrooms. In any instructional regime, at least some students are bound to struggle at particular times (e.g., with specific content, with participating in mathematical practices). It is likely that when attempting to accomplish ambitious goals for the teaching and learning of mathematics, struggle is even more prevalent – students are being asked to engage in forms of practice that they likely have not been asked to engage in before. Prior research suggests that how teachers frame the problem of student struggle in mathematics impacts instructional decisions (e.g., Diamond, Randolph, & Spillane, 2004; Horn, 2007; Jackson, 2009).
Coburn (2003) summarized the complexity of what is entailed in developing forms of ambitious instructional practices: it requires changes in teachers’ “underlying assumptions about how students learn, the nature of subject matter, expectations for students, what constitutes effective practice, underlying pedagogical principles,” and “norms of social interaction with students” (p. 4). It is likely, then, that supporting mathematics teachers to reform instruction involves supporting the re-organization of teachers’ visions of what counts as high-quality instruction, mathematical knowledge for teaching, forms of practice, and ways of framing (including approaching) students’ struggle in mathematics. This suggests the value of being able to assess, both prospectively and retrospectively, the forms of knowledge, practice, and perspectives that are necessary to accomplish ambitious instructional reform in mathematics. Although there are existing measures or assessments of the quality of instruction (e.g., Boston, 2012; Hill, Blunk, et al., 2008), mathematical knowledge for teaching (Hill, Ball, et al., 2008), and instructional vision (Munter, under review), we do not know of an assessment that targets how practitioners’ frame students’ struggle in mathematics.

In what follows, we describe our efforts to develop a way of reliably assessing how practitioners frame students’ struggle in mathematics (that could then be complimented with existing measures of, for example, mathematical knowledge for teaching and the quality of instruction). We begin by elaborating on how we conceptually approached this work. We then elaborate on the development of the specific assessment. As we explain below, we developed this assessment in the context of a longitudinal study of large, urban districts pursuing ambitious reform in middle-grades mathematics. We then provide descriptive statistics on what we found regarding teachers’, coaches’, and school leaders’ diagnostic and prognostic framing of students’ struggle in mathematics. This snapshot illustrates that a significant challenge in mathematics
education reform efforts entails supporting the reorganization of how practitioners frame the problem of students’ struggle in mathematics. Finally, we describe how the assessment we developed is related to, but distinct from, extant measure and articulate both the limitations and the potential uses of this specific assessment.

**Framing Problems of Practice**

Consider these two responses from middle-grades mathematics teachers to the following interview question: When your students don’t learn as expected, what do you find are typically the reasons?

Teacher 1: “I normally look first at me to see or is there something in the lesson that I didn't emphasize well enough or… I may talk to the teacher they had last year and say ‘When you went over this was this something that they struggled with?’”

Teacher 2: “Well I’m, you know, you’re not supposed to think necessarily but I, I believe there’s some innate, you know, ability in differences, you know…. You know again math comes easier to some kids than others, you know.”

In this paper, drawing from the literature on *framing* (e.g., Benford & Snow, 2000; Goffman, 1974), we suggest that Teacher 1 frames a common problem of students’ struggle in mathematics as related to instructional opportunities, while Teacher 2 frames this same problem as one due to inherent traits of students (e.g., some students are naturally better at mathematics than others). Furthermore, we suggest that the nature of these two frames likely has consequences for the quality of instruction and support that students receive in classrooms.

Framing refers to how a particular situation is understood or interpreted. In the case of a problem of practice, like student struggle in mathematics, particular frames offer particular representations of the problem, and therefore “inevitably highlight certain aspects of the situation
while deemphasizing others (Weiss, 1989)” (Coburn, 2006, pp. 343-344). Scholars across anthropology, sociology, and psychology have argued for the importance of attending to framing processes because how specific situations or problems are framed delimits what count as potential solutions (Benford & Snow, 2000; see also Hand, Penuel, & Gutiérrez, 2012). Relatedly, sociologists attend to at least two “framing tasks” when analyzing framing processes—*diagnostic framing* and *prognostic framing* (Benford & Snow, 2000). Diagnostic framing involves articulating the source of the problem, or as Coburn (2006) writes, “attributing blame,” whereas “[p]rognostic framing involves articulating a proposed solution to the problem” (p. 357). Further, as Coburn clarifies, the two tasks of framing are “intertwined, in that prognostic framing often rests implicitly on the problem definition and attribution that is part of diagnostic framing” (p. 357). For example, Teacher 1 frames the problem of students not learning as expected as instructional in nature, while instruction is noticeably absent in Teacher 2’s representation of the same problem. It is difficult to imagine, then, that given Teacher 2’s diagnostic framing of the problem that she would then alter instruction to support students who struggle in her class.

We draw from a few cases of framing analyses to illustrate why we are suggesting that identifying how participants frame the problem of student struggle in mathematics matters, particularly in the context of pursuing ambitious reform. For example, an ethnographic study of the implementation of an ambitious reading policy in a California elementary school, Coburn (2006) showed how the school’s response to the policy “depended on, in part, how teachers and principals constructed their understanding of the relevant problem to be solved” (p. 344). The majority of teachers initially framed the problem of their students’ poor reading comprehension as due to “student or family deficits” (p. 352) and some suggested it was an issue of
organizational features of the school, like class size. Only a minority framed the problem as one of instruction, and they only articulated this privately. On the other hand, the principal framed the problem as one of instruction from the outset of the reform. The principal recognized the importance of how teachers framed this particular problem; until they came to see it as a problem of instruction, it was unlikely they would work to implement the instructionally focused reform. As Coburn shows empirically, it took several months of principal-initiated conversation and activity aimed at reframing the problem for the majority of the teachers to appreciate the problem as one of instruction.

Similarly, in an ethnographic study, Horn (2007) studied the framing of a common problem of practice—the fact that not all students are academically successful in mathematics classrooms—by high school mathematics teachers in two high schools. To do so, she focused on the content and quality of teacher conversations in regularly scheduled teacher workgroups. She documented the categories that teachers used to describe groups of students, and in particular to explain why some students succeeded in classrooms while others struggled. Crucially, Horn found a relationship between teachers’ category systems for describing groups of students and teachers’ views of mathematics. She argued that the two were related, and that both informed how teachers framed the problem of differential success in the mathematics classroom.

Horn borrows from anthropologists’ use of the term category systems, which refers to how people collectively name and talk about people, objects, activity, and so forth. The categories that groups use render some aspects of an activity, object, or person visible and other aspects invisible (2007). Anthropologists detail cultural groups’ category systems because categories and their associated meanings reveal how groups organize and understand their local settings (Bowker & Star, 1999). Broadly speaking, categories provide a set of possible slots for
people to occupy (for examples in education, see Eckert, 1989, 2000; Horn, 2007; McDermott, 1993; Rampton, 2005; Rist, 1970; Wortham, 2008).

The local categories groups of people use to describe and understand a phenomenon, for example students’ performance in mathematics classes, are influenced by both formal and informal resources (McDermott, 1993). Formal schemes are often designed to support diverse groups of people to communicate about a similar phenomenon. For example, the recent No Child Left Behind legislation has provided a formal classification scheme of sub-populations of students (e.g., identified according to race/ethnicity, socioeconomic status, Limited English Proficiency status, and Special Education status). Most states mandate that districts (and in turns, schools) report achievement scores according to given categories of students. This scheme shapes the characteristics of students to which administrators and teachers attend. Academic tracks are another example of formal categories that shape how administrators and teachers view students (e.g., as “advanced” or “regular”). On the other hand, other informal categories are not likely to extend beyond a local setting.

Although distinct groups of people across contexts (and people within the same context) might use similar categories (both formal and informal), it is an empirical question as to what people mean by the categories they use. It is also an empirical question as to the nature of the consequences of categorizing, in this case, students in particular ways. That said, there are likely relations between the quality of categories used to describe students and ways of attending to and supporting students in classrooms. This is because, as Horn (2007) explains, one important function of categorizing is that it contributes to how problems of practice are framed.

In one department, Horn found that teachers tended to account for students’ performance in terms of inherent traits of the students (e.g., students were fast, slow, lazy). These same
teachers also tended to view mathematics as “a well-defined body of knowledge” with a rather fixed sequential order of topics (Horn, 2007, p. 43). Against this view of mathematics, the teachers aimed to cover the topics in a particular sequence to prepare students for subsequent coursework. And, when students did not learn as expected, teachers placed the blame on the students, and felt there was little they could alter about instruction.

Horn found that the teachers in the other department tended to view mathematics as a connected and conceptual web of ideas. They also tended to account for students’ performance in terms of the learning opportunities provided in the classroom. For example, rather than attribute a student’s struggles to “laziness,” they considered the nature of learning opportunities that had been provided to the student. Students’ engagement or disengagement depended, in part, on the nature of any given activity (rather than some inherent characteristic of the student). Therefore, if students were not engaged, the teacher was more likely to consider how she might alter instruction. And, because mathematics was viewed as a web of ideas, rather than a sequential ordering of topics, teachers felt more freedom in altering curriculum.

In sum, Horn (2007) argues that how teachers framed student success/struggle and mathematics together framed the instructional decisions and approaches they took in the classroom; she argues that framing discourses “[delimit] a range of reasonable pedagogical responses. Teachers can do little to change students’ innate abilities—their best chance is to be engaging, perhaps overcoming low levels of motivation. However, if teachers are given conceptual support to view mathematics in a more connected way, if they are provided with more complex categories of students in discussions issues in practice, the problem space for teaching shifts accordingly” (p. 74).
Another study that illustrates that how student struggle and success is framed matters for the design and enactment of classroom practice is that of Jackson (2009, 2011). In an ethnographic study of interactions in a fifth grade classroom that was part of a large middle-grades charter network that aimed to provide college-preparatory education to low-income children of color, she documented a tight coupling between how school staff framed who students were and their prior experiences and the quality of learning opportunities provided in mathematics. Discourses circulated at an institutional level that suggested that “these” students were under-prepared in their former neighborhood schools, and that they generally lacked the character and self-motivation necessary to succeed in a college-prep program. Therefore, school-wide instruction entailed enacting external motivation systems designed to support the students to develop the intended character traits. The fifth grade mathematics curriculum exclusively focused on developing a procedural understanding of mathematics – this was deliberate as school officials put forth that in light of the children’s prior schooling and home experiences, they arrived at the school absent “basic skills.” Jackson argues that had staff at Johnson Middle School framed who their students were in different ways, they might have designed and enacted different schooling and classroom practices.

Highlighted in all three of these examples is the fact that framing is a social process (Benford & Snow, 2000; Coburn, 2006; Goffman, 1974; Hand et al., 2012). Framing student struggle, as illustrated above, likely depends on teachers’ histories of working in a particular context, including relations of accountability and support with others – including instructional leaders, opportunities to collaborate with others, available tools, historical discourses regarding specific groups of students and why they succeed or struggle in mathematics, and so forth. Framing is also not a straightforward process – it is often “contested,” especially as different
individuals and groups negotiate alternative, or in some cases, competing frames (Coburn, 2006, p. 347).

Development of an Interview-Based Assessment of How Practitioners Frame Students’ Struggle in Mathematics

Research Context

In response to findings like those described above, we purposefully set out to develop a way of accounting for how practitioners’ were framing the problem of students’ struggle in mathematics in the context of a longitudinal study investigating instructional improvement in middle-grades mathematics at the scale of large, urban districts. The larger study is an eight-year study, with two phases. In Phase 1 (2007-2011), four districts were purposively selected to participate in the study for a few reasons. The districts were typical of large, urban districts in terms of the challenges they faced, including high teacher turnover and large numbers of students identified as low-performing. However, the districts were unusual in that they responded to high-stakes accountability pressures by attempting to achieve an ambitious vision of mathematics instruction, or instruction that at the time, was broadly compatible with the National Council of Teachers of Mathematics’ Standards (2000). In three of the four districts, teachers were provided with either the first or second edition of the Connected Mathematics Project (CMP) curriculum (Lappan, Fey, Fitzgerald, Friel, & Phillips, 1997, 2009) a curriculum aimed at supporting ambitious learning goals for students. (District leaders designed their own curriculum in one of the districts – the goals of which were broadly compatible with NCTM Standards). Additionally, in order to assist teachers to develop ambitious instructional practices, each district provided a number of supports (e.g., curriculum frameworks, professional development, regular time to collaborate with colleagues on issues of instruction, coaches, professional development for principals aimed at the development of instructional leadership). Given that the districts were
pursuing ambitious reform, we conjectured that it would be important to account for how
teachers, coaches, and school leaders framed a common problem of practice in the mathematics
classroom – that of students struggling, or not learning what the teacher intended. In Phase 1, in
each district, approximately 30 teachers and their instructional leaders (principals, assistant
principals, and coaches) located in a sample of 6-10 schools participated in the study. In Phase 2
(2011-2015), we continued to work with two of the original four districts. In each district,
approximately 60 teachers and their instructional leaders located in a sample of 12-13 schools
participated in the study.

Each year, several types of data were collected to test and refine a set a series of
hypotheses and conjectures about district and school organizational arrangements, social
relations, and material resources that might support mathematics teachers' development of high-
quality instructional practices at scale (Cobb & Jackson, 2011b; Cobb & Smith, 2008). Given
the scope and design of the MIST project, we were unable to investigate ethnographically how
teachers framed students’ struggle, as, for example, Horn (2007) and Jackson (2009) had.
However, we were curious regarding what we might be able to learn in interviews with a
relatively large sample of teachers and instructional leaders. Interviews would allow us to probe
on the context of practitioners’ work, thus allowing us to gather information closer to practice,
perhaps, than that collected through a survey measure. That said, we acknowledged that this
perspective on a practitioner’s framing was partial and limited– we would not be able to track,
for example, how teachers negotiated framings in conversation with one another or with their
instructional leaders.

Over the course of now seven years of data collection, we have refined a way of
assessing how participants frame student struggle, both diagnostically and prognostically,
through interviews. Interviews took place each January, and generally lasted 45 minutes. In addition to how participants framed student struggle, teacher interviews focused on their vision of high-quality mathematics instruction, their perceptions of the supports they received to improve their practice, and who they were accountable to and for what. Interviews with coaches and school leaders focused on similar aspects of their work, with of course, additional emphasis on either their coaching or school leadership practices.

**Dimensions of Framing the Problem of Students’ Struggle in Mathematics**

**Diagnostic framing: Explanations of students’ struggle (or success) in mathematics.**

In order to elicit how practitioners diagnostically framed the problem of students’ struggle in mathematics, we asked teachers and coaches questions like, “When your students don’t learn as expected, what do you find are typically the reasons?” We also asked teachers to describe the challenges they face, which often provide us with insight into how they frame student struggle. We asked school leaders, “Could you describe the gaps in mathematics achievement between various groups of students at your school?” as we knew this was a relevant problem of practice for them, given high-stakes accountability pressures. To elicit how they diagnostically framed the problem of students’ struggle, we then followed up with, “In your view, what are the sources of the gaps in mathematics achievement between these groups of students?” Furthermore, interviewers were trained to press on teachers’ explanations of why students struggle.

To be clear, our questions took some categories for granted. For example, we deliberately asked if teachers viewed all of their students as “motivated,” a potential category. Our purpose, however, in asking this question was to determine whether this was a relevant category for a teacher (which in most cases, it appeared to be), and more so, whether the teacher viewed
motivation as an inherent property of individuals (and thus unlikely to be affected by instruction) or as a characteristic that could be influenced in instruction.

We refer to our elicitation of participants’ diagnostic framing as participants’ “explanations of why students struggle (or succeed) in mathematics” (hereafter referred to as “explanations”). We include “or succeed” because we found that participants often compared “struggling students” with “successful students,” and that accounts of why some students succeed also suggest why some students fail, or struggle.

We make a distinction between two kinds of diagnostic frames, or explanations. In particular, does the teacher describe student struggle in terms of inherent traits of the child (e.g., laziness, lack of motivation) or due to factors outside of instruction (e.g., families, community)? Or, does the teacher frame a problem of student struggle (or success) as in relation to the nature of instruction, or learning opportunities? We termed the former unproductive explanations of student struggle and the latter productive explanations. We use the terms of unproductive and productive to signal that if, for example, a teacher frames the source of student struggle as outside of instruction, it is unlikely that she will act to examine or alter her current instruction to support the struggling child. On the other hand, if a teacher frames the source of student struggle as in relation to what is happening instructionally, we conjecture that she would be amenable to examining, and perhaps, altering her instruction.

Prognostic framing: Nature of instructional supports one provides (or should provide) for struggling students. The second dimension we elicit is a prognostic framing of student struggle – that is, how practitioners describe responding to struggling students (or their expectations for doing so, in the case of coaches and school leaders). To elicit participants’ prognostic framing, we followed up on diagnostic framing with questions like, “So what do you
do to address that challenge?” We also systematically asked teachers questions like if they found they needed to adjust their instruction for different groups of students, and if so, why and how they did so. We systematically asked coaches and school leaders what their expectations were for how math teachers should adjust their instruction for different groups of students.

We refer to our elicitation of participants’ prognostic framing as participants’ descriptions of how they (should) support students who are struggling in mathematics as another (hereafter referred to as “supports”). Given the nature of the reform that the districts were pursuing, we were particularly interested in the distinction between whether the teacher was deliberately working to support struggling students to participate in rigorous activity, or not. For example, imagine that a student is struggling to solve a rigorous math task in a math classroom where ostensibly the goal is to develop both conceptual understanding and procedural fluency in a range of mathematical domains. If a teacher suggests that the best way to support that student is to, for example, show the child how to solve the problem, it may indicate that the teacher does not frame that particular student as capable of achieving the ostensible learning goals, at least in that particular classroom context. On the other hand, imagine that the teacher suggests that the best way to support that student is to pre-teach some material that the student might need to draw on to engage in the task at a rigorous level. This may indicate that the teacher does frame that student as capable of participating in rigorous mathematical work, albeit with targeted support. We termed the former unproductive supports and the latter productive supports to indicate the extent to which the nature of supports described appear to frame the struggling student(s) as capable of participating in rigorous activity.

Of course, being able to describe what supports one might enact to provide access to a student without lowering the cognitive demand of the overall activity suggests that a teacher has
been provided with supports herself. It is worth noting that, to date, we know of little research that has investigated what supports teachers might enact to support struggling students to participate in rigorous mathematical activity (for exceptions, see Boaler & Staples, 2008; Horn, 2012).

**Development of a Reliable Coding Scheme for Assessing Practitioners’ Framing of Student Struggle**

Our first step in developing a reliable way of assessing the quality of framings elicited in interviews involved developing a coding scheme based on reading approximately one-third of the 2007-2008 interview transcripts from all teachers, coaches, and school leaders in the larger study. Our initial coding scheme included 1) the categories participants used to describe groups of students and the characteristics they ascribed to the categories; 2) the pedagogical actions teachers described that they took to meet the needs of groups of students; 3) instructional leaders’ expectations regarding supporting all students; 4) extent to which a teacher or instructional leader took responsibility for groups of students’ learning; and 5) participants’ views about learning mathematics and the curriculum. After having achieved a stable coding scheme, we then coded interview transcripts for the remaining teachers, coaches, and school leaders in Year 1 of the study. The two authors individually coded all of the transcripts, and came to consensus on the particular codes we assigned to each instance in a transcript.

We knew that this initial coding scheme was too unwieldy, however we found this to be an important step in helping us clarify what, specifically, about problem framing we might reliably assess. To do so, we created analytic memos that for 22 of the 30 schools in the study that described the patterns and variations across teachers, coach, and school leaders, based on our initial coding scheme. We then looked across the analytic memos and found that it appeared
possible to consistently characterize participants’ framing along the two dimensions described above: explanations and supports.

The first author then drafted a coding scheme broadly organized according to the two dimensions described above. She worked with a team of coders in each of the summers of 2009-2012 to refine this scheme in the practice of coding interviews collected each year (the coding process is described in detail below). The coding scheme presented here is in its penultimate form, and has since been used to code all January interview data collected for the first six years of the project.

Table 1 provides an abbreviated version of the rubric (coding scheme) to assess explanations. Note, that in addition to categories of productive and unproductive (as described above), we also use a category of “mixed.” Mixed indicates that a participant wavers between explaining student performance (e.g., failure, success, engagement, interest) as a relationship between student(s) and instructional and/or schooling opportunities and as due to an inherent property of students and/or as produced in relation to something other than instructional opportunities. Mixed is also used to qualify instances in which a participant suggests there are some students but not all for whom performance (e.g., failure, success, engagement, interest) is produced in relation to instructional and/or school opportunities.

In addition, if a participant indicates that student motivation is a challenge, we use a related rubric to qualify how motivation is framed. For example, we code talk about student motivation as productive if it is described as a relationship between student(s) and instructional and/or schooling opportunities. If a participant wavers between suggesting that students are inherently (un)motivated and suggesting that motivation is a relationship between student(s) and instructional opportunities, we code that instance of talk as mixed. And, if student motivation is
described as an inherent property of students and/or as produced in relation to something other than instructional and/or schooling opportunities (e.g., parents don’t value education, therefore students don’t), we code that instance as unproductive.

Table 2 provides an abbreviated version of the coding scheme to assess supports not specific to students not identified as English learners (ELs) or students identified as receiving special education services. We use a different rubric (but similar, in terms of its orientation to supporting ELs to participate in rigorous mathematical activity) to code when practitioners reference ELs specifically, in light of that particular research base. Given that our team did not include expertise in special education, we did not feel comfortable coding for supports when specific to students identified as receiving special education services. Instead, we flag these instances of talk – with the idea that in the future, someone with the necessary expertise could develop a relevant coding scheme.

Similar to explanations, in addition to categories of productive and unproductive (as described above), we also use a category of “mixed.” Mixed supports are aimed at supporting struggling students to participate in rigorous mathematical activity (high-cognitive demand activity), but some of what the participant suggests is aimed at conventional, low-cognitive demand activity.

In order to code an instance of talk with the supports rubric, participants must articulate the function of the particular supports they describe. Oftentimes, when describing supports for struggling students they describe forms of instruction without clarifying the functions of such forms. For example, participants may say they “use manipulatives” or “put students in groups.” We did not find that this kind of information did not provide us with insight into how participants were framing the problem of student struggle. We therefore trained interviews to
ask, “Why?” in those cases, and we only code instances of talk about supports if we can infer the function, or goal, of such supports. (We flag all “form-only” talk of supports.)

**Coding Process**

Coders were trained to search for specific questions and keywords pertaining to teachers’ explanations and supports within interview transcripts. For each passage specific to a dimension, coders aimed to assign a code of unproductive, mixed, or productive. Given that we intended to use this coding in quantitative analyses (as an example, see Wilhelm, Munter, & Jackson), we then assigned quantitative values to each dimension, with scores of 0, 1, or 2 representing unproductive, mixed, and productive, respectively. If all passages for a specific dimension were coded as 0, the final value for the interview assigned was a 0. If all passages were coded as a 2, the final value for the interview assigned was a 2. And, if all passages were scored as a 1, or there was a combination of scores, the final value assigned for the interview was a 1.

Coders were required to reach 80% agreement with particular previously scored transcripts before they began coding new transcripts. The first author double-coded 20% of the interview transcripts to check for ongoing reliability. The overall percent agreement was 71.7% and kappa was 0.506. It is important to note that for some participants, we were unable to code for this variable within the interviews (given, for example, a lack of probing on the interviewer’s part), so some teachers in the larger study are missing a score for either or both of the dimensions.
Table 1. Coding scheme to assess the nature of participants’ explanations regarding students’ struggle (or success) in mathematics (abbreviated version).

<table>
<thead>
<tr>
<th>Code</th>
<th>Example</th>
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<tbody>
<tr>
<td>PRODUCTIVE</td>
<td>Interviewer: What typically when that happens do you find are the reasons it's not going as well as you’d like? Teacher: I normally look first at me to see or is there something in the lesson that I didn't emphasize well enough or, once I do that I decide is this something that the students struggle with. I may talk to the teacher they had last year and say &quot;When you went over this was this something that they struggled with?&quot;</td>
</tr>
<tr>
<td>MIXED</td>
<td>Interviewer: In your classrooms, when the students do not learn as expected, what do you find are the typical reasons? Teacher: Probably me...I don’t put blame on the students. I mean, I think it’s a combination. They have to do their part, and I have to do mine, so if they’re not getting it, it may, and this, this may not be the best way, but I’ll be honest, I look to the students that are consistently successful, and if they don’t understand something, I know I’m doing something wrong, so I need to go back, and I need to think it through again or come up with a different strategy or a way of showing them to do the problem. You know, if it’s a kid that is consistently off task and playing around or something, then I might just kind of think that, “Well, they’re not paying attention,” so, it’s just kind of like what the majority of the class is doing, and I kind of judge off that.</td>
</tr>
<tr>
<td>UNPRODUCTIVE</td>
<td>Interviewer: So what are some of the major challenges ... of teaching mathematics in this school? Teacher: The kids already don’t want to learn math. They have this notion of not caring for it and usually it’s instilled by their parent’s cause their parents didn’t get it, so they think its okay that they didn’t get it.</td>
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</tbody>
</table>

Student performance (e.g., failure, success, engagement, interest) is described as a relationship between student(s) and instructional and/or schooling opportunities.

Participant wavers between explaining student performance (e.g., failure, success, engagement, interest) 1) as a relationship between student(s) and instructional and/or schooling opportunities and 2) as due to an inherent property of students (e.g., students are lazy) and/or as produced in relation to something other than instructional opportunities (e.g., parents don’t value education, therefore students don’t).

Could entail suggesting there are some students but not all for whom performance (e.g., failure, success, engagement, interest) is produced in relation to instructional and/or school opportunities.

Student performance (e.g., failure, success, engagement, interest) is attributed to an inherent property of students (e.g., students are lazy) and/or as produced in relation to something other than instructional and/or schooling opportunities (e.g., parents don’t value education, therefore students don’t).

Explanation presents students’ mathematical capabilities as relatively stable (i.e., they are not likely to change).
Table 2. Coding scheme to assess the nature of how participants describe supporting struggling students in mathematics (not specific to students identified as English language learners or students receiving special education services) (abbreviated version).

<table>
<thead>
<tr>
<th>Code</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>PRODUCTIVE</strong></td>
<td>Description of instructional actions one takes to support <strong>struggling students</strong> are aimed at rigorous learning goals.</td>
</tr>
<tr>
<td></td>
<td>• Below is a list of instructional actions that are generally aimed at supporting struggling students to participate in rigorous activity in the context of mainstream instruction. Note that this is not an exhaustive list and that the coder will need to make judgments regarding the nature of what participants describe.</td>
</tr>
<tr>
<td></td>
<td>o <strong>Pre-teach particular skills to struggling students prior to mainstream instruction; this is sometimes done in the context of a 2nd math class or intervention.</strong></td>
</tr>
<tr>
<td></td>
<td>o <strong>Focus on how the task is introduced, or set-up. Ensure students are familiar with the context in a problem-solving scenario.</strong></td>
</tr>
<tr>
<td></td>
<td>o <strong>Use tasks with multiple entry points.</strong></td>
</tr>
<tr>
<td></td>
<td>o <strong>Focus on norms of participation.</strong></td>
</tr>
<tr>
<td></td>
<td>o <strong>Assign competence to students (e.g., strategically mark students’ contributions as important to attend to).</strong></td>
</tr>
<tr>
<td></td>
<td>o <strong>Various grouping strategies that aim to maximize each student’s participation (e.g., assigning roles, assigning near-peers).</strong></td>
</tr>
</tbody>
</table>

| **MIXED** | Clearly articulates learning goals and instructional supports for **struggling students** that are aimed at rigorous activity however, some of what participant says indicates that some instructional actions are aimed at conventional learning goals. |
|           | • “I’m always afraid to go ahead because I don’t feel my kids are mastering things and I try to challenge my kids and use a lot of word problems, use a lot of words and a lot of real world settings because that’s what they’re going to, you know, they’re not going to sit in some room doing a hundred adding fractions problems, but at the same time some of my kids actually need to do a hundred addition problems with fractions just so it sticks in their head that they’ve got to get a common denominator.” |

| **UNPRODUCTIVE** | Description of instructional actions one takes to support **struggling students** are generally aimed at lessening the cognitive demand of activity (e.g., proceduralizing a task). |
|                  | • Below is a list of instructional actions that are generally aimed at lowering the cognitive demand of activity. Note that this is not an exhaustive list and that the coder will need to make judgments regarding the nature of what participants describe. |
|                  |   o **Remove any prompts that ask students to explain their thinking.** |
|                  |   o **Shorten problems.** |
|                  |   o **Show students how to complete a similar problem.** |
|                  |   o **Provide examples.** |
|                  |   o “**Drill,** “Use direct instruction.”” |
|                  |   o **Assign fewer problems.** |
|                  | • “And some students that have low skills, they just need to practice.” |
Limitations

Before providing descriptive statistics, we first discuss the limitations of this interview-based assessment. One limitation is that an individual interview context does not provide insight into how individuals develop particular frames. Relatedly, as noted earlier, framing problems of practice is an inherently social process. However, in the context of an interview with a researcher, at best, we are able to elicit how the interviewee chooses to share how she frames a specific problem of practice in this specific (unnatural) context. We were initially dubious that participants would share what we’ve termed “unproductive framings” with us, however, we have found that it is more common that not that teachers share framings we have termed unproductive. Similarly, the code we generate is specific to an event – we do not claim that it represents how the participant always frames the problem of students’ struggle in mathematics.

Another limitation is that we are eliciting how individuals frame a particular problem of practice – that of students’ struggle in mathematics. The way we pose questions assumes that indeed, this is a problem of practice from the participant’s perspective. That said, we always begin teacher interviews by asking what challenges they face, and in the majority of cases, the teacher identifies an issue associated with students struggling – and we are therefore able to follow that particular thread and probe on how they frame the problem.

Last, in the case of any interview-based assessment that is being administered by a team of researchers, undoubtedly, interviewers are not consistent in how they ask questions and do not always probe in the same ways. As a result, a sizeable number of participants in each year do not have scores on one or more of the rubrics. This problem has improved over the course of the larger study, as we improved the quality of training we provided to the team of interviewers. However, this remains a challenge.
**Descriptive Statistics Regarding How Participants Framed the Problem of Students Struggle in Mathematics**

Here, we briefly provide some descriptive statistics regarding how teachers, coaches, and school leaders framed the problem of students’ struggle in mathematics across the first five years of the larger study. Table 3 provides information regarding the number of participants for whom we were able to assign a code for explanations and supports in Years 1-5 of the study. As is evident, there was a dramatic increase in the number of participants whose transcript could be coded for explanations in Year 5. We attribute that to a targeted interview training effort. There was not the same notable increase in supports over the course of the study. This is because even with targeted probing, participants often do not articulate the *goal* of their supports – and thus, we code their response as form only.

Table 3. Information on number of participants who received a code for explanations or supports, Years 1-5.

<table>
<thead>
<tr>
<th>Nature of participants’ explanations of why students struggle in mathematics</th>
<th>Nature of instructional supports for struggling students</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Year</strong></td>
<td><strong>Has a Score</strong></td>
</tr>
<tr>
<td>1</td>
<td>61%</td>
</tr>
<tr>
<td>2</td>
<td>48%</td>
</tr>
<tr>
<td>3</td>
<td>57%</td>
</tr>
<tr>
<td>4</td>
<td>50%</td>
</tr>
<tr>
<td>5</td>
<td>82%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>60%</strong></td>
</tr>
</tbody>
</table>

We found that explanations and supports do not differ by teachers’ race, gender, years of experience, certification status, or number of mathematics courses taken. Notably, we found that teachers were significantly less likely to describe productive explanations or productive supports for struggling students than coaches or school leaders (see Figures 1 and 2).
We did not detect any significant differences by district for participants’ explanations. Notably, we did not detect any statistically significant changes in explanations or supports across the five years. However, teachers in district A were significantly more likely to describe productive supports than teachers in District D and were significantly less likely to describe unproductive supports than teachers in all of the other districts (see Figure 3). We hypothesize

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Note: Because how teachers framed student motivation is an example of framing student struggle, we combined the scores. All 0s resulted in a 0, all 1s resulted in a 1, all 2s resulted in a 2, and any combination of 0, 1, and 2 resulted in a 1.
this is because District A had a ten-year history of using CMP at the start of the study, and in the past, District A mathematics leaders had devoted a significant amount of resources to training their teachers in “Complex Instruction” (Cohen, 1994), which focuses on how to engage heterogeneous groups of students in rigorous activity.

Figure 3. Comparison of mean score for supports for teachers by district, by year.

The Relationship of an Assessment of How Practitioners Frame the Problem of Students’ Struggle in Mathematics to Other Established Constructs

Above, we provided an overview of how we conceptualized and operationalized an interview-based assessment of how practitioners frame the problem of students’ struggle in mathematics. We now turn to a brief discussion of how this assessment is distinct from and similar to other established constructs that arguably account for why practitioners act to support, or not, students who struggle.

From a psychological perspective, one way in which this issue has been framed is in terms of teacher “self-efficacy” (Bandura, 1993; Gibson & Dembo, 1984; Sosa & Gomez, 2012; Tschannen-Moran & Hoy, 2001), in other words, a teacher’s belief that s/he “can influence learning” (Sosa & Gomez, 2012, p. 879). A number of different conceptualizations of this construct have been proposed, but current research suggests that there are two dimensions:
“personal competence” and “analysis of the task in terms of the resources and constraints in particular teaching contexts” (Tschannen-Moran & Hoy, 2001, p. 795). In other words, one dimension focuses on the teacher’s perceptions of their own capabilities not specific to the context in which she teaches and one dimension focuses on the teacher’s perceptions of her capabilities in relation to the context in which she teaches. In typical psychological studies of teacher self-efficacy, teachers are provided with a survey in which they report on the extent to which they feel that they can affect change in their students’ learning. It usually emphasizes the extent to which they teachers believe they “can help even the most difficult or unmotivated students” (Gibson & Dembo, 1984, p. 569). Teachers who are identified as having high self-efficacy are those who perceive that they can overcome challenges, whereas teachers identified as having low self-efficacy are those who perceive they can not overcome challenges. A number of studies have linked teachers’ self-efficacy to student outcomes (e.g., student achievement, motivation, and efficacy) and teachers’ behavior in the classroom (e.g., teacher effort, retention, enthusiasm for teaching, and commitment to teaching) (Tschannen-Moran & Hoy, 2001). While there is evidence that self-efficacy is likely to influence what teachers do in the classroom, there is no specific evidence linking teachers’ self-efficacy and the quality of instruction.

A related way in which why teachers act to support struggling students (or not) has been framed is in terms of teachers’ “responsibility” (e.g., Halvorsen, Lee, & Andrade, 2009; Lee & Smith, 1996). Lee and Smith (1996) describe a measure of responsibility as including:

- teachers internalizing responsibility for the learning of their students, rather than attributing learning difficulties to weak students or deficient home lives; a belief that teachers can teach all students; a belief that teachers can teach all students; willingness to
alter teaching methods in response to students’ difficulties and success; and feelings of efficacy in teaching. (p. 114).

Halvorsen et al. (2009) differentiate responsibility from teacher efficacy in the following way: “Responsibility focuses more on the teachers’ willingness to take responsibility for helping all students learn rather than on teachers’ beliefs about their professional effectiveness” (p. 183).

Our assessment of participants’ framing is designed to be close to practice – it is about, for example, teachers’ students in their classroom. Measures of self-efficacy aim to assess self-efficacy more generally as well as specific to a schooling context. To some extent, responsibility is also both generic and specific to a schooling context. For example, assessing beliefs in whether all students can learn is not framed as specific to a teacher’s classroom, whereas articulating responsibility for one’s students presumably is.

One way in which our assessment of participants’ framing of student struggle is decidedly different from measures of self-efficacy regards what is taken-for-granted. Surveys designed to assess self-efficacy assume categories like “motivated students” or “difficult students.” Although in interviews, we often start with such categories, we then probe on what those categories mean to participants, and allow for the possibility that such categories do not hold meaning. (Notably, we’ve had a handful of teachers tell us, “I actually don’t think about my teachers as motivated or not.”) In other words, we aim to probe and characterize the source of the problem, as opposed to characterize only whether a practitioner feels she can address a problem.

In this respect, measures of responsibility seem more akin to how we’ve conceptualized framing the problem of student struggle. We are, indeed, interested in whether teachers appear to take responsibility for addressing students’ struggle in instruction. However, we are interested
in understanding this specific to a particular vision of instruction. Hence, our supports rubrics take a stance on what is worth knowing and doing mathematically, and what are ways to support struggle students to come to more fully participate in rigorous mathematical activity.

Yet another related (yet distinct) construct is Carol Dweck’s (1986, 2006) conceptualization of mindset. Whereas the work described thus far has focused on teachers’ self-efficacy and responsibility, the work on mindset has generally focused on that of students. Dweck (1986), influenced by social cognitive theory, suggested that students tended to either believe intelligence was either fixed or malleable. Further, “children who believe intelligence is a fixed trait tend to orient toward gaining favorable judgments of that trait,” which Dweck identified as evidence of having “performance goals” (p. 1041). On the other hand, “children who believe intelligence is a malleable quality tend to orient toward developing that quality,” which Dweck identified as evidence of having learning goals (p. 1041). She argues that those who pursue learning goals, rather than performance goals, tend to be more successful in terms of what they learn – particularly when learning involves a challenge – and how they are judged by others. More recently, Dweck (2006) has suggested that this work suggests that teachers should work to support their students to develop what she terms “growth” mindsets as opposed to fixed mindsets.

We see a likeness between Dweck’s emphasis on not viewing intelligence as fixed and our emphasis on suggesting that explanations of student struggle that suggest students are inherently one way or another are unproductive instructionally. However, the emphasis on supporting students to develop particular mindsets seems distinct from analysts working to identify how issues of struggle are framed by practitioners.

**Implications of This Assessment for Reform Efforts**
We began this paper by suggesting that how teachers frame the problem of student struggle (and success) in mathematics is likely quite important in understanding whether, and if so, in what ways, ambitious reform in mathematics education takes hold. In fact, the snapshot we provided of how teachers frame the problem of student struggle in mathematics illustrates this is a significant challenge in mathematics education reform efforts. We suggest that an assessment like the one we’ve described can play at least three different functions in designing and assessing reform efforts in mathematics education.

First, we suggest that prior to designing specific efforts, it is important to take account, prospectively, of how teachers are currently framing the problem of student struggle in mathematics. If an unproductive framing is prevalent, this would indicate the need for deliberate attention to shifting the framing. Of course, shifting how problems are framed is not easy work (Coburn, 2006). It takes incredible skill and patience to craft ways in which practitioners come to appreciate the value of framing problems differently. That said, we are doubtful of efforts aimed at shifting how the problem of student struggle is framed absent the provision of high-quality support regarding how to support students with diverse academic experiences participate in cognitively demanding activity. In other words, it’s not enough to say “we must think about this differently” – practitioners also need support to know how to act differently (cf. Sosa & Gomez, 2012).

Second, we suggest that how participants are framing the problem of student struggle needs to be monitored as part of reform efforts. It is very unlikely that if unproductive framings continue to dominate the work context that all students are going to be provided with the necessary support to learn how to participate in rigorous mathematical activity. It is important to
be able to assess on an ongoing basis how framings are changing, or not – which can then be used to shape subsequent reform efforts.

Third, we suggest that having an assessment like the one described here is useful to include in analyses aimed at understanding instructional improvement efforts. For example, Wilhelm et al. (2014) investigated the relationship between explanations and the quality of instruction enacted in classrooms in Years 1-4 of the larger study and found a positive, significant relationship between explanations and the quality of whole-class discussions, in particular. On the other hand, using the same data set, Wilhelm (under review) found a positive, significant relationship between supports and the extent to which teachers maintained the cognitive demand of a high-level task across the course of a lesson. Findings such as these help researchers further pinpoint important aspects of accomplishing reform at scale and identify areas deserving of future investigation.

References


