TEACHER NOTICING STUDENTS' MATHEMATICAL STRENGTHS

Lisa M. Jilk
University of Washington
jilklisa@uw.edu

Sandra Crespo
Michigan State University
crespo@msu.edu

Research about teacher noticing of students' mathematical thinking has been an important and ongoing strand of research and practice in mathematics education. Our work extends this agenda by working collaboratively with teachers to learn together how to notice students' mathematical strengths. The lens on strengths runs counter to the prevalent culture in U.S. schools to overemphasize gaps in students' understandings. In this paper we describe a video club focused on identifying and naming students' mathematical strengths and the protocols that support this focus. We illustrate and discuss the important shifts in teachers' ways of noticing and talking about students' mathematical activity. We also discuss implications for further research and professional development focused on teacher noticing of students' math strengths.

Keywords: Secondary Mathematics; Equity and Diversity; Teacher Knowledge

Researchers and professional developers focus on teacher noticing because noticing informs practice, and teachers' practices are consequential for students' learning. Current video technology has made it possible to study and facilitate teacher learning to notice students' mathematical thinking and understanding (Goldsmith & Seago, 2011; Jacobs et al., 2011; van Es, 2011; van Es & Sherin, 2008) and instructional features of classrooms (Star & Strickland, 2008). Video also supports teachers to practice attending to important features and critical events happening within the complex setting of classrooms before they are faced with them in real time.

As the knowledge base for equitable mathematics teaching continues to grow there is arguably more in classrooms now than ever before to which math teachers must attend, including knowledge of mathematics for teaching (Ball, Thames & Phelps, 2008), knowledge about communities (Civil, 2007), knowledge about math identities (Aguirre, Mayfield-Ingram & Martin, 2013), knowledge about social and academic status (Featherstone et al., 2011), and an understanding of the critical relationships between math learning, math learners and broader sociopolitical structures (Gutiérrez, 2013).

In addition, teaching for equity requires a focus on resources (what students have) and students' potential rather than deficits (what students are lacking). When teachers focus on strengths, they position young people as competent learners (Cohen, 1997), support students to create positive math identities (de Abreu & Cline, 2007; Jilk, 2014; Martin, 2000), help them recognize and value peers as intellectual resources (Cohen, 1997) and expand school mathematics to include a rich set of skills, practices and understandings in which students can find themselves (Boaler & Greeno, 2000; Featherstone, et al., 2011). Maybe even more important, a strength-based classroom culture disrupts the dominant educational discourse focused on gaps and deficits (Gutiérrez, 2008) and provides a new and more realistic narrative about learning for young people who have traditionally been marginalized by school math.

Believing that students have strengths from which to connect and build is challenging work. Recognizing (and naming) these strengths in real time is even more difficult. Research has shown that even very well intentioned teachers who profess a stance towards teaching for equity are challenged to enact these beliefs in their day-to-day teaching practice (Ladson-Billings, 1994; Walker, 2012). Our experiences working with math teachers confirm these results. Even teachers who desperately want their students to positively identify as "math people" often struggle to know

Bartell, T. G., Bieda, K. N., Putnam, R. T., Bradfield, K., & Dominguez, H. (Eds.). (2015). *Proceedings of the 37th annual meeting of the North American Chapter of the International Group for the Psychology of Mathematics Education*. East Lansing, MI: Michigan State University

what "counts" as a mathematical strength or how to talk with young people about the strengths they have. We believe that there are valid reasons for such challenges.

Teaching is a cultural activity filled with taken-for-granted assumptions and shared convictions and values (Stigler & Hiebert, 1999). As U.S. educators, we are immersed in a culture that focuses on students' deficits and perpetuates unexamined habits of teaching as fixing students' problems and misconceptions. These daily practices tend to get in the way of re-imagining and inventing instructional moves that instead focus on accessing and building on students' strengths and multiple ways of understanding (Ladson-Billings, 1994).

In addition, professional noticing is also a cultural practice. Hand (2012) argues that "dispositions relate to what teachers do or do not notice" (p. 234) in their classrooms and therefore drive instructional decisions. We attend to the classroom events that we have been taught to value. The cultures in which we have been immersed essentially train us to see and hear what is important to us. It therefore makes sense that if teachers are now expected to reshape their ways of noticing and their repertoire of teaching practices, then they need repeated opportunities to practice seeing and hearing students' strengths in action and practice articulating these strengths to students in ways that are convincing.

The video club we report on here sought to challenge and disrupt our collective tendency to look for students' mathematical shortcomings. The video club was designed to provide a shared, local experience from which a heterogeneous group of teachers could learn to notice (Sherin, Jacobs & Phillip, 2011; van Es & Sherin, 2002) students' math strengths in ways that could be useful and usable in their classrooms. A focus on drawing attention to students' intellectual strengths is a noteworthy feature of equity teaching practices in general and of *Complex Instruction* in particular, which is the instructional approach that the teachers in this video club had committed to learn and use in their classrooms. Next we share key features of the context and design of this video club in order to then share our analysis of shifts in teachers' noticing and their ways of talking about students' mathematical activity.

Context and Background of Video Club

The teachers who we describe in this paper are part of a professional development network that has six mutually informed learning spaces. The learning spaces include a weeklong course about Complex Instruction, In-Classroom Support, Common Planning Time with course teams, a monthly video club and Teacher-leader meetings. The learning spaces are connected in several ways for the goals of developing coherence with common themes and making connections across spaces. An important goal for this network is to re-culture math departments with empowering professional development experiences in ways that build and strengthen teachers' capacity to take up and sustain Complex Instruction as their equity pedagogy across the entire department.

Complex Instruction, at its core, requires a belief that all students come with intellectual, social, and cultural resources and are able to learn rigorous content (Cohen & Lotan, 2014; Cohen & Lotan, 1997). Complex Instruction (CI) creates a classroom "social system" that directly attends to and addresses problems of social inequality inside the classroom. Based on status generalization theory (Berger, Rosenholtz & Zelditch, 1980), CI methods are deliberately designed to "disrupt typical hierarchies of who is 'smart' and who is not" (Cohen, 1994; Sapon-Shevin, 2004, p. 3).

Multiple ability treatments and assigning competence are two specific CI strategies used to address status issues in classrooms (Cohen & Lotan, 1997, 2014; Tammivaara, 1982). A multiple ability treatment makes visible the array of intellectual abilities, skills and competencies that are required to be successful with a given task. Assigning competence is a teaching move that also disrupts students' perceptions of competence of self and peers by creating a mixed set of expectations for participation and success by publicly names the strengths students use when they are learning together. Hence, both of these practices rely heavily on teachers' abilities to notice and name

Bartell, T. G., Bieda, K. N., Putnam, R. T., Bradfield, K., & Dominguez, H. (Eds.). (2015). *Proceedings of the 37th annual meeting of the North American Chapter of the International Group for the Psychology of Mathematics Education*. East Lansing, MI: Michigan State University

students' mathematical strengths in real time. In short, successful implementation of Complex Instruction pedagogy requires an ability to look at students' mathematical activity and interactions with peers, listen to their sense making in real time in order to monitor their participation and understanding and find ways to further their learning.

It is important to clarify that we are not advocating for "feel good" teaching practices that emphasize compliments and empty praise to help students feel better about themselves. Nor are we suggesting that teachers lower their standards for academic rigor or cognitive demand by searching for anything a student does or says that is remotely mathematical. Not everything we see or hear in classrooms is worth attending to. In a strength-base video club we consider a rich and expanded view of mathematical understanding that is conceptually demanding and includes both content knowledge and learning practices.

The video club component of the professional development network was developed because program facilitators and math teachers needed an opportunity to observe the same classroom event simultaneously. The video club provided this experience along with a collective capacity to create a shared language about math strengths that could be used not only by individual teachers, but by *all* teachers, across grades and schools, thereby providing continuity and coherence to students' school math experiences.

The video club met monthly for two hours. Participants included all of the mathematics teachers who were members of the larger network, any student teachers who worked alongside these teachers, and the administrators and instructional coaches for math from participating schools and districts. A typical monthly video club meeting drew approximately twenty-five teachers from grades 6-12 from three different schools in two urban school districts. In the 2013-14 school year, there were 17 female and 9 male teachers who attended video club. Of these, 23 were White, 2 were Black and 2 were Asian. Table 1 reports the demographics for the public schools in which the teachers worked.

Table 1: School Demographic Data (U.S Department of Education).

	Male	Female	Multi-racial	White	Black	Latino	Asian Pacific Islander	American Indian	Free & Reduce Lunch	ELL
HS A	50.5%	49.5%	3.2%	4.4%	41.2%	11.8%	37.2%	2.2%	75.0%	12.2%
HS B	52.8%	47.2%	.9%	15.7%	34.8%	16.8%	30.8%	1.0%	56.9%	15.0%
Middle School	50.7%	49.3%	3.9%	12.1%	35.0%	20.0%	27.7%	1.3%	75.0%	15.0%

We share this data for several reasons. First, this particular information contributes to readers' understanding of the context in which we work and how it informs the examples we share about teachers' accomplishments in shifting any aspect of their teaching practice. Second, the meaning of "urban school" varies across the country depending on the local context in which schools and readers are situated. We want to be clear about the meaning of "urban" in this particular locale as it relates to teacher and student demographics. Finally, we provide this data, because culture matters. Skin color, gender, language, and SES, among other factors, shape our lived experiences, and these experiences act as lenses through which we notice and interpret classroom events. Since most of the teachers in this program are members of the dominant culture, and the young people with whom they work are poor students and students of color, it is reasonable to imagine these teachers might be additionally challenged to perceive and interpret moments of classroom activity as strengths and potential resources for learning (Chazan, 2000; Hand, 2012; Ladson-Billings, 1994).

The video clips we use come directly from the classrooms of teachers who participate in the network. For the purpose of supporting teachers to notice students' mathematical strengths, video clips show one group of 3-4 students working cooperatively for 8-10 minutes without interruption.

This kind of video clip makes several important things available for noticing students' strengths, including looking at students when working unassisted by the teacher, their resourcefulness and inventiveness, how they wrestle with ideas that they have not yet studied, and opportunities to watch and hear students get stuck and unstuck as they make progress on a group-worthy task (Lotan, 2003).

Supporting Teachers' Noticing of Students' Strengths

In addition to carefully selecting videos for video club, careful coordination of video club structures and attention to potential status issues from skilled facilitators is important. The norms, protocol and focus questions developed to guide the video club meetings include: learning requires participation, we all have something intellectually valuable to contribute, we all have something to learn, and we are smarter together. Unsurprisingly these norms were shaped by the pedagogical principles of Complex Instruction providing facilitators with opportunities to model, practice and reinforce strategies for promoting equal-status participation and learning.

Articulating strengths rather than deficits was initially challenging for teachers. The strengths teachers most often noticed at first were articulated in relation to state standards or learning objectives. For example, a 7th grade math teacher might state that her students could "use proportional relationships to solve multistep ratio and percent problems" (NGA, 2010). This grade-specific objective does not easily translate into language that makes visible *the actions* of students as they make sense of ratio and percent problems or what they did and said to figure out such problems. In other words, the shift towards noticing strengths in students' meeting particular learning objectives was a good start but not enough to make visible the important math thinking and actions the students had engaged with when working on those tasks.

In response to this challenge, program facilitators developed a structured evidence-based protocol to disrupt patterns of deficit talk about students' mathematical activity and to support teachers to generate descriptions and talk about students' strengths. In addition to a focus on strengths, the video club protocol aims to promote safety and intellectual risk taking and support teachers to make connections between the video footage and events in their own classrooms.

Unlike other projects that use small group discussions to support teachers' learning with video cases, this video club used a general Go-Round structure (McDonald et al, 2003), sometimes referred to as a Round Robin Protocol, to organize how the teachers shared ideas for each focus question. There are a few things to note about this protocol that are important for facilitating this kind of video club. First, this protocol is inclusive. It affords each person an opportunity to share ideas and it supports the expectation that each of us participates. The Go-Round structure also gives us access to an expansive set of ideas about student strengths that no one person would notice alone. Finally, the sentence frame we ask teachers to use in conjunction with the Go-Round Protocol offers explicit guidance for how to talk about students with a strength-based lens. Our assumption is that teachers are learning to speak and gain fluency with a new language (language of strengths) and this takes time and practice.

What Teachers Noticed about Students' Strengths

In order to appreciate students' mathematical activity and support the noticing of students' strengths, each video club starts with teachers doing math together. In this first phase of the meeting, teachers work cooperatively in groups of 3-4, most often with colleagues from different sites and grade levels to complete parts of the task that will be shown in the video. Doing math together affords a later conversation about learning objectives and provides teachers with the entire group-worthy task (Lotan, 2003), from which they might consider students' prior knowledge, potential common mistakes and misconceptions, the flow of mathematical ideas throughout a task, task development and the inclusion of Complex Instruction structures that support participation, autonomy and accountability (Cohen & Lotan, 2014).

Bartell, T. G., Bieda, K. N., Putnam, R. T., Bradfield, K., & Dominguez, H. (Eds.). (2015). *Proceedings of the 37th annual meeting of the North American Chapter of the International Group for the Psychology of Mathematics Education*. East Lansing, MI: Michigan State University

The group then moves to phase two to consider students' math strengths in relation to the learning objectives for the lesson. They watch the video clip for the first time and attend to students' understanding of math content by pointing to and naming what students said and did that had mathematical potential and then provide a strength-based interpretation (Prompt #4 in the Protocol is reproduced in Figure 1 here).

> ***What did students do or say that was mathematically smart?***
>
> I think it was smart when (name of student) did/said (evidence from the video), and I think this because (how does this strength support students' learning?) .

Figure 1: Sentence Frame for Noticing Students' Strengths

The following are some examples of strengths teachers noticed using the sentence frame to name a student's strength and justify its connection to learning. These examples come from different video club sessions throughout a school year with teachers who work in grades 6-12.

- Damarius **translated** .40 into "4 tenths," and then he was able to write it as fractions, 4/10 and $\frac{2}{5}$, because three representations of the same number helped him figure out how to move between the different forms.
- Rashida **created a system** for organizing and making zeros and then keeping track of them in an algebraic expression, because it allowed Rashida and her group to keep track of their terms and combine them correctly.
- Lydia **noticed a pattern** for how to use parenthesis to group terms in an expression, because this pattern allowed her to see the like terms before she combined them.
- Tian **hypothesized** that the similar figure would be bigger and not smaller, because then her group decided to try multiplying the lengths of sides with the scale factor instead of dividing.

Many would consider it enough for teachers to notice that Damarius understood how to convert decimals to fractions or that Rashida correctly combined like terms. However, referencing topics, objectives or standards is not sufficient if teachers are to create classroom systems in which students choose to actively engage in learning, support each other in the learning process and create positive math identities. As we have noted earlier, equity-oriented teaching pedagogies such as Complex Instruction require an understanding of what students should come to know along with the processes, skills, and actions (verbs) they use as they come to know these things, so connections can be made to prior knowledge and leveraged for new learning. Damiarius and his team will soon believe in his strengths as a math learner and likely come to rely on these strengths much more often if Damarius's teacher notices and names his strategy for translating multiple representations of number and explains how this strength contributes to Damarius' learning. An orientation towards strengths and the specific strength-based language will support students' expectations for competence and produce more equal-status interactions between students when they are engaged in learning math.

In the third phase of video club the focus turns to the norms for participation that students enact that move their math understanding and groupwork forward. Norms for participation are "learning practices" (Cohen & Ball, 2001), ways in which we expect students "to go about the work of learning" (p. 75). Specific to Complex Instruction, norms are intended to promote autonomy and interdependence in groups and to foster mathematical learning (Cohen, 1994). Teachers must be transparent about participation norms, provide students with opportunities to practice them, and notice and assign competence to these practices to make them a more normal way of going about the business of learning math. To this end, we provide teachers with an opportunity to notice these

behaviors in action (replayed back in the video clip) and practice talking about them as strengths. Below are some examples of the norms for participation that teachers noticed. Again, each teacher statement below used the sentence structure: *I think it was smart when*_____, *because*_____.

- Tamika **pressed for clarification** from her group about "what to go up by" when scaling the x-axis, so all of the group data could fit on the graph. I think it was smart, because then Dariana had to explain how she scaled the y-axis, and Jason talked about the range of their data set. It helped the whole group learn more about how to create an accurate graph.
- TJ **expressed confusion** about the different meanings of minus in both the geometric and algebraic representations, because knowing these different meanings will help her in other contexts that use minus.
- Asad **made sure that everyone in his group understood the directions** before they started the task, because then the whole group could get started together and consider more than one way to do the problem.
- Sierra **took a huge risk** by sharing her ideas about combining like terms with the entire class, because learning requires intellectual risk taking and people usually learn more when they are willing to try something new.

Implications for Research and Professional Development of Teacher Noticing

> "I just start talking this way. These sentences [from the video club protocol] help me focus my thinking on students and their strengths when I'm back in my classroom" (math teacher).

The small shifts we document here about the ways teachers are learning to notice and talk about students' strengths in the context of video clubs are hugely important because they carry into classrooms. Teachers who are participating in these video clubs *are* thinking and speaking differently about their students when they go back into their classrooms. We have evidence from working with teachers in the other learning spaces of this professional development network that they are seeing and hearing strengths more often in real time, and they are more willing to speak a language of strengths with their students. Perhaps more importantly teachers themselves are noticing their own transformation as the quote above suggests.

Collectively, the math teachers are often reminded of the power they have to help students notice their own mathematical strengths, change their participation and learn mathematics. The *Feature Teachers,* the teachers whose classroom videos are used, often reflect positively on video club after they have the rare experience of listening to their colleague's talk about the many ways in which their students are smart. Feature teachers usually return to their classrooms feeling rejuvenated by this feedback and convinced that teaching practices grounded in strengths are well worth investing in.

Changing how we frame students and their participation in math classes is not easy. It takes a concerted effort to shift perceptions about students and learning in which we have been immersed for many years. Even after one or two years of participating in this program, teachers still find it challenging to articulate math strengths in real time. The heterogeneity of the video club community addresses this challenge. Participants come with a range of experiences teaching different courses and grades. This means that they notice different things and contribute to a more expansive set of ideas about what counts as a strength, how different student behaviors might be interpreted as strengths, and how to name strengths in real time. Additionally, the diversity of teaching experiences affords articulation that is rare and powerful and often contributes to improved course design and program development in teachers' home-sites. High school teachers hear middle school students make sense of math in ways they rarely consider. Middle school teachers get glimpses of former students on film demonstrating math practices they never thought possible. Teachers often report

feeling more hopeful about their ability to impact students' learning when they have opportunities to talk across grade levels.

Finally, and perhaps most importantly, we have also noticed shifts in the ways the teachers talk about themselves and their colleagues. They often assign competence to each other, sometimes playfully, but always with intent to bring attention to particular strengths. They might highlight something new they have learned from a peer and describe how it impacted their teaching. Sometimes they mention a particular way a colleague might draw out different strengths from others. These new ways of being professionals are not surprising. In addition to video club, these teachers are immersed in a culture of professional development in which the norm is to work from strengths rather than focus on deficits. We notice what we *can* do before addressing what we have yet to improve. We practice naming our resources so we know what we have to offer. We ask our colleagues to show up and speak up and share their many ways of being smart so we can be more successful together. This is the kind of transformative learning that all teachers deserve so as to support and sustain their equity work with students.

References

Aguirre, J., Mayfield-Ingram, K., Martin, D.B. (2013). *The impact of identity in K-8 mathematics: Rethinking equity-based practices*. Renton, VA: National Council of Teachers of Mathematics.

Ball, D. L., Thames, M. H., & Phelps, G. (2008). Content knowledge for teaching: What makes it special? *Journal of Teacher Education*, *59*(5), 389-407.

Berger, J. B., Rosenholtz, S. J., & Zelditch, M., Jr. (1980). Status organizing processes. *Annual Review of Sociology*, *6*, 479-508.

Boaler, J. & Greeno, J. G. (2000). Identity, agency, and knowing in mathematics worlds. Multiple perspectives on mathematics teaching and learning: International perspectives on mathematics education (pp. 171-200). Westport, CT: Ablex Publishing.

Civil, M. (2007). Building on community knowledge: An avenue to equity in mathematics education. In N. S. Nasir & P. Cobb (Eds.), *Improving access to mathematics: Diversity and equity in the classroom* (pp. 105-117). New York: Teachers College Press.

Cohen, D. K. & Ball, D. L. (2001). Making change: Instruction and its improvement. *Phi Delta Kappan*.

Cohen, E. G. & Lotan, R. (2014). *Designing groupwork: Strategies for the heterogeneous classroom* (3rd ed.). New York: Teachers College Press.

Cohen, E., & Lotan, R. A. (1997). *Working for equity in heterogenous classrooms*. New York: Teachers College Press.

de Abreu, G., & Cline, T. (2007). Social valorization of mathematics practices: The implications for learners in multicultural schools. . In N. S. Nasir & P. Cobb (Eds.), *Improving access to mathematics: Diversity and equity in the classroom*. New York: Teachers College Press.

Featherstone, H., Crespo, S., Jilk, L. M., Oslund, J., Parks, A., Wood, M. (2011). *Smarter together! Collaboration and equity in the elementary math classroom*. Reston, VA: National Council of Teachers of Mathematics.

Goldsmith, L. T., Seago, N. (2011). Using classroom artifacts to focus teachers' noticing: Affordances and opportunities In V. R. J. Miriam Gamoran Sherin, Randolph A. Philipp (Ed.), *Mathematics Teacher Noticing* (pp. 169-187). New York: Routledge.

Gutiérrez, R. (2008). A "gap-gazing" fetish in mathematics? Problematizing research on the achievement gap. *Journal for Research in Mathematics Education, 39*(4), 357-364.

Gutiérrez, R. (2013). Why (urban) mathematics teachers need political knowledge. *Journal of Urban Mathematics Education, 6*(2), 7-19.

Hand, V. (2012). Seeing culture and power in mathematics learning: Toward a model of equitable instruction. *Educational Studies of Mathematics, 80*, 233-247.

Jacobs, V. R., Lamb, L., Philipp, R. A., Schappelle, B. P. (2011). Deciding how to respond on the basis of children's understandings. In V. R. J. Miriam Gamoran Sherin, Randolph A. Philipp (Ed.), *Mathematics Teacher Noticing* (pp. 97-116). New York: Routledge.

Jilk, L. M. (2014). "Everybody can be Somebody:" Expanding and valorizing secondary school mathematics practices to support engagement and success. In N. S. Nasir, C. Cabana, B., *Successful practice* (pp. 107-128). New York: Teacher College Press.

Jilk, L. M., & O'Connell, K. (2014). Re-culturing high school math departments for educational excellence and equity. In N. S. Nasir, C. Cabana, B. Shreve, E. Woodbury & N. Louie (Eds.), *Mathematics for equity: A framework for successful practice* (pp. 207-232). New York: Teachers College Press.

Lotan, R. A. (2003). Group-worthy tasks. *Educational Leadership*, 72-75.

Martin, D. B. (2000). *Mathematics success and failure among African-American youth: The roles of sociohistorical context, community forces, school influence, and individual agency*. Mahwah, NJ: Lawrence Erlbaum Associates, Inc.

McDonald, J. P., Mohr, N., Dichter, A., & McDonald, E. C. (2003). *The power of protocols: An educator's guide to better practice*. New York: Teachers College Press.

Sapon-Shevin, M. (2004). Introduction. In E. G. Cohen, C. M. Brody & M. Sapon-Shevin (Eds.), *Teaching cooperative learning: The challenge for teacher education* (pp. 1-12). Albany, NY: SUNY.

Sherin, M. G., Jacobs, V. R., & Philipp, R. A. (Eds.). (2011). *Mathematics teacher noticing: Seeing through teachers' eyes*. New York: Routledge.

Sherin, M. G., & van Es, E. A. (2009). Effects of video club participation on teachers' professional vision. *Journal of Teacher Education, 60* (1).

Star, J. R., & Strickland, S. K. (2008). Learning to observe: Using video to improve prospective mathematics teachers' ability to notice. *Journal of Mathematics Teacher Education, 11*, 107-125.

Stigler, J. W., & Hiebert, J. (1999). *The teaching gap*. New York: Free Press.

U.S. Department of Education. Institute of Education Sciences, National Center for Education Statistics. Retrieved from http://nces.ed.gov.

Tammivaara, J. (1982). The effects of task structure on beliefs about competence and participation in small groups. *Sociology of Education*, *55*, 212-222.

van Es, E. A., & Sherin, M. G. (2008). Mathematics teachers' "learning to notice" in the context of a video club. *Teaching and Teacher Education, 24*, 244-276.

Walker, E. N. (2012). *Building mathematics learning communities: Improving outcomes in urban high schools*. New York: Teachers College Press.