



LEADERS IN MATHEMATICS EDUCATION REFLECT ON MAP CLASSROOM CHALLENGES

A Conversation With Eminent Mathematics Educators

Five nationally recognized mathematics educators served as “Key Classroom Observers” for the Mathematics Assessment Project (MAP) in the development of formative assessment lessons known as Classroom Challenges (CCs). These educators’ many years of working with students, teachers, school and district administrators, as well as state and national policymakers provided a rich intellectual context for their observations of the Classroom Challenges. Over the five-year development process, each observed approximately 30 classrooms annually—a total of 750 classroom sessions of first-hand experiences with the CCs.

The following presents these educators’ unique perspectives on opportunities the Classroom Challenges afford the math education improvement community. It is a reconstructed conversation between the interviewer and the panel of five experts, the outgrowth of a discussion that occurred in fall 2013. The questions and responses provide the experts’ insights and advice for those interested in using MAP Classroom Challenges in their own schools and districts.¹

What is MAP?

The Mathematics Assessment Project (MAP) is a collaborative effort between teams of mathematics educators from the Shell Center for Mathematical Education at the University of Nottingham and from the University of California, Berkeley. The goal of the Mathematics Assessment Project is to design and develop well-engineered, high-quality assessment tools to support teachers and schools in implementing the Common Core State Standards in Mathematics (CCSSM).

The Mathematics Assessment Project has developed 100 Classroom Challenges (CCs) which are available to teachers for download, free of charge, for non-commercial usage, from the MAP website: <http://map.mathshell.org>.

Who participated in the conversation?

Mary Bouck was a middle and high school mathematics teacher for 18 years before moving into school administration in Michigan where she worked as Director of Curriculum, Instruction, and Assessment for Battle Creek Public Schools, and then as the Superintendent of Farwell Area Schools, a rural district. In both of these roles, Mary led efforts to improve instruction by promoting problem-based curriculum and developing professional learning communities. In the 1990s she was involved with both the Connected Mathematics Project, a middle-grades curriculum development project, and The Balanced Assessment Program, a project that involved designing performance assessment tasks for grades 4, 8, 10, and 12. Currently she is an independent consultant.

Linda Fisher is the Director of the Mathematics Assessment Collaborative (MAC) for the Silicon Valley Mathematics Initiative (SVMII). She taught middle school mathematics for over 30 years. During her teaching years she was involved in the Math Renaissance where she was introduced to the Balanced

¹ Quotes are taken directly from transcripts and edited for grammatical correctness and readability. In some instances quotes have been collapsed or combined for the sake of brevity, but in all instances the integrity of the quotes has been maintained. The intent and meaning have not been altered.

Assessment Program, the creation of Hugh Burkhardt and Malcolm Swan at the Mathematics Assessment Resource Service (MARS) at the University of Nottingham. In an effort to keep mathematics education focused on student thinking during the 1990s in California, she and David Foster created the MAC that still functions today as a key component of the SVMI set of offerings to schools and districts across the world.

David Foster is the founder of the Silicon Valley Mathematics Initiative (SVMI). He began his career in mathematics education as a middle-school teacher in 1974, joined the advisory committee of the California Math Project when it was established in 1982, and served as the regional director of the Santa Clara and Orange County Math Renaissance, which was aimed at developing and disseminating innovative curriculum units. Later David worked at the Noyce Foundation, developing what was to become the SVMI. Today he serves as the Executive Director of the initiative, which is described as a comprehensive effort to improve mathematics instruction and student professional development through a formative and summative performance assessment system, pedagogical content coaching, leadership training, and networks.

Sally Keyes began teaching middle school in 1974, finishing her teaching career and beginning her math coaching career in Palo Alto USD at the time when the district was “at the vortex of the math wars.” Through two decades of coaching in San Francisco’s South Bay area, Sally became involved with SVMI as a professional development presenter and as a trainer on the use and scoring of MARS assessments. Today she serves as the Director of Professional Development at SVMI, overseeing the institutes that are offered to high school teachers.

Diane Schaefer began teaching at the elementary level over 30 years ago, continuing on to teach both middle and high school mathematics for 18 years. As a State of Rhode Island Presidential Award winner she sat next to the State Commissioner of Education at the awards dinner. He asked her to come to the Rhode Island Department of Education where she served as a Mathematics Specialist and Director of the Office of Instruction for another 18 years. While there she worked with Rhode Island districts to implement professional development for teachers and administrators focused on the teaching of mathematics, in particular supporting them to implement formative assessment using the MARS Balanced Assessment Tasks. For the past five years she has worked as an independent consultant.

Mark St. John is the founder and president of Inverness Research, an independent educational research and consulting company that has provided formative feedback, documentation, and summative evaluation to the MARS group over the past several decades. He has a broad background in science and mathematics education at all levels. For over 30 years he has been involved in the study of public and private initiatives aimed at improving science and mathematics education. He also advises philanthropies about investments in educational improvement.

What was the purpose the conversation?

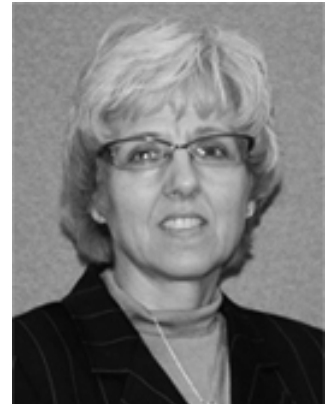
Mark *Let me introduce our conversation with the following background. Over many decades of studying educational improvement efforts at Inverness Research, we’ve seen how most research firms hire researchers to collect data. But we turn that idea a little on its head. In our work, the most interesting data we collect is the thinking of the researchers.*

You have spent your careers thinking about mathematics and mathematics education. You know what good classrooms look like, how school and district systems work, and you’ve all worked to design ways to help teachers become better at teaching mathematics. You have a tremendous amount of knowledge in a wide range of dimensions, and thus we see you as finely tuned instruments, specialists in math education. We want to tap that. Our aim is to give others access to your ideas and insights about these formative assessment lessons.

What is a MAP Classroom Challenge?

Mark Classroom Challenges aren't easily classifiable. They seem to be amalgams, some kind of mix of things. But it seems important for people out there to understand the nature of these non-traditional instructional materials. What are they?

Sally I prefer the term "formative assessment lesson." But to me a Classroom Challenge is a purposeful lesson devised to maximize and promote learning for the students and for the teacher. It is a platform for encouraging and supporting the kind of mathematical understanding and learning that I think we are looking for in the Common Core. Learning for both the students and the teacher—that is key. Every student is learning from the lesson, in particular the piece within the lesson where students revisit, revise, and talk about what it is they are learning. That is so powerful and important for those students, but for the teacher as well. She is doing the very same thing, thinking about what it is the students are learning and what her next steps might be based on what she's observed throughout the process.



Mary Bouck

Linda There are two key features that come to my mind. First, well-designed Classroom Challenges allow and promote misconceptions to come to the surface so that they are exposed. Within each of the lessons is a deliberately designed place where kids get some sort of corrective feedback. It's then that kids can talk about those misconceptions, to have conversations with each other to help resolve the dilemmas that have been exposed. Then, because of the design of the lessons, teachers get a chance to observe their students' thinking. They gain real understanding because there is so much student conversation about what they are really thinking, rather than just what appears on their papers. It allows teachers to ask better questions to tie the bow together at the end of the lesson or to think about what their next steps need to be to really promote a different kind of understanding of that procedural knowledge.



Linda Fisher

The other really powerful part of each Classroom Challenge people should know about is that **every piece of the lesson is designed to have all students participate**. For example, everyone in the class has to respond to feedback, everyone has to participate in fair-share conversations, and everyone has to take turns explaining and asking each other questions. Those deliberately designed demands on students put the focus of learning on students trying to make sense of the matter, rather than teachers trying to make sense.

Diane Yes, what stands out for me are the radically different roles for teachers and students. The primary responsibility for learning shifts to the student in the Classroom Challenges.

David When I think of Classroom Challenges I think "formative assessment lessons," formative as defined by the work of Paul Black and Dylan Wiliam, beginning with their publication of "Inside the Black Box" in the late 1990s.² And when I think about

² Black, Paul and Wiliam, Dylan. "Inside the Black Box: Raising Standards Through Classroom Assessment," King's College, London. Phi Delta Kappan, October 1998.

formative assessment, I think about it in terms of what highly effective teachers do minute-to-minute and day-to-day in their classroom. It's the idea that a teacher is providing students with a worthwhile task, listening to what students say and looking at what students do, hearing conversations between students, examining the work that they are producing, making instructional decisions in real time, and then providing feedback in a way that they wouldn't and couldn't have done if they hadn't carefully listened and observed the students.



David Foster

*Looking at **the way the Classroom Challenges are designed**, I believe **the purpose is, first and foremost, to surface students' understanding**. That's because as a teacher you want to find out what students know, and then you want to find out where students are struggling so that you know where to go with that, so that you can develop clear instructional goals. A CC deepens students' conceptual understanding of the topic and it allows students to go deeper. I think it clears up misconceptions that the students have, and I think it extends the learning that goes on.*

Mary *First of all I think of the Classroom Challenges as big tasks. **They are designed with a broader vision of what it means to know, understand, and do mathematics—broader than anything we find in the majority of currently available curriculum materials**. I think that is a big difference. The answer is not just right there in front of the students. It's not just "spit it back." The CCs go further and deeper with respect to what it means to do mathematics. This is not your vanilla-pudding mathematics.*

Mark *Is there anything else that is important for people to understand about the unique character of the Classroom Challenges?*

David *Underscoring what Sally mentioned earlier, the great advantage that these curricula have over others is that **they have been informed by the Common Core standards and, more importantly, by the Standards of Mathematical Practice**. This is really the first genre of curriculum that actually had the eight Standards of Mathematical Practice to use as a guide. I think the authors have done a superb job of using those to serve as the core of the mathematics that kids are learning.*

Why is the design of the Classroom Challenges important?

Mark *These lessons seem to have structure to them—structure that is repeated from CC to CC, a kind of template if you will. Is this structure an important design feature of Classroom Challenges?*

David *There are two reasons why the structure seems to work. First, it's comforting to teachers. **It's comforting to have a template** that is going to roll out in a certain way. So there is a familiarity that develops over some time. Secondly, **the structure has a tendency to make planning for lessons easier**. If you have done a couple of CCs then you are going to look for the pattern.*

Sally *Sometimes that can be a drawback. While the lesson structure provides accessibility into the mathematics for teacher and students alike, **without a teacher's focus on conceptual development, the lesson format may become a procedural exercise**.*

Mary I think the structure actually is a plus. I think of it when I use it with teachers who were “stand and deliver” teachers five years ago when I started with them. The embedded structure within the Classroom Challenges has helped them move out of that model. Without that design structure they wouldn’t have. So I see the structural features as tools for talking about the mathematics in a broader sense, for helping people think about what it means to use formative assessment, and for moving practice.

Mark So the design is educative. The CCs teach the teacher.

Linda I think that the structures promote different kinds of thinking about mathematics. For example, the card sorts really help kids make connections between different types of procedures and different kinds of understandings. Or, the “Sometimes, Always, Never” activity pushes students toward building their level of justification. As another example, the structure of the problem-solving lessons gets students to view math as perseverance—there’s a rough draft and another rough draft and another draft, where you are always pushing toward a better solution rather than getting the quick right answer. So I think there is something brilliant about those different genres that expand ideas about mathematical practice. And that’s true for both students and teachers.



Sally Keyes

David Another feature besides the things that Linda just talked about is what I think of as a kind of skateboard ramp. The design of the Classroom Challenges follows a ramp, where there is a scaffold supporting the mathematics so that every kid has some access into it, moves up the ramp, and gets to the core mathematics. In contrast, even other good and innovative curricula aren’t structured to provide that ramp, that access. All you have is a big problem to do but it’s not helping the students get into the problem.

Mary I want to add one thing... what I really think is so powerful about that ramp that’s built into the CCs is that it provides an opportunity for heterogeneous classrooms to engage together in the mathematics. The ramping provides access and it pushes the mathematics, and I think that design is so critical for success in a typical classroom, any classroom, not just the high-achieving ones.

SAMPLE

Classroom Challenge - Problem Solving

Designing: Candy Cartons - Grade 6

3 towers of 6 candies.
This carton is neat and attractive. It shows well because it won't fall over and it packs up close with no gaps, so it will be good on the shelves in the store. It fits into a letter size sheet of card real easy and it is easy to fold up. The sides of the carton will be nice and big for graphics for the candy product details.

Julia

Design a carton for a candy company that will contain 18 candies, each 1 cm by 2 cms, from a single sheet of letter-size cardboard with as little cutting as possible.

Mathematical Goals

This lesson unit is intended to help teachers assess how well students are able to:

- Select appropriate mathematical methods to use for an unstructured problem.
- Interpret a problem situation, identifying constraints and variables, and specify assumptions.
- Work with 2- and 3-dimensional shapes to solve a problem involving capacity and surface area.

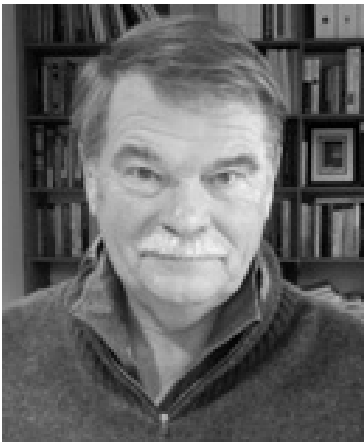
What are benefits to teachers of using the Classroom Challenges?

Mark Talk about a teacher success you've seen. Where have you seen a teacher adjust or think differently about students through using the Classroom Challenges?

Sally Oh, that's an easy one. Just yesterday all of us were visiting a middle school here in Berkeley. We were there to interview teachers about what they had learned using the Classroom Challenges. One of the most powerful statements was from a teacher who said, "What I learned from using these tasks was that I don't have high enough expectations of my students. I could see kids doing things that I never thought they were capable of at my grade level."

Linda A different teacher said, "I thought I was doing a good job." And he was, in a way. He did a great "stand and deliver," making kids excited because he uses bells and whistles and all kinds of laser lights and stuff like that. Yesterday he said, "You kept telling me that I had to just stop and let kids do it, and that I had to let go. So I did, and it was amazing to watch what happened when you forced me to not talk at them and to let them work."

Mary You know my stories about the varsity football coach, and you also know that the reason I chose him to pilot the CCs is because he's in a tough department, but where he goes, people follow. He's the one who said, "I used to think if I taught all the bits, step by step, the kids would get it ... but when I did the CC where students are asked to build and solve an equation, and I saw that the kids couldn't do it, I was dumbfounded. I'd just taught them how to do it!" So he's experienced some very big "ahas," in the last few years and he's learned some different ways to teach. But the really important thing is that he has a different definition of what it means to know mathematics. He has a different definition of his role in the classroom, and he has different expectations of his students. Now he's also saying, "We have to do this as a department and as a district. The kids need more from us." Because of his influence over the past five years, Classroom Challenges are being implemented across his district. Teachers use them quarterly in every Algebra class, every Geometry class and every Algebra 2 class.



Mark St. John

SAMPLE

Classroom Challenge - Concept Development

Fractions, Decimals and Percents - Grade 6

Students are asked to place decimal, percent, and fraction cards in order, along with area and linear diagrams that assist them in explaining their thinking.

Mathematical Goals

This lesson unit is intended to help students:

- Compare, convert between, and order fractions, decimals, and percents.
- Use area and linear models of fractions, decimals, and percents to understand equivalence.

0.2 ____%	0.05 ____%	-.____ 80%
0.375 ____%	-.____ 12.5%	0.75 ____%
1.25 ____%	-.____ 50%	-.____ ____%

What is your practical advice to teachers who are getting started using the Classroom Challenges? What should they be sure to do?

Mark What are three things you would tell teachers they absolutely should do when they start to use the Classroom Challenges? In a minute I'll ask you about three things teachers absolutely should not do. But first, what's important to do when you're starting out?

Diane First, *teachers need to engage in professional development before they actually start teaching. I also think they need to do the math, they need to do the tasks themselves before they start teaching. And third, they should pose questions to students on the pre-assessments. Don't skip that part.*

Linda Make sure that you *model how you want kids to share ideas with each other and how you want them to ask questions of each other before they start an activity. Then think about how to use the materials to allow all students to be engaged in what is going on in the class, rather than scrimping on materials. Third, work the problems with colleagues and share strategies so that you are prepared to think about different ways students might solve the problem.*

David *Support students to discuss and collaborate together. Expect more of your students and they will reward and surprise you. And observe how your students are thinking about the mathematics.*

Mary *First, read through the whole lesson. Second, work through the task—you have got to do the task yourself before you give it to your students. And three, follow the guide exactly as it is written the first two or three times you teach that lesson and try to see why it's written the way it is.*

Sally *I'm in agreement. Read the lesson all the way through, cover to cover, every word, and think about the implications. Then, do all the mathematics and anticipate what students will or won't understand. And third, make sure you maximize the whole group discussion at the end because that is what helps them with the learning.*



Diane Schaefer

What should teachers be sure not to do?

Mark We have a lot of agreement about what to do to get started. Briefly now, what about things not to do?

Diane *Don't change the lesson, keep to the fidelity of the lesson at the beginning. Don't teach the Classroom Challenge as you would one of your traditional lessons. And don't help students find a solution, pose questions instead.*

Mary *Don't score the pre-assessment, and don't worry that your students can't do that much on the pre-assessment.*

- Sally** *I'm thinking in a slightly different direction, from the district administration angle. I would say, **don't mandate to teachers how many or which of the Classroom Challenges they should do.** You need to allow teachers to select the ones they feel comfortable with.*
- Linda** *Yes, for buy-in, teachers need to be able to own the idea of the selection.*
- Sally** *My advice is, **don't do the CCs alone. Collaboration is especially important.** It's important for the district office and the school principals to offer support for the teachers who are going to be doing the CCs. Give them time for follow-up after the teaching of the lessons so that teachers can collectively reflect and decide on next steps, because they need to get the information from each other.*
- Mark** *I think you have a proposition hidden between the lines—if teachers work collectively with Classroom Challenges, perhaps working on a common one together and having discussions and so forth, it will greatly increase the degree to which the CCs become educative for the teachers.*
- Linda** *Yes, I strongly believe that **the lessons support the idea of learning from each other** and using the formative assessment idea of activating each other's resources and thinking about the learning for oneself. So I think that we need to help promote that professional learning support—learning from each other.*

What are your final thoughts about the Classroom Challenges?

- Mark** *Any additional insights about the Classroom Challenges?*
- Mary** *I see the Classroom Challenges as a way to start getting ready for the Common Core, and it's the first thing I say to administrators when I want to get their attention. I draw on James Stigler's thinking, when he says that one of the reasons that people don't move forward is because they become paralyzed. Innovations are introduced to them along with the demand to change **everything**. No one can do that. So he talks about the 10%. What if we could change 10% a year? I present the Classroom Challenges as a 10% type of strategy to start moving forward.*
- David** *We have lots and lots of top-down stuff in our schools and districts, but in truth **real change has to come from the classrooms up.** And that's another thing that's really lovely about the Classroom Challenges is that in general they are not mandated or adopted across districts. Rather, individual teachers are picking them up and using them. And I would argue that for something to be effective, it has to work that way.*
- What we are really doing is changing teaching, we are shifting the teaching practice. A CC is a good tool to help a teacher do that. So that means it has to be ongoing, some kind of ongoing professional development has to be provided, because good teachers get better all of the time. We are leaving an era where we have been "teacher-proofing," that is what No Child Left Behind is, as opposed to this idea of really professionalizing teaching. So to me the conversation is about improving teaching.*

Inverness Research, a national education evaluation and consulting group headquartered in Northern California, has over 25 years of experience studying local, state, and national investments in the improvement of education.

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