

WHAT IS A MATH ASSESSMENT PROJECT CLASSROOM CHALLENGE?

AND WHY WOULD A MIDDLE OR HIGH SCHOOL MATH TEACHER WANT TO KNOW?

In July 2012, Inverness Research conducted lengthy interviews with 12 middle and high school teachers who piloted the Math Assessment Project (MAP) Classroom Challenges in California, Michigan, and Rhode Island. These teachers collectively piloted more than 50 Classroom Challenges with their students over three years. As demonstrated in the interview quotes used throughout this document, their voices speak to the questions a typical middle or high school math teacher might have about the MAP Classroom Challenges.

What is a MAP Classroom Challenge?

MAP Classroom Challenges (CCs), also known as formative assessment lessons (FALs), are unique hybrids that include elements of mathematical investigations, lessons, tasks, assessments, and cooperative group collaborations. CCs are of two types:

Concept Development Lessons are designed to reveal and develop students' conceptions and misconceptions of significant mathematical ideas and how these ideas connect to their other knowledge.

Problem Solving Lessons are designed to assess and develop students' capacity to apply their mathematics flexibly to non-routine unstructured problems, both from the real world and within pure mathematics.

What is MAP?

The Math 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 for Mathematics (CCSSM).

The Math Assessment Project is developing 100 Classroom Challenges, many of which are available to teachers for download, free of charge, for non-commercial use, from the MAP website: <http://map.mathshell.org>.

Thus, concept development lessons focus on assessing and developing conceptual understanding, while problem solving lessons focus on applying previously learned mathematics to non-routine problems. Both types of Classroom Challenges are anchored in the content described in the Common Core State Standards for Mathematics, centering in particular on the eight Standards for Mathematical Practices, which pose the major new challenge in the CCSSM.

“ *I think a Classroom Challenge is a type of formative assessment that lets you know where your students are. It's a broader way of assessing student understanding because it covers so much more than asking students to answer a simple question. Instead, you are asking students to take on a task where they analyze their own thinking, collaborate with someone else, and then analyze someone else's thinking. They have to come up with a plan to attack the task or problem and make a presentation to other people so that it makes sense to them. So there is a big element of making students' thinking visible.* ”

“ *I would say that Classroom Challenges are collaborative lessons that are built around one concept and that are structured in ways to allow an initial entry point that every student can access in some way. They also include multiple representations, so that in that collaborative setting the lesson allows different people to see things in different ways. The lesson is open-ended enough that no one in my experience—no one—walks away feeling stupid. They really allow a group of students to explore their understanding of the concept.* ”

How is a MAP Classroom Challenge different from a regular math lesson?

Students learn mathematical content while participating in a MAP Classroom Challenge, just as they might in a traditional high school or middle school math lesson, but a CC looks and feels very different. It focuses on only one topic or problem, rather than several. It generally takes 2 to 3 classroom periods, thus extending over several days. The most salient difference between a conventional math lesson and a Classroom Challenge is that students, not the teacher, are doing the majority of the work. CCs are structured so that students are required to draw on prior mathematical knowledge, talk or write about their ideas, collaborate, and work in groups, thereby making their mathematical thinking visible to the teacher, to other students, and to themselves.

“ *One of the big differences is that students talk about mathematics, they use their mathematical vocabulary to try to explain things to each other, and that is a big advantage. In a small group of two or three students, they have to talk to each other or they are not going to get anything accomplished. In a big classroom, they could go days or even weeks without saying anything mathematical at all in a class.* ”

“ *During the group work you can start to see difficulties that individual students have. Listening to the discussion between the kids is so valuable. A lot of times kids were teaching other kids in these lessons. Before, in my traditional classroom, I did all of the teaching. I was up front and I presented everything. So for me, it was amazing to listen to the kids who had knowledge and were able to pass it onto other kids.* ”

How does a MAP Classroom Challenge work?

Classroom Challenges follow a format and flow that involves six steps:

1. The teacher assigns a **pre-assessment problem** to students to complete individually.
2. The **teacher reviews** students' pre-assessment work to understand the range of their understandings and misunderstandings.
3. Based on the review of initial student work and suggestions from the MAP teacher's guide, the teacher develops **questions to focus students on the mathematics concept** embedded in the initial problem.
4. The teacher then reintroduces the problem, which students tackle in **small groups** while the teacher listens and facilitates.
5. The teacher orchestrates and facilitates a **whole group discussion**.
6. **Students re-examine their previous work and revise** it based on the additional knowledge they have gained from the preceding processes.

Why are Classroom Challenges designed this way?

The pre-assessment phase (steps #1 and #2) reveals student thinking to the teacher, surfacing individual levels of understanding as well as misconceptions about the focal math concept. With this clearer and often surprisingly fresh view of their students' abilities, teachers are prepared to further the development of students' learning in the remainder of the Classroom Challenge process.

“ *I was just so surprised at some of the misconceptions that the kids had, and so it was a big eye-opener for me.* ”

“ *The independent work that students are asked to do at the beginning of a Classroom Challenge is great. It is really important for me to be able to see where the students are coming from, to learn what they know and what they don't know. It is also really important to see which students don't mind that struggle and which ones get really frustrated. Having that preview of what students know and how they approach problem solving is really, really important to me.* ”

“ *It is always very enlightening to see what my students are thinking. It identifies misunderstandings, and that helps me to clear them up.* ”

In the phase where the teacher presents a new but related challenge (steps #3 and #4), students work collaboratively in small groups. Observing and interacting with each group gives teachers the opportunity to see their students at work, to listen to them carefully, and to ask facilitating questions. The small group work also provides a safe and structured setting in which students of all abilities can take risks, contribute, and learn from one another through the group’s discussion.

“ *In my opinion the most critical part of the Classroom Challenge is the collaborative piece in the center of the lesson, the task students complete in small groups. That’s where everyone has access. Even if they are just observing, they are seeing other people make connections, and that can help them make their own connections. Even those who are disconnected from math class are seeing good mathematics practice modeled for them in a group setting that they can’t escape.* ”

The final phase (steps #5 and #6) of a typical Classroom Challenge is the learning payoff. Students come together in a whole-group discussion that is carefully orchestrated by the teacher, and they are able to reflect on their own work as well as the work of others. Individuals then revisit and revise their work based on new information and their own newly constructed knowledge.

“ *I really like the idea of students going back on their own and seeing what gains they have made.* ”

“ *The revision process is hard for students, but I do think that by using the Classroom Challenges over time, my students have learned that they are expected to think on a deeper level and not necessarily finish what is initially set in front of them as fast as they can.* ”

What do students learn from using MAP Classroom Challenges?

Pilot teachers report that many benefits accrue as students participate in Classroom Challenges.

The greatest benefit is that when students are engaged in CCs they are, by necessity of the lesson design, **engaged in one or more of the eight Mathematical Practices called for in the CCSSM**—practices that are generally absent from traditional curricula. As a result, math students become more proficient at practices such as “making sense of problems and persevering in solving them,” “reasoning abstractly and quantitatively,” and “constructing viable arguments and critiquing the reasoning of others.”

“ *Students have a chance to talk about mathematics. They have to make an argument and justify their thinking and reasoning. It’s important mathematically to be able to do that, but it’s also an important life skill.* ”

“ *My math students always used to look to me to tell them who was right and who was wrong. I see them now trying to justify their answers and trying to convince another person. I think that’s a very important mathematical skill, a higher level thinking skill that my students need.* ”

Participation in the CCs **transforms students’ thinking**, not only about the fundamental nature of mathematics, but also about their relationship with the discipline.

“ *At my school kids have generally not been interested in mathematics. They haven’t seen it as exciting, as a chance to think critically, and as a fun challenge. But I think Classroom Challenges change that. The CCs offer the right portrayal of what mathematics is about. When kids begin to experience that they see how rich and how exciting the subject really is.* ”

Because Classroom Challenges are genuinely interesting, pilot teachers find their students becoming **genuinely motivated to learn math content**.

“ *Students are interested in the content. They find the Classroom Challenges exciting. In fact some students who I normally don't see participating are interested in the ideas and have things to say.* ”

“ *Students start asking questions about things that they have always wondered or have always thought but never had the opportunity or courage to delve into.* ”

Classroom Challenges **engage and benefit all students in class**, not just those who have traditionally been “good at math.” The nature of the challenges levels the playing field by posing problems that are deliberately designed to have many points of access and that are intended to surface and display a variety of responses. Students have many different ideas about the problems, all of the ideas are valued, and thereby every student is valued.

“ *There is a lot more activity in my classroom when I use a Classroom Challenge. The kids are busy and working at it. They are working at their different levels. The high-level students are challenged and the lower level students participate and work on the problem too. They are in a kind of comfort zone, in that they are all working on parts of the lesson that they can do. So it's a much busier, more active classroom, with so much less of me showing them how to do everything. That is a benefit to students.* ”

What are some tips to get started using MAP Classroom Challenges with your students?

Because MAP Classroom Challenges are unlike traditional lessons, getting started in the classroom may not come naturally. Although pilot teachers unanimously and enthusiastically encouraged others to use Classroom Challenges, they indicated there could be some bumps along the way to classroom implementation and offered the following words of wisdom to other teachers.

- *I would encourage you to just do it! It's made me a better teacher. The Classroom Challenges have helped me reach more students with mathematics, get more students involved and interested than they have been.*
- *Grab a buddy, another teacher in your building who you can work with, and collaborate a lot.*
- *If you can, go observe another teacher who is using a Classroom Challenge. A picture is worth a thousand words, and you'll have a better concept of what a CC is after you've had that direct experience.*
- *Pick a Classroom Challenge that appeals to you, and then do the problems while you are asking yourself a few questions: What are the important mathematical ideas? What do I think my students would do with these problems?*
- *Read the guide and follow it. It's excellent. Each activity is so well thought out and so well formulated.*
- *Dedicate at least three classroom periods to a CC. They take longer, and it's worth it.*
- *Pay particular attention to the questions that deepen your students' understanding.*
- *Be prepared to step aside and allow the lesson to be student-driven.*
- *Slow down. Don't be in a hurry to fix students' mistakes.*
- *Think of the Classroom Challenges not as a steady diet of activities in your classroom, but as a supplement or enhancement for your curriculum.*
- *Be prepared to work hard. I have worked so much harder on these Classroom Challenges than I ever had before, but I also can't believe the results I have gotten with my kids. When they had a breakthrough and understood something for the first time, they were so excited and wanted to talk and wanted to tell other kids what they had figured out. The excitement level just goes up in the classroom.*

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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