The Teaching for Robust Understanding (TRU) Observation Guide for Mathematics

A Tool for Teachers, Coaches, Administrators, and Professional Learning Communities

This *Teaching for Robust Understanding Observation Guide for Mathematics* is designed to support teachers, coaches, administrators, and professional learning communities in planning, conducting, and reflecting on observations in mathematics classrooms. It is based on the Teaching for Robust Understanding (TRU) Framework (see, e.g., Schoenfeld, 2013, 2014; Schoenfeld & the Teaching for Robust Understanding Project, 2016). The key idea behind the framework is that the five dimensions of classroom activity described in figure 1 are central in determining the degree to which students will emerge from the classroom being proficient mathematical thinkers and problem solvers.

The Five Dimensions of Powerful Mathematics Classrooms				
The Mathematics	**Cognitive Demand**	**Equitable Access to Mathematics**	**Agency, Ownership, and Identity**	**Formative Assessment**
The extent to which classroom activity structures provide opportunities for students to become knowledgeable, flexible, and resourceful mathematical thinkers. Discussions are focused and coherent, providing opportunities to learn mathematical ideas, techniques, and perspectives, make connections, and develop productive mathematical habits of mind.	*The extent to which students have opportunities to grapple with and make sense of important mathematical ideas and their use. Students learn best when they are challenged in ways that provide room and support for growth, with task difficulty ranging from moderate to demanding. The level of challenge should be conducive to what has been called "productive struggle."*	*The extent to which classroom activity structures invite and support the active engagement of all of the students in the classroom with the core mathematical content being addressed by the class. Classrooms in which a small number of students get most of the "air time" are not equitable, no matter how rich the content: all students need to be involved in meaningful ways.*	*The extent to which students are provided opportunities to "walk the walk and talk the talk" – to contribute to conversations about mathematical ideas, to build on others' ideas and have others build on theirs – in ways that contribute to their development of agency (the willingness to engage), their ownership over the content, and the development of positive identities as thinkers and learners.*	*The extent to which classroom activities elicit student thinking and subsequent interactions respond to those ideas, building on productive beginnings and addressing emerging misunderstandings. Powerful instruction "meets students where they are" and gives them opportunities to deepen their understandings.*

Figure 1. The five dimensions of powerful mathematics classrooms

This *Observation Guide for Mathematics* is part of a support system for collaborative partnerships between teachers and observers[1]. Optimally, each observation is one of a series of classroom visits contributing to teacher growth. There should be ample time to plan observations, to observe lessons, and to discuss the observations, over the course of a term or a year.

Prior to an observation, it is useful for the teacher and observer to discuss the lesson plan and decide on the main points of focus for the observation. The observation might be general; it is possible for a practiced observer to take notes on all dimensions. Alternatively, the teacher and observer might agree to focus on one or two areas the teacher wants to address in detail. Either way, reflecting beforehand on goals for the lesson and for the observation is a good way to make the most of the observation. A useful tool for planning and debriefing is the *Teaching for Robust Understanding Conversation Guide* (Baldinger, Louie, and the Algebra Teaching Study and Mathematics Assessment Project, 2016). The *Conversation Guide* lays out a series of questions for each dimension that teacher and observer can use in planning the lesson, and in reflecting on it as well.

When planning observations, it is useful to think of what the classroom experience looks and feels like from the perspective of a student – students, after all, are the ones experiencing the instruction! The questions in Figure 2 provide an orientation that helps in seeing the lesson from the student perspective.

Observe the lesson through a student's eyes	
The Mathematics	• What's the big idea in this lesson? • How does it connect to what I already know?
Cognitive Demand	• How long am I given to think, and to make sense of things? • What happens when I get stuck? • Am I invited to explain things, or just give answers?
Equitable Access to Mathematics	• Do I get to participate in meaningful mathematical learning? • Can I hide or be ignored?
Agency, Ownership, and Identity	• Do I get to explain, to present my ideas? Are they built on? • Am I recognized as being capable and able to contribute in meaningful ways?
Formative Assessment	• Do classroom discussions include my thinking? • Does instruction respond to my thinking and help me think more deeply?

Figure 2. Observing a mathematics lesson from the student perspective

The form of the observation guide and its use are straightforward. Each observation sheet focuses on one dimension of the framework, and is one page long. Each observation sheet looks like this:

[1] Additional tools can be found at the Mathematics Assessment Project and Algebra Teaching Study web sites (at <http://map.mathshell.org/> and <http://ats.berkeley.edu/tools.html> respectively. A more extensive set of tools will be housed at <http://TRU.berkeley.edu/>.

<table>
<tr><td colspan="2">The name of the dimension
A description of it</td></tr>
<tr><td>A list of some student behaviors to look for…</td><td>A list of some actions by teachers that could support such student behaviors…</td></tr>
<tr><td colspan="2">Space for focal points for this particular observation, if desired</td></tr>
<tr><td colspan="2">Space for note-taking</td></tr>
<tr><td colspan="2">A brief description of key goals related to this dimension</td></tr>
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Figure 3. The structure of an observation sheet[2]

The top and bottom parts of each observation sheet provide concise descriptions of the relevant dimension and goals for it. Beneath the description of the dimension are some examples of "look fors"- actions on the part of students and teacher that are often indicators that things are going well. They are things to aim for in general, and over time – they are NOT a list of things to be checked off in any particular lesson. We imagine teacher and observer discussing these prior to a lesson and deciding which, if any, might be things to focus on in the upcoming observation. The list is not meant to be comprehensive; teacher and observer may decide on another focus and write it in the space provided. The center of the observation sheet provides space for writing down observations.

There are many possible goals for classroom observations. Teacher and observer may decide to focus on one or two issues, or they may agree that the observer will provide a systematic run-through of all the dimensions. It is useful, and typically most comfortable, for the post-lesson conversation to start with the main focal points – on agreed-upon foci, along with events in the lesson that were particularly interesting and salient. But, even if particular foci have been chosen for the observation, it is valuable to run briefly through all of the dimensions – the Teaching for Robust Understanding Framework is intended as a way of seeing and talking about instruction, and it provides a language for thinking about it. After a few observations, it becomes a natural way for teachers, coaches, administrators, and professional learning communities to talk about teaching.

[2] We are indebted to the San Francisco Unified School District for its development of "Observational Tool for LEAD," which provided the inspiration for the design format of this *Guide.*

Here are a few important points about the TRU framework and its use. The Teaching for Robust Understanding framework highlights five dimensions of classroom mathematical activity. They are described separately because each can be the object of coherent focus, as part of ongoing professional development. In the classroom, however, they are all deeply interrelated. In particular:

- Issues related to mathematical content permeate all five dimensions – and all classroom activities. Dimension 1 focuses on the quality of the content *per se*. If the mathematics isn't rich, there is nothing meaningful for the students to learn. But what matters in addition is the set of opportunities that each student has to engage with and make sense of the mathematics. Thus Dimension 2, cognitive demand, should be conceived of as opportunities for productive struggle with core mathematical concepts and practices. Issues of access (Dimension 3) and opportunities to develop agency, ownership, and identity (Dimension 4) concern the ways in which every student relates to the big ideas of the discipline. And, of course, the purpose of formative assessment (Dimension 5) is to facilitate access to the mathematics.
- Similarly, issues of equity also permeate all five dimensions and should be central at all times. The key point is that *every* student should be supported in developing a positive mathematical identity (Dimension 4) through meaningful access and participation (Dimension 3) to rich mathematical content (Dimension 1). That participation can only be meaningful for a student if the level of cognitive demand is right for sense making (Dimension 2), something achieved by formative assessment (Dimension 5). At the same time, Dimension 3, Equitable Access to Mathematics, does need specific, focused attention: teaching in ways that provide meaningful opportunities for all students to engage with central mathematical content, and to build productive mathematical identities, is extremely challenging.
- As noted above, each observation sheet has room for specific observational goals established by the teacher and observer. One place where this will be essential is for Dimension 1, the content. The "look fors" on the first observation sheet are general across mathematics, and they should be supplemented by specifics for the lesson being observed.

This *Observation Guide for Mathematics* is a product of The Teaching for Robust Understanding project at the University of California, Berkeley, with support from the National Science Foundation (Grant 1503454, "TRUmath and Lesson Study: Supporting Fundamental and Sustainable Improvement in High School Mathematics Teaching") and the Bill and Melinda Gates Foundation (Grant OPP1115160, "Networked Improvement Community to Support Common Core State Standards"). It builds on work by the Algebra Teaching Study (U.C. Berkeley and Michigan State University: see <http://ats.berkeley.edu/>) and the Mathematics Assessment Project (U.C. Berkeley and the University of Nottingham: see <http://map.mathshell.org/>).

Suggested citation:

Schoenfeld, A. H., and the Teaching for Robust Understanding Project. (2016). The *Teaching for Robust Understanding (TRU) observation guide for mathematics: A tool for teachers, coaches, administrators, and professional learning communities.* Berkeley, CA: Graduate School of Education, University of California, Berkeley. Retrieved from: <http://TRU.berkeley.edu> or <http://map.mathshell.org/> or <http://ats.berkeley.edu/>.

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Baldinger, E. Louie, N., and the Algebra Teaching Study and Mathematics Assessment Project. (2014). *TRU Math conversation guide: A tool for teacher learning and growth*. Berkeley, CA & E. Lansing, MI: Graduate School of Education, University of California, Berkeley & College of Education, Michigan State University. Retrieved from: http://ats.berkeley.edu/tools.html and/or http://map.mathshell.org/materials/pd.php.

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Schoenfeld, A. H. (2014). What makes for powerful classrooms, and how can we support teachers in creating them? A story of research and practice, productively intertwined. *Educational Researcher*, *43*(8), 404-412.

Schoenfeld, A. H., & the Teaching for Robust Understanding Project. (2016). *An Introduction to the Teaching for Robust Understanding (TRU) Framework.* Berkeley, CA: Graduate School of Education. Retrieved from http://map.mathshell.org/trumath.php or http://ats.berkeley.edu/tools.html or http://tru.berkeley.edu.

The observation sheets follow.

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THE MATHEMATICS

The extent to which central mathematical content and practices, as represented by State or he Common Core State Standards, are present and embodied in instruction. Every student should have opportunities to grapple meaningfully with key ideas and, in doing so, to become a knowledgeable, flexible, and resourceful mathematical thinker and problem solver. Teachers should have opportunities to consider and discuss how each lesson's activities connect to the concepts, practices, and habits of mind they want students to develop over time.

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Each Student…

- Engages with grade level mathematics in ways that highlight important concepts, procedures, problem solving strategies, and applications
- Has opportunities to develop productive mathematical habits of mind
- Has opportunities for mathematical reasoning, orally and in writing, using appropriate mathematical language
- Explains their reasoning processes as well as their answers.

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Teachers…

- Highlight important ideas and provide opportunities for students to engage with them
- Use materials or assignments that center on key ideas, connections, and applications
- Explicitly connect the lesson's big ideas to what has come before and will be done in the future
- Support the purposeful use of academic language and of representations (e.g., graphs, tables, symbols) central to mathematics
- Support students in seeing mathematics as being coherent, connected, and comprehensible

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• Other focal points for observation:

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What are the big ideas in this lesson? How do they connect to what has come before, and/or establish a base for future work? How do the ways students engage with the material support the development of conceptual understanding and the development of mathematical habits of mind?

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Goal: All students work on core mathematical issues in ways that enable them to develop conceptual understandings, develop reasoning and problem solving skills, and use mathematical concepts, tools, methods and representations in relevant contexts.

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COGNITIVE DEMAND

The extent to which students have opportunities to grapple with and make sense of important mathematical ideas and their use. Students learn best when they are challenged in ways that provide room and support for growth, with task difficulty ranging from moderate to demanding. The level of challenge should be conducive to what has been called "productive struggle."

Each student…	Teachers…
• Engages individually and collaboratively with challenging ideas • Actively seeks to explore the limits of their current understandings • Is comfortable sharing partial or incorrect work as part of a larger conversation • Reasons and tests ideas in ways that connect to and build on what they know • Explains what they have done so far before asking for help • Continues to wrestle with an idea after the teacher leaves	• Position students as sense makers who can make sense of key conceptual ideas. • Use or adapt materials and activities to offer challenges that students can use, individually or collectively, to deepen understandings • Build and maintain classroom norms that support every student's engagement with those materials and activities • Monitor student challenge, adjusting tasks, activities, and discussions so that all students are engaged in productive struggle • Supports students without removing the challenge from the work they are engaged in

• Other focal points for observation:

What opportunities do students have to make sense of mathematical content and practices? How are they supported in sense making so that they are not lost – yet real challenge has been maintained, so that they have opportunities to grapple with important ideas?

Goal: All students have opportunities to make their own sense of important mathematical ideas, developing deeper understandings, connections, and applications by building on what they know.

EQUITABLE ACCESS TO MATHEMATICS

The extent to which classroom activities invite and support the meaningful engagement with core mathematical content and practices by all students. Finding ways to support the diverse range of learners in engaging meaningfully is the key to an equitable classroom.

Each student…	Teachers…
• Contributes to collective sense making in any of a number of different ways (e.g., proposing ideas, asking questions, creating diagrams…) • Actively listens to other students and builds on their ideas • Supports other students' developing understandings • Explains, interprets, applies and reflects on important mathematical ideas • Participates meaningfully in the mathematical work of the class	• Create safe environments • Use tasks and activities that provide multiple entry points and support multiple approaches to the mathematics • Provide opportunities for students to see themselves, and their personal and community interests, reflected in the curriculum • Validate different ways of making contributions • Build and maintain norms that support every student's participation in group work and whole class activities • Support particular needs, such as those of language learners, for full participation • Expect and support meaningful mathematical engagement from all students, helping them contribute and build on contributions from others

• Other focal points for observation:

In what ways does each student engage in the work of the class? How can more opportunities for every student to participate in meaningful ways be created?

Goal: All students are supported in access to central mathematical content, and participate actively in the work of the class. Diverse strengths and needs are built on through the use of various strategies, resources, and technologies that enable all students to participate meaningfully.

AGENCY, OWNERSHIP, AND IDENTITY *The extent to which every student has opportunities to explore, conjecture, reason, explain, and build on emerging ideas, contributing to the development of agency (the willingness to engage academically) and ownership over the content, resulting in positive mathematical identities.*	
Each student… • Takes ownership of the learning process in planning, monitoring, and reflecting on individual and/or collective work • Asks questions and makes suggestions that support analyzing, evaluating, applying and synthesizing mathematical ideas • Builds on the contributions of others and help others see or make connections • Holds classmates and themselves accountable for justifying their positions, through the use of evidence and/or elaborating on their reasoning	Teachers… • Provide time for students to develop and express mathematical ideas and reasoning • Work to make sure all students have opportunities to have their voices heard • Encourage student-to-student discussions and promote productive exchanges • Assign tasks and pose questions that call for mathematical justification, and for students to explain their reasoning • Employ a range of techniques that attribute ideas to students, to build student ownership and identity
• Other focal points for observation:	
What opportunities do all students have to see themselves and others as proficient mathematical thinkers, to grapple with challenges and construct new understandings, to build on others' ideas, and demonstrate their understandings? How can more of these opportunities be created?	
Goal: All students build productive mathematical identities through taking advantage of opportunities to engage meaningfully with the discipline and share and refine their developing ideas.	

FORMATIVE ASSESSMENT

The extent to which classroom activities elicit all students' thinking and subsequent interactions respond to that thinking, by building on productive beginnings or by addressing emerging misunderstandings. High quality instruction "meets students where they are" and gives them opportunities to develop deeper understandings, both as shaped by the teacher and in student-to-student interactions.

Each student…	Teachers…
• Explains their thinking, even if somewhat preliminary • Sees errors as opportunities for new learning • Consistently reflects on their work and the work of peers • Sees fellow students as resources for their own learning • Provides specific and accurate feedback to fellow students • Makes use of feedback in revising their work	• Create safe climates in which students feel free to express their ideas and understandings • Use materials that elicit multiple strategies, and have students explain their reasoning, in order to gain information about student' emerging understandings • Flexibly adjust content and process, providing students opportunities for re-engagement and revision • Provide timely and specific feedback to students, as part of classroom routines that prompt students to make active use of feedback to further their learning • Create opportunities for students' individual and collaborative reflection on their knowledge and learning

• Other focal points for observation:

What opportunities exist for all students to demonstrate their understandings? What opportunities exist to build on the thinking that is revealed? How do teachers and/or other students take up these opportunities? Where can more be created?

Goal: Every student's learning is continually enhanced by the ongoing strategic and flexible use of techniques and activities that allow students to reveal their emerging understandings, and that provide opportunities both to rethink misunderstandings to build on productive ideas.