

# Using professional literature to learn to facilitate mathematical discussions

## Summary

This strategy draws on the professional literature as a resource to help teachers learn to broaden mathematical discussions and questions used in classrooms. Engaging in mathematical talk deepens students' understanding and helps them develop and demonstrate their mathematical knowledge and skills. The key is a change of roles with teachers moving toward:

- facilitating rather than dominating discussion among students of their reasoning on substantial problems-not just asking questions of fact.
- choosing substantial problems worthy of such discussion
- increasing students' responsibility for exploring each problem and explaining and justifying their own solutions.

The tools provide models and methods for engaging students in mathematical discussions and creating classroom cultures where mathematical talk is valued. Each tool contains guidance for classroom use and glimpses into classrooms where mathematical talk is evident through student work, video, or teacher dialogue. The resources also provide research evidence on the role of talk in developing mathematical understanding.

**Challenge addressed:** *How do I engage students in mathematical discussions?* Learning to communicate mathematically is at the heart of deepening understanding in mathematics for teachers and students, but teachers find it difficult to engage students in meaningful mathematical discussions.

## Background

The National Council of Teachers of Mathematics published three standards documents: *Curriculum and Evaluation Standards for School Mathematics*, 1989; the *Professional Teaching Standards*, 1991, and *Principles and Standards for School Mathematics (PSSM)*, 2000. These documents set standards for classroom discourse and describe the changing roles of teachers and students and tools for development in mathematics classrooms.

The discourse of a classroom - the ways of representing, thinking, talking, agreeing and disagreeing - is central to what students learn about mathematics as a domain of human inquiry with characteristic ways of knowing. Discourse is both the way ideas are exchanged and what the ideas entail: Who talks? About what? In what ways? What do people write, what do they record and why? What questions are important? How do ideas change? Whose ideas and ways of thinking are valued? Who determines when to end a discussion? The discourse is shaped by the tasks in which students engage and the nature of the learning environment; it also influences them. (NCTM 1991, p. 34)

**Teachers** need to:

- create a culture which values and supports discourse;
- choose tasks that merit and promote discussion;
- pose questions to elicit students' reasoning, sense making and to reveal their depth of understanding;

- orchestrate the classroom discussion, listening carefully to what students say, monitoring and guiding the mathematical talk;
- provide extensions or challenges to meet teaching and learning goals.

**Students** are expected to

- explore problems;
- explain and justify their approaches and solutions;
- listen, make sense of other's reasoning, and challenge faulty thinking and unreasonable approaches and solutions;
- take responsibility for their own work, and their own learning.

## Implementing the strategy

### Mathematical Discourse: Talking about Mathematics

This strategy is based on teachers using selected readings and trying ideas for encouraging talk about their students' mathematical thinking. Engaging in mathematical talk may be a new journey for teachers and students; therefore, teachers need to be patient and reflective when implementing ideas they find in the literature. They need to analyze their current practice, try some new ways to get students to talk about their thinking, and reflect on what they are learning about students' understandings through the questions they pose.

Teachers should select from the literature models and methods most suited to their individual needs, interests and grade level.

Although there isn't a prescribed sequence of readings for teachers to follow, the *NCTM Professional Teaching Standards* (PTS) is a valuable resource for initial reading. The PTS elaborate on what is meant by worthwhile mathematical tasks, mathematical discourse, roles for teachers and students, tools for discourse, and describes a learning environment that supports engagement in discourse to develop student understanding. Vignettes are used throughout PTS to highlight and illustrate key aspects of each key idea.

In the book, *Talking Mathematics: Supporting Children's Voices* (ISBN 0-435-08377-5), elementary teachers will find strategies that can be easily implemented. They may find it helpful to form study groups with peers to read chapters, discuss new strategies, try them out in their classrooms, then come back together to talk about how it went and what they learned. The complementary video, *Talking Mathematics: Supporting Classroom Discourse* (ISBN 0-435-08399-6), provides an introduction to using mathematical talk in the classroom. The videotape highlights teachers' and students' engagement with tasks and activities that require students to explain their mathematical thinking and reasoning. Teachers may find it useful to videotape and analyze their own mathematics lessons to specifically focus on the range and type of questions posed, and how students engage in mathematical talk.

To engage students in mathematical discourse, teachers need to use substantial mathematical tasks. These tasks may be open-ended with different solutions possible, or open-middle with one solution but multiple ways to approach and solve the problem. The tasks should vary in length, type, mathematical content and processes. Typically, these types of tasks are non-routine and ask students to explain how they reasoned about the mathematics. There are many published resources that contain mathematical tasks of this kind (e.g., *Balanced Assessment: classroom packages*). *Encouraging Mathematical Thinking: Discourse around a Rich Problem* is an online tool that provides video, text, and tasks for teachers to use to engage students in mathematical discussions. This tool is unique in that it takes a mathematical problem context and provides grade level appropriate lesson plans for elementary through advanced high school mathematics classes.

Additional resources can be found in NCTM publications, [standards-based mathematics curricula](#), some textbooks, and a number of websites (e.g., NCTM Navigation Series, <http://www.nctm.org/standards/navigation.htm>, NCTM Illuminations website at <http://illuminations.nctm.org>, Math Forum at <http://mathforum.org/>)

### **Mathematical Discourse: Writing about Mathematics**

Writing as a means of communicating thinking and reasoning is a common strategy that is used routinely by elementary teachers in language arts, but rarely used in the mathematics classroom. Teachers of K-12 students will find a range of ideas presented in *Writing to Learn Mathematics: Strategies that Work, K-12* by Joan Countryman (ISBN 0-435-08329-5), very practical and easy to implement. Through the use of learning logs, journals, word problems, and projects, teachers can gain additional insights into students' understandings.

### **Getting Started**

Individual teachers can benefit from reading the professional literature on mathematical discourse. To that end teachers may find it helpful to form study groups with their peers to read chapters from selected books, discuss new strategies, and relate them to their own practice. Additionally, videotaping and analyzing their mathematics lessons to examine the range and type of questions posed, and how students engage in mathematical talk in their classroom would be invaluable.

There are many ways that a study group could be organized: pairing grade-level teachers; grouping teachers across grade bands (e.g., K-2, 3-5); grouping by teachers by course taught. Groups should decide which resources to start with and establish a time-line for reading, experimenting, meeting, discussing, and reflecting on what they learn. It is important for study groups to meet on a regular basis, ideally once a week, for a few months. Teachers may find it powerful to write about their learning in a journal and share things that worked—or didn't. If the focus is on writing to learn mathematics, teachers will want to bring samples of student work where they have written about their reasoning for group discussion.

### **Implementation Issues**

Study groups typically meet outside of regular class time and may need an incentive to meet on a routine basis. Given the competing demands that teachers experience, there may be many tensions around curriculum coverage, time constraints, district expectations, and on-demand assessments from external sources. It is important for a building administrator to value and promote reflection and life-long learning as a powerful tool for school improvement. The administrator needs to find creative ways to allocate time and provide incentives for groups to meet (e.g., staff meetings include time for study group discussions). It is also important that there is a person(s) who take responsibility for facilitating study groups so that a) time allocated is put good educative use, and b) a professional learning environment is constructed that supports and values risk-taking.

### **Strengths**

- Students explore mathematics in greater depth, leading to deeper understanding;
- Students take greater responsibility for their own learning;
- Students explain and justify their approaches and solutions;

- Students learn to listen and make sense of other's reasoning;
- Students learn to challenge faulty thinking, unreasonable approaches and solutions;
- Teachers learn choose tasks worthy of discussion;
- Teachers pose questions to explore the depth of students' thinking and learn more about how the range and types of questions they ask impact student learning;
- Teachers learn to facilitate rather than dominate a classroom discussion;
- Teachers enhance their ability to listen to students' reasoning;
- Teachers engage in an ongoing professional development activity that highlights reflection and experimentation as a tool for growth.

### **Likely challenges**

- Teachers need time to learn how to facilitate mathematical discourse;
- Teachers need time to try new strategies, reflect on, and refine their practice;
- Tasks may not be aligned with curriculum that is in use;
- Mathematical talk may be perceived as an impediment to "covering" the curriculum.

### **The Tools**

*NCTM Professional Teaching Standards*, <http://www.nctm.org>.

*Talking Mathematics: Supporting Children's Voices* and the complementary videotape

*Talking Mathematics: Supporting Classroom Discourse*, <http://www.heinemann.com>.

*Writing to Learn Mathematics: Strategies that Work, K-12* (Heinemann),

<http://www.heinemann.com>.

*Encouraging Mathematical Thinking: Discourse around a Rich Problem*,

<http://mathforum.org/brap/wrap/index.html>.