Connecting Practice and Research
in Mathematics Education

Math-Talk Learning Community

Research Synopsis

Math-Talk Learning Community

Hufferd-Ackles, Fuson, and Sherin (2004) define a *Math-Talk Learning Community* as a community in which individuals assist one another's learning of mathematics by engaging in meaningful mathematical discourse (p. 82).

Important Aspects of a Math-Talk Learning Community

The key components within a Math-Talk Learning Community are: questioning, explaining mathematical thinking, source of mathematical ideas, and responsibility for learning. *Questioning* in an effective Math-Talk Learning Community features a shift away from the teacher as questioner to students *and* teacher as co-questioners. In this community, students are encouraged to ask questions of their peers in order to understand one another's thinking. *Explaining mathematical thinking* is closely related to, and an obvious product of, good questioning. Students are increasingly afforded the opportunity to articulate their ideas and new learning to the teacher and to each other within a supportive environment. In a Math-Talk Learning Community students are able to explain, defend and justify their mathematical thinking with confidence. In a more traditional classroom the key *source of mathematical ideas* was often the teacher, solving problems in a procedural manner for students to then imitate. Whereas, in this environment, students as well as the teacher are each seen as important sources of mathematical ideas. The mathematical "talk" often features the negotiation of student understanding of a given concept, and the ideas of students are considered as valid and worthy of further exploration. In the Math-Talk Learning Community students increasingly take *responsibility for their own learning* and for the evaluation of others and self. According to the findings of Ackles, Fuson, and Sherin, "When student thinking began to be elicited, students became more engaged and involved in classroom discourse as speakers and listeners. Their responsibility for their own learning was indicated by their desire to ask questions in class, their eagerness to go to the board to demonstrate their understanding of problems, and their volunteering to … assist struggling students" (p. 106).

Developing an ideal Math-Talk Learning Community is a process that requires adequate time and support. Appendix 1 provides the reader with the researchers' rubric outlining the noticeable characteristics of the four components at each of the four stages of growth (i.e., Levels 0–4). This "developmental trajectory," or growth continuum, enables a teacher to track the progress of their students and of themselves as they continue to evolve together as a Math-Talk Learning Community. In terms of the four components outlined above, a progression is shown to occur from a focus on answers to a focus on mathematical thinking; the role of the teacher transforms from a central position of control to one of a coach or facilitator; and the role of student transforms from one of a passive to much more active participant in the classroom learning activities.

The research of Ackles, Fuson, and Sherin (2004) is particularly significant in that it indicates that even "urban classrooms with students that are below grade level in mathematics can function and learn as a math-talk learning community." In order to cultivate this positive Math-Talk Learning Community environment, it is critical for teachers to be patient with their students, to listen carefully to them, to draw out their ideas whenever possible, and to encourage them to listen to each other. "Classroom discourse and social interaction can be used to promote the recognition of connections among ideas and the reorganization of knowledge…. By having students talk about their informal strategies, teachers can help them become aware of, and build on, their implicit informal knowledge" (NCTM, 2000, p. 21). Teachers must create a classroom climate in which all students are able make sense of the mathematics that they are learning and to gain confidence in their mathematical ability. With this confidence comes the ability for students to take risks in communicating their mathematical thinking.

Considerations regarding a Math-Talk Learning Community

- Students must have a grasp of the language of the particular strand of mathematics being studied in order to carry on "math talk (e.g. to describe one's own thinking, to question, or to extend the work of others)
- Mathematics must be accessible to students to be able to participate in meaningful mathematical discourse
- Not every day includes extensive "math talk" (i.e., some days may involve individual work or paired practice)
- Time is needed to develop a Math-Talk Learning Community; a growth continuum implies ongoing change
- The rubric is meant to assist teachers in monitoring their own "math-talk" progress, and that of their students

References

Hufferd-Ackles, K., Fuson, K. C., & Sherin, M. G. (2004). Describing levels and components of a math-talk learning community. *Journal for Research in Mathematics Education, 35*(2), 81–116.

National Council of Teachers of Mathematics. (2000). *Principles and standards for school mathematics.* Reston, VA: Author.

Evidence of Math-Talk Learning Community: Action Trajectory for Teacher and Student

General Descriptor	**Traditional teacher-directed classroom with brief answer responses from students.**	**Teacher beginning to pursue student mathematical thinking. Teacher plays central role in the math-talk community.**	**Teacher modeling and helping students build new roles. Some co-teaching and co-learning begins as student-to-student talk increases. Teacher begins to physically move to side or back of room.**	**Teacher as co-teacher and co-learner with students. Teacher monitors all that occurs, still fully engaged. Teacher is ready to assist, but now in more peripheral and monitoring role (coach and assister).**
Questioning Shift from teacher as questioner to students and teachers as questioners.	*Teacher is the only questioner. Short frequent questions function to keep students listening and paying attention to the teacher.* Students give short answers and respond to the teacher only. No student-student math talk.	*Teacher questions begin to focus on student thinking and focus less on answers. Teacher begins to ask follow-up questions about student methods and answers. Teacher is still the only questioner.* As a student answers a question, other students listen passively or wait their turn.	*Teacher continues to ask probing questions and also asks more open questions. She also facilitates student-to-student talk, e.g., by asking student to be prepared to ask questions about other students' work.* Students ask questions of one another's work (on the board), often at the prompting of the teacher. Students listen to one another so they do not repeat questions.	*Teacher expects students to ask one another questions about their work. The teacher's questions still may guide the discourse.* Student-to-student talk is student initiated, not dependent on the teacher. Students ask questions and listen to responses. Many questions are "Why?" questions that require justification from the person answering. Students repeat their own or other's questions until satisfied with answers.
Explaining mathematical thinking Students increasingly explain and articulate their math ideas.	*No or minimal teacher elicitation of student thinking, strategies, or explanations; teacher expects answer-focused responses. Teacher may tell answers.* No student thinking or strategy-focused explanation of work. Only answers are given.	*Teacher probes student thinking somewhat. One or two strategies may be elicited. Teacher may fill in explanations herself.* Students give information about their math thinking usually as it is probed by the teacher (minimal volunteering of thoughts). They provide *brief descriptions* of their thinking.	*Teacher probes more deeply to learn about student thinking and supports detailed descriptions from students. Teacher open to and elicits multiple strategies.* Students usually give information as it is probed by the teacher with some volunteering of thoughts. They begin to stake a position and articulate more information in response to probes. They explain steps in their thinking by providing *fuller descriptions* and *begin to defend* their answers and methods. Other students listen supportively.	*Teacher follows along closely to student descriptions of their thinking, encouraging students to make their explanations more complete; may ask probing questions to make explanations more complete. Teacher stimulates students to think more deeply about strategies.* Students describe more complete strategies: they *defend* and *justify* their answers with little prompting from the teacher. Students realize that they will be asked questions from other students when they finish, so they are motivated and careful to be thorough. Others students support with active listening.

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Source of mathematical ideas Shift from teacher as the source of all math ideas to students' ideas also influencing direction of lesson.	*Teacher is physically at the board, usually chalk in hand, telling and showing students how to do math.* Students respond to math presented by the teacher. They do not offer their own math ideas.	*Teacher is still the main source of ideas, though she elicits some student ideas. Teacher does some probing to access student ideas.* Some student ideas are raised in discussions but are not explored.	*Teacher follows up on explanations and builds on them by asking students to compare and contrast them. Teacher is comfortable using student errors as opportunities for learning.* Students exhibit confidence about their ideas and share their own thinking and strategies even if they are different from others. Student ideas sometimes guide the direction of the math lesson.	*Teacher allows for interruptions from students during her explanations; she lets students explain and "own" new strategies. (Teacher is still engaged and deciding what is important to continue exploring.) Teacher uses student ideas and methods as the basis for lessons and mini-extensions.* Students interject their ideas as the teacher or other students are teaching, confident that their ideas are valued. Students spontaneously compare and contrast and build on ideas. Student ideas form part of the content of many math lessons.
Responsibility for learning Students increasingly take responsibility for learning and evaluation of others and self. Math sense becomes the criterion for evaluation.	*Teacher repeats student responses (originally directed to her) for the class. Teacher responds to student answers by verifying the correct answer or showing the correct method.* Students are passive listeners; they attempt to imitate the teacher and do not take responsibility for the learning of their peers or themselves.	*Teacher begins to set up structures to facilitate students listening to and helping other students. The teacher alone gives feedback.* Students become more engaged by repeating what other students say or by helping another student at the teacher's request. This helping mostly involves students showing how *they* solved a problem.	*Teacher encourages student responsibility for understanding the mathematical ideas of others. Teacher asks other students questions about student work and whether they agree or disagree and why.* Students begin to listen to understand one another. When the teacher requests, they explain other students' ideas in their own words. Helping involves clarifying *other* students' ideas for themselves and others. Students imitate and model teacher's probing in pair work and whole-class discussions.	*The teacher expects students to be responsible for co-evaluation of everyone's work and thinking. She supports students as they help one another sort out misconceptions. She helps and/or follows up when needed.* Students listen to understand, then initiate clarifying other students' work and ideas for themselves and for others during whole-class discussions as well as in small group and pair work. Students assist each other in understanding and correcting errors.