Math Newsletter March/April 2021

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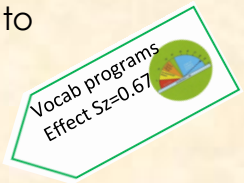
Mathematical Process Feature—Communication **C**

"The person in the room doing the talking is the person doing the learning"

How often is our voice (teacher voice) the dominant voice in the room? More often than we think, according to the research. What we know is that learning is a "social construct"—for all of us. We all learn best by being part of a community of learners. We know that students think more deeply and consolidate their reasoning by communicating their math thinking. In *Reflections on Research in School Mathematics*, Glanfield summarized the reasons that discussion must be centre stage in math classrooms. "Communication helps students organize and reflect on their own thinking. Furthermore, math in the real world does not happen in isolation, but rather through collaboration and co-operation. All authentic mathematical work includes an element of explanation and justification of reasoning, whether verbal or written.
(Glanfield 2007).



Studies suggest we only truly understand something when we've had to verbalize it, and brain research has demonstrated that people learn best by collaborating with others. Both receptive and expressive forms of communication are beneficial to learners. The act of formulating dialogue around a mathematical topic forces students to collate the concepts logically. Giving students opportunities to converse about math concepts allows them to develop their mathematical **vocabulary**, and helps them construct meaning for themselves. Students benefit from hearing, evaluating, and analyzing others' strategies. By reading and writing about, listening to and discussing mathematical ideas using both personal and formal mathematical language and symbols, students can create **connections** to their own ideas and prior knowledge.

We need to establish classroom norms that promote routine dialogue and debate about our mathematical thinking, and ensure that students' mathematical communication is valued. Teachers can communicate by modeling their thinking out loud, which can be an effective instructional practice. By using tools such as word walls, glossaries, and online dictionaries, we can encourage students to use correct mathematical terminology. Students need opportunities to speak, read, and write about their mathematical ideas.

-Saskatchewan Ministry of Education, Renewed Math Curriculum (2009)

Florence Glanfield, (2007). Building Capacity in Teaching and Learning. Reflections on Research in Mathematics. Pearson Education Canada

Elementary Mathematics Pedagogical Content Knowledge: Powerful Ideas for Teachers, by J.E. Schwartz, 2008 edition

National Council of Teachers of Mathematics

Hattie, J. (2017). Visible Learning for Mathematics. Corwin. Thousand Oaks, CA

A dynamic, collaborative classroom is an environment more conducive to learning and understanding mathematics than one where students work silently in isolation.

Communication [C]

Communication works together with reflection to produce new relationships and connections. Students who reflect on what they do and communicate with others about it are in the best position to build useful connections in mathematics.
(Hiebert et al., 1997, p. 6)

Students need opportunities to read about, represent, view, write about, listen to, and discuss mathematical ideas using both personal and mathematical language and symbols. These opportunities allow students to create links among their own language, ideas, and prior knowledge, the formal language and symbols of mathematics, and new learnings.

Communication is important in clarifying, reinforcing, and adjusting ideas, attitudes, and beliefs about mathematics. Students should be encouraged to use a variety of forms of communication while learning mathematics. Students also need to communicate their learning using mathematical terminology, but only when they have had sufficient experience to develop an understanding for that terminology.

Alberta Regional Consortia

Communication

"Students need opportunities to read about, represent, view, write about, listen to and discuss mathematical ideas." (pg. 6)

"Students should be encouraged to use a variety of forms of communication while learning mathematics." (pg. 6)

"Emerging technologies enable students to engage in communication beyond the traditional classroom..." (pg. 6)

(The Alberta 10-12 Mathematics Programs of Study with Achievement Indicators 2008, Alberta Education)

Seven Mathematical Processes
- **Communication**
- Connections
- Mental Mathematics and Estimation
- Problem Solving
- Reasoning
- Technology
- Visualization

Thoughts on Communication

Student learning is increased when students are able to discuss mathematical concepts and teach each other. Techniques for identifying questions to stimulate dialogue is important to engage students in understanding math.

The following teaching strategies may be used to promote student discussion.

Board Work / Group Work
Think - Pair - Share

Students can create products that may help them practice a variety of forms of communication (written, audio, video, etc).

The following are some possible products that students may create:

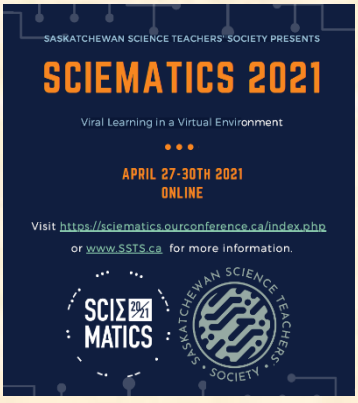
Research Project
Show Me You Know Assignment
Applying Assignment

For more information and additional supports for implementation, visit http://erlc.ca/resources/filter.php?theme=11&title=Mathematics

Last updated Fall 2013. Materials developed were based on content and discussions from the High School Math Moodle demonstration courses: http://learning.arpdc.ab.ca/course/view.php?id=214.

Click this page to go to the PDF with working links. From Alberta Regional Consortia Professional Development

There are many ways to do a "Gallery Walk". They are effective from Kindergarten to High School. Here's a video of a middle years' Gallery walk, where students are carefully told what to look for and what to notice as they view their colleague's work
https://youtu.be/OC2k0uuH9Og



CLASSROOM MANAGEMENT: CREATING A POSITIVE CLASSROOM CLIMATE

Identify foundations of a positive learning environment that supports student engagement and classroom management.

Wednesday, March 24, 2021 - 1:00 pm to 4:00 pm
Wednesday, March 31, 2021 - 4:00 pm to 5:00 pm

Formative Assessment Feature

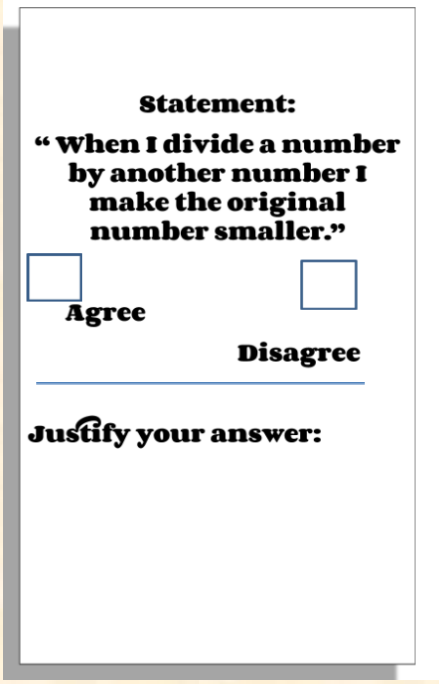
Here are a couple formative assessment ideas that go along with the theme of Communication in Mathematics. Many of these assessment ideas also provide movement breaks, and are fun and engaging. More importantly, they promote deeper thinking, reasoning, and dialog about mathematics

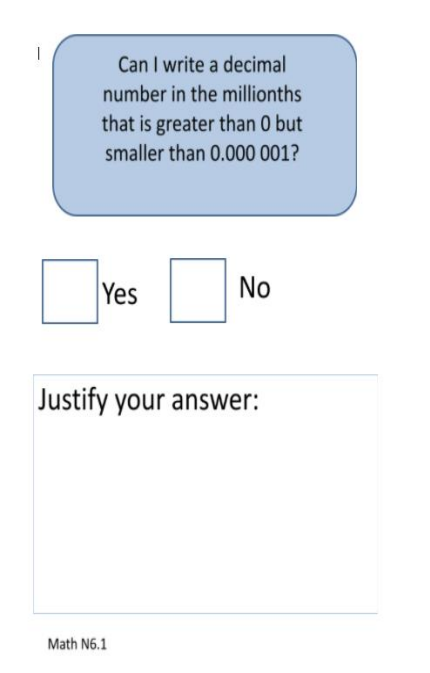
Commit and Toss

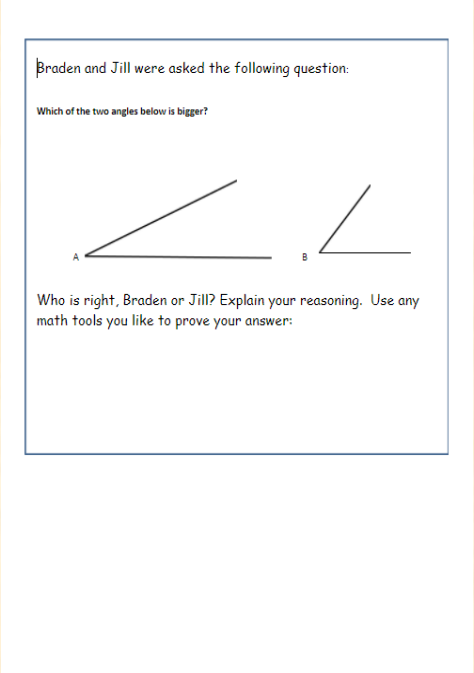
This activity is useful for exploring misconceptions, and for having students verbalize others' reasoning. Ask a question that requires choice and explanation. You can put the prompt on the board or printed on half-sheets of paper. Students need to commit to answer but also provide their reasoning. In this activity, you will need to establish a norm of anonymity—do your best to ensure everyone uses pencil (no identifiable purple pens, etc) and tell your students its only fair and meaningful if all answers remain anonymous. Student commit to an answer and express their reasoning on paper, then crunch the paper up into a "snowball". When you ask them to, they toss the snowballs around until you say STOP . Students present the ideas written on the piece of paper they are holding.

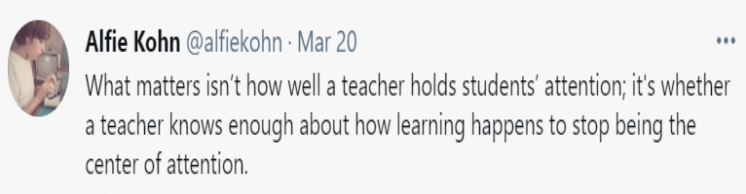
In this activity, no one presents their own ideas. They present the ideas of an "anonymous other", with no judgement, providing a non-threatening way to make everyone's thinking public. This is a great activity for your thinkers who don't like to speak up.

The activity requires the teacher to get a read on what common misconceptions may exist, or errors in reasoning. For a "very enthusiastic" group of learners, you can modify "Commit and Toss" to "Commit, Fold, and Pass".
A few examples of commit and toss prompts are shown below:









Four Corners

You've no doubt seen or used this classroom activity before. In math, it works really well for providing a movement break as well as stimulating debate. The cognitive demand is high while the time and set up are minimal. It works well with misconceptions or concepts that require rationalization or explanation.

Some examples are: "Two negatives always make a positive" (Corners would be yes, no, it depends—so three corners in this case). "If I divide a number by another number, it gets smaller" (Always, Sometimes, Never)

Or " 2^{-3} = (Corners are 8, -8, 1/8, and -1/8. You can add 6 and -6 if you like). Never provide a "Not sure" or "I don't know" corner. Kids need to commit. Students go to the corner designated for what they think is the correct answer. This kind of activity is best done early in the introduction of the topic, or midway—not prior to any learning and seldom at the end because hopefully at that point all kids would understand correctly.

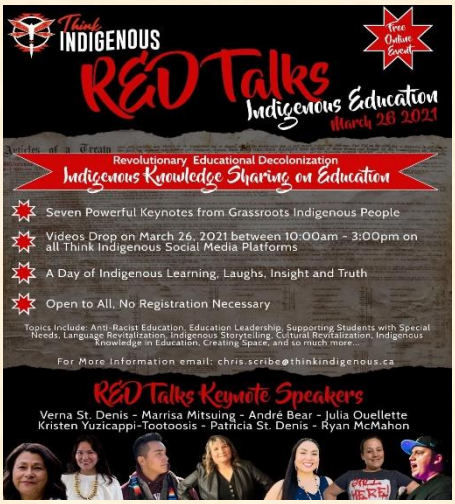
Once in their corner with their like-minded classmates, they need to prepare a defense of their answer. You can offer chalk board/white board space to provide examples and proof. Groups can choose a spokesperson if you like. Then have groups try to convince others of their solution. The real gold standard of math learning is debate! Having students create an argument and proof for their reasoning is very high-level thinking. After some discussion, you may have students request to switch corners.

One option is, if your class remains divided and didn't talk each other in to correct reasoning, cease the activity and leave them hanging. You can resolve it later, or provide more teaching to see if they resolve on their own. Any time kids leave your class wondering about something, or having that cognitive dissonance, you have created a great thinking opportunity! Sometimes they will discuss with each other on their own outside of class, or even with their families. Yay!

Keeley, P., and Tobey, R. (2011). *Mathematics Formative Assessment: Seventy-Five Practical Strategies for Linking Assessment, Instruction, and Learning*. Corwin.

PROFESSIONAL GROWTH OPPORTUNITIES

STF –Blended Learning Series, with Racquel Biem and Jade Ballek. Sessions include Approaches to Distance Learning, Planning, the Art of Asynchronous and Synchronous Remote Learning, Student-Led Learning. Sessions are in April and May https://www.stf.sk.ca/professional-resources/events-calendar/blended-learning-series-2021aprilmay



Websites of interest: Jon Orr and Kyle Pearce "Building Resilient and Determined Math Students. Maybe you've already heard of these guys or listened to their podcasts. I'm just discovering them...LOVE the podcasts! There are resources on their website like activities as well as archived podcasts. https://mrorr-isageek.com/building-resilient-determined-math-students/

Graham Fletcher: Building Fact Fluency –There is so much stuff on this site, including 3-Act maths and learning progressions. People are talking about this guy...you could create your own PD course on his web site. Great support for teachers https://gfletchy.com/

Bookmark this one, especially if you teach elementary grades or do interventions. This is the foundation of numeracy—understanding our base ten system. This is where we learn mental math, compensating, decomposing number—it all starts here, with the ten frame. https://poweroften.ca/

Dynamic Paper: Are you studying nets in grade 4 or 8 yet? This site will make jpegs or pdfs of any net...also, graphs, number lines, shapes, spinners, grids and tessellations. https://www.nctm.org/Classroom-Resources/Illuminations/Interactives/Dynamic-Paper/

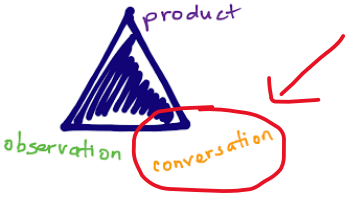
Supporting Equitable Conversations in the Mathematics Classroom

How can we establish a mathematically "safe" environment where students are willing to take the risks to talk and share their reasoning? It doesn't happen magically! We know we have students that are resistant to answer out loud and share their ideas. We need to explicitly train our students to discuss mathematics in a meaningful and respectful way. We need to model what mathematical conversations look like, and teach our routines explicitly. It doesn't matter what grade level! We sometimes think this should just come naturally to our older students, and to some it does, but all kids benefit from going over expectations. Don't assume that students—even those in high school-- understand how to have respectful conversations.

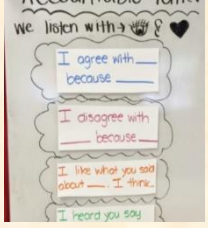
Be transparent with students about why you are going to set up talk routines. Let them know that this improves their mathematical understanding. Tell them it's important for their learning, and also that we are a community of learners, so we need them to also encourage their classmates' conversations. Letting students in on the "why" of our classroom techniques helps their metacognition by focusing attention on how they are learning and what helps them learn.

Help all students develop a growth mindset. Encourage *thinking* rather than producing work, and focus on *learning and growing* rather than grades or marks. Carol Dweck's work on growth mindset (https://www.brainpickings.org/2014/01/29/carol-dweck-mindset/) found that students that see themselves as learners are more persistent and successful than students that believe their ability in math is limited. Most importantly in math, we need to help students feel comfortable with making mistakes. Jo Boaler's research (https://www.youcubed.org/evidence/mistakes-grow-brain/) points out that mistakes are fundamental to math learning. It is by making mistakes that our brain grows new neural connections. Errors and misconceptions create brain growth. Help students feel safe when they get things wrong, and promote an attitude to math that embraces mistakes as a natural part of learning. Teachers can even celebrate mistakes as teaching and learning opportunities! Check out this video of one classroom routine, called "My Favourite No" https://youtu.be/srJWx7P6uLE

Triangulating evidence for assessment means we need to be listening to students speak about math. We can't do this if we don't create opportunities for mathematical dialog.

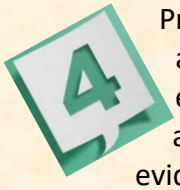


Model verbalizing reasoning to students. One powerful instructional strategy in math is the think aloud (https://youtu.be/fBB0nbY-a8Y) —where a teacher models their thought process as they work through a complex problem. This strategy supports not only communication, but also reasoning, visualizing and problem solving. You may also just model what mathematical dialog looks like and sounds like. Have another teacher come in your room and mock up some mathematical dialog, where you express reasoning and ask each other clarifying questions.

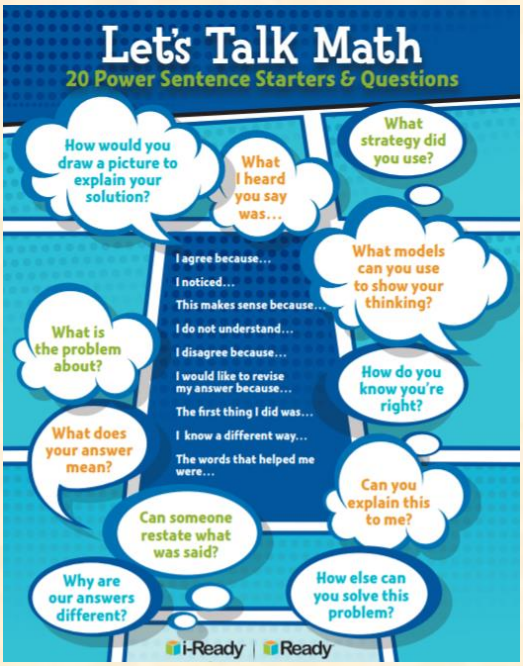


Co-create with students: What does mathematical dialog sound like? Look like? Feel like?

http://smathsmarts.com/accountabletalk/



Practice! Tell your students you are going to practice productive mathematical conversations. There are lots of tools and prompts out there to help! Tell them you are listening for their reasoning, their explanations, their mathematical language and vocabulary. You are listening for respectful discourse, and you are wanting to know if they invite others to share. Do your student know that assessment evidence is triangulated?? That it's not just "products"? That proof and explanation are fundamental to higher level maths? Tell them!



Here is a poster of "talking stems" or prompts—there are tons of these out there. You can get them as cards students keep at their desk. Model these clarifying questions ("Did you see what I did there?"), model redirecting, and paraphrasing for understanding. As you *listen for student dialog*, tell them you are *listening* for these questions, redirects, and prompts as they discuss their reasoning and solutions.

Attend to vocabulary! As you teach, you are surrounded by kids who don't know what the words mean. They are used to this, and they don't ask, so it passes us by unnoticed (until assessment happens). But what a barrier to learning!! Mathematics is its own language, and is full of complex words and symbols, as well as the numbers and computations that are already creating cognitive load.

Teaching "generative vocabulary" is the most effective way to link vocabulary to understanding. This means attending to *root words* and making connections to other subjects and to real life: Quad, four, quadratic, quadrant, quad ATV, quart, quadriceps quadrillion, quadruple, and so on. There has been very good effect size shown for studying words in math and having a school-wide initiative to attend to generative vocabulary across all curricula.

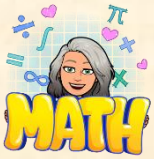
Frayer models (https://www.theteachertoolkit.com/index.php/tool/frayer-model) are a great way to teach deep word meanings conceptually. Word walls are effective *if used properly*—displaying words relevant to the topic of study, providing visuals, and referring to the words when they come up in instruction or dialog.

What *isn't* effective? Downloading and posting a "canned" word wall, that remains up all year and isn't integrated in instruction. https://luminouslearning.com/blogs/sped-math/teaching-math-vocabulary

To summarize: model appropriate math language, notice and draw attention to students using appropriate mathematical language and vocabulary as you *listen* to their mathematical discourse.

There are a couple "Old school" tricks to make sure everyone gets a chance to talk. Have you ever used "tokens" in your groups? Kids get a limited number of tokens each. Every time they contribute they have to put a token in the pot. Once you're out of tokens, you're done talking. This helps control the dominant group members who monopolize conversations. You can also have them withdraw a token every time they ask someone else to contribute.

Review and reflect. "How did your conversations go?" "Did you prompt anyone to explain their reasoning?" "Did you invite others to the conversation?" "Did you redirect?" "Did you learn anything new? See a different strategy? A different approach?" Help students realize that not everyone thinks or conceptualizes like they do, and there is strength in hearing and exploring these differences.



Want to chat more?
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