
KNOWLEDGE BUILDING IN ACTION

JUNIOR (4–6)



**Getting Knowledge Building Started
in Mathematics**

Written by Suzana Milinovich

Bringing IDEAS to life!

2.5 GETTING KNOWLEDGE BUILDING STARTED IN MATHEMATICS

Written by Suzana Milinovich, Grade 6/7 teacher, HWDSB

INTRODUCTION

Suzana Milinovich is a Grade 6/7 Teacher at W.H. Ballard School in Hamilton, Ontario. Her class consists of 25 students: 16 males and 9 females. There are five children with Special Needs, three of whom are working on an Individualized Education Plan with modified expectations in Mathematics.

START WITH THE KB PRINCIPLES

In Suzana's classroom, it was a significant challenge to ignite mathematical conversations between a diverse set of learners in order to advance an entire group's knowledge. Suzana decided to narrow in on setting the conditions for **Knowledge Building Discourse**, that would lead to **Democratizing Knowledge** within the group. It was critical for students to understand that all learners in the classroom are relevant contributors to the group's learning, and have the opportunity to experience this.

KB PROVOCATION

The majority of students (88%) commenced the year with a negative attitude towards mathematics; in an informal survey Suzana asked students to fill out at the onset of the year showed that 85% of the students felt that they exhibited no strengths in the entire subject area. Suzana identified this as her problem of practice and began to embark on a professional inquiry that would shift the attitude and learning of mathematics with these students.

What was your greatest challenge?

Students had deep rooted opinions and beliefs surrounding their individual place in a mathematics classroom... They viewed mathematics as a subject in which they either excelled or struggled... Statements such as, "I can't do this" and, "This is too hard" echoed in the room daily. A student even dressed up as an "I hate Math" Calculator for our Halloween festivities!

STRATEGIES FOR SUSTAINING IDEA IMPROVEMENT

Move 1. Encouraging KB Discourse through Number Talks!

With the understanding that student discourse is a highly effective principle in learning, Suzana looked for ways to encourage this in her math class. She provided opportunities for students to learn how to effectively collaborate by having better conversations where all students could be accountable. During mathematics class, she introduced Number Talks (3-5x week) in which students, without the teacher, were encouraged to share their individual strategies when solving a number problem.

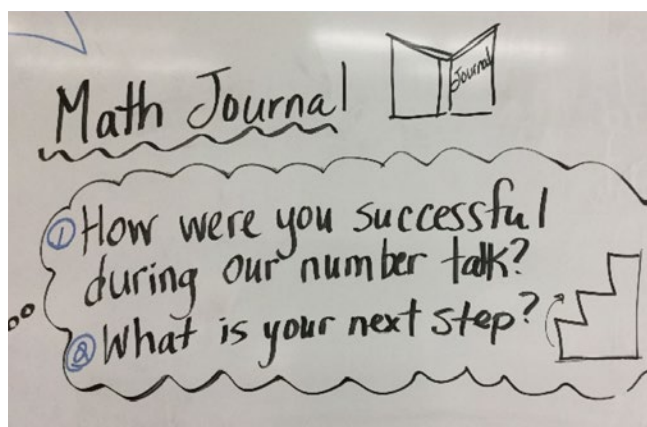
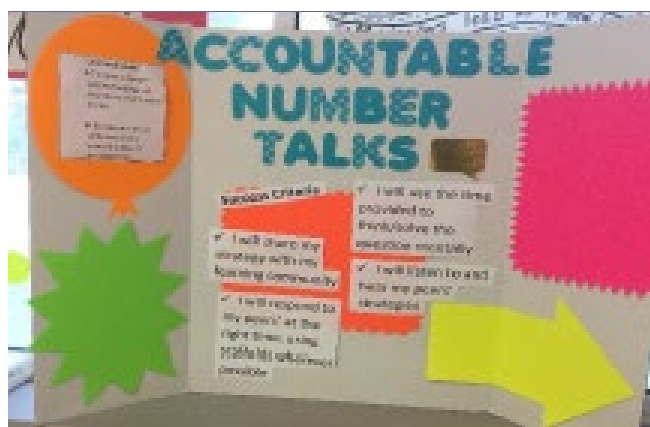
The purpose of Number Talks was to deepen conceptual knowledge of numbers, and number sense AND to intentionally create a Knowledge Building culture by teaching effective knowledge building discourse in the mathematics.

When sharing, students were encouraged to explain their thinking as though they were trying to convince a room full of skeptics. As **students discussed**, Suzana sketched/recorded responses. **Simultaneously, students were encouraged, as listeners, to become skeptics of their peers' strategy and respectfully question each other's ideas in order to build critical thinking skills.** Suzana would pose questions such as:

- "Can someone re-phrase _____'s strategy?"
- "Can anyone build on _____'s theory?"
- "Would anyone like to ask _____ a question about their thinking?"

Other Important Elements of Number Talks:

- **Learning Goals and Success Criteria** were clearly communicated, re-visited and articulated at start of each Number Talk session.
- **KB Scaffolds:** All Knowledge Builders (students, teacher) model/use KB scaffolds during each discussion
- **Reflection and Self-Assessment:** Students were encouraged to reflect on the key KB Scaffolds that they used and were comfortable with. Students reflected on the use of a scaffold in their math journals (e.g., setting a goal to use a specific scaffold next time, how one was used and how it helped the learning/understanding of the knowledge community).



Accountable Number Talks Success Criteria and Learning Goals (left); Math journal prompts (right).

Move 2. Creating a Non-Threatening Classroom Environment

Creating a safe culture in which students would feel open to share and address problems with one another was something Suzana identified as a need for the group. She took some time to help students better understand the role of a skeptic that fostered citizenship skills in the learning environment. This included dressing up as a skeptic, posing for a photo shoot, creating dramatic role play scenarios, and reflecting on these during a KB circle. Suzana provided a deep integration of Character Education

in the learning community throughout all subject areas studied. The group of students became the leaders of the Positive School-Wide Culture Initiative, as they created #choosekindWHB with student voice concurrently deepening their individual knowledge of specific traits: Respect, Optimism, Compassion, and Kindness.

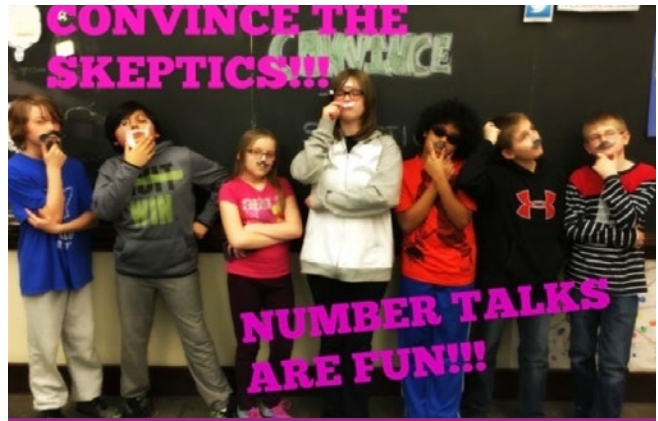
As the culture grew stronger, the number of student contributions to the group discussions increased. As accountable number talks and KB Circles progressed, Suzana documented and summarized each student contribution and posted them to a visual conversation bulletin board about 3-5x a week.

Move 3. Democratizing Knowledge with the T.O.G.A. Table!

With anticipation of developing a collaborative learning space while transforming the environment, Suzana positioned a double table with whiteboard placed over top at the centre of the classroom. Students gathered around this central table to share, reflect, explore, and create during their KB circle. Suzana identified the success and significance of this new space, **and** encouraged the class to develop a name for it. The students coined the name T.O.G.A. (Table of Great Achievement). This marked a memorable moment during Math class, as the students felt a sense of connectedness as they giggled, and chanted its name alongside their teacher.

Suzana added new KB Scaffolds gradually to the T.O.G.A table as they arose in the students' discourse. In the image to the right, the Knowledge Building Community is at the preliminary stage of discourse, as represented by only two scaffolds on the T.O.G.A Table.

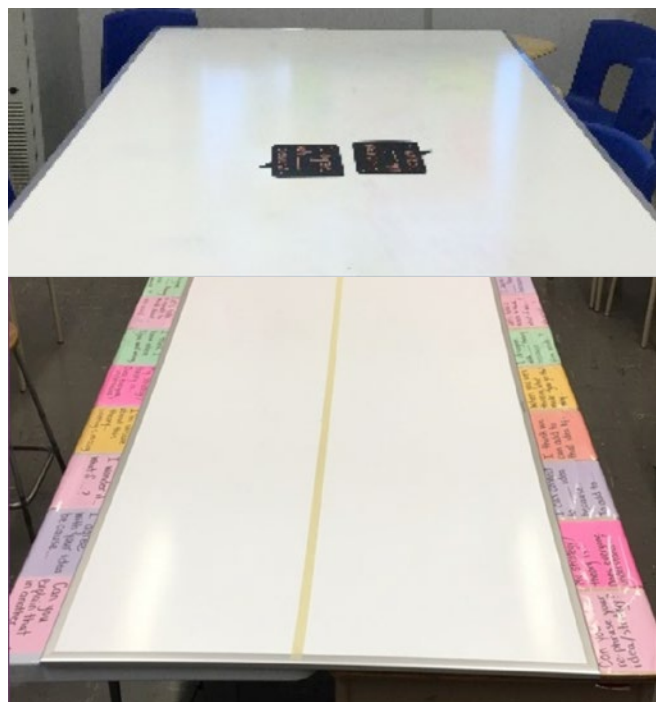
- "I agree/disagree with _____
_____ 's solution because..."



Students dress up as "skeptics" as part of the learning taking place around community-building and citizenship skills through Number Talks.



Visual conversation bulletin board.



Initially, the T.O.G.A. table has only two scaffolds (top). As the discourse deepens and the Number Talks progress, additional scaffolds are added to the table (bottom).

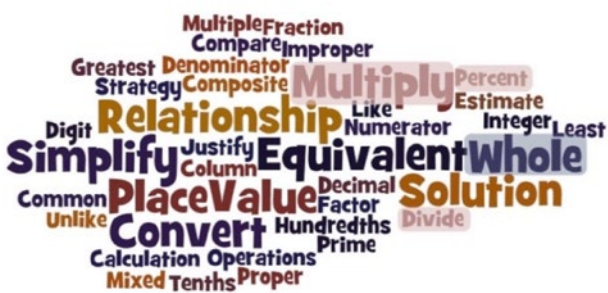
Over time, however, several other **scaffolds emerged and naturally became a part of the community members dialogue. These scaffolds were written down on coloured paper and pasted along the outside of T.O.G.A.** to create accessible visuals for students. Students became increasingly empowered to contribute to the shared goals of the **Knowledge Building community**.

The teacher gradually releases responsibility in the discourse, promoting peer-to-peer mathematical interactions.

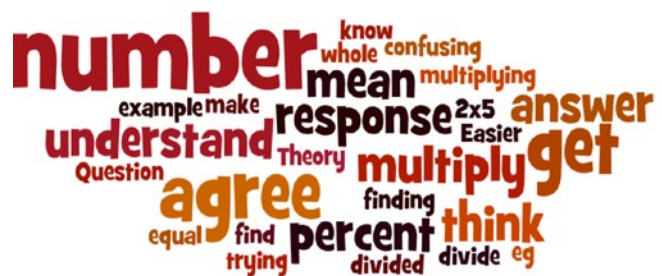
The students were encouraged to reflect on the success of their KB Circles regularly. They clearly identified that everyone’s idea **was** needed and desired, and **Idea Diversity occurred naturally during the discourse**. Suzana also encouraged her students to reflect on the key scaffolds that they used and were comfortable with. Students became increasingly empowered to contribute to the shared goals of the **Knowledge Building community**. As students gained the confidence and ability to take pride in contributing to collaborations during a study of fractions, decimals, and percentages, Suzana turned over the KB discussion entirely to the students. It was a huge Aha! moment for Suzana, to finally release her responsibility during knowledge building circles. The students had arrived at a destination where they could freely explore big ideas and value each other’s strengths throughout the learning process.

Move 4. Constructive Use of Authoritative Sources

Students were encouraged to use and evaluate source materials to further refine their ideas around decimal theories and principles. With the help of Dr. Monica Resendes, Suzana provided an expert vocabulary word cloud that highlighted key mathematical terms extracted from authoritative sources, such as textbooks and Ontario Curriculum Guides. The students were also provided the opportunity to view a word cloud **based on their own vocabulary** that was generated on Knowledge Forum. This was a non-evaluative assessment for students to connect terms to principles, deepening their understanding of the mathematical procedures with the vocabulary during investigations and communications. Students used this feedback to further explore and refine their understanding of mathematical concepts that additionally resulted in the use of more mathematical vocabulary when justifying solutions in mathematics.



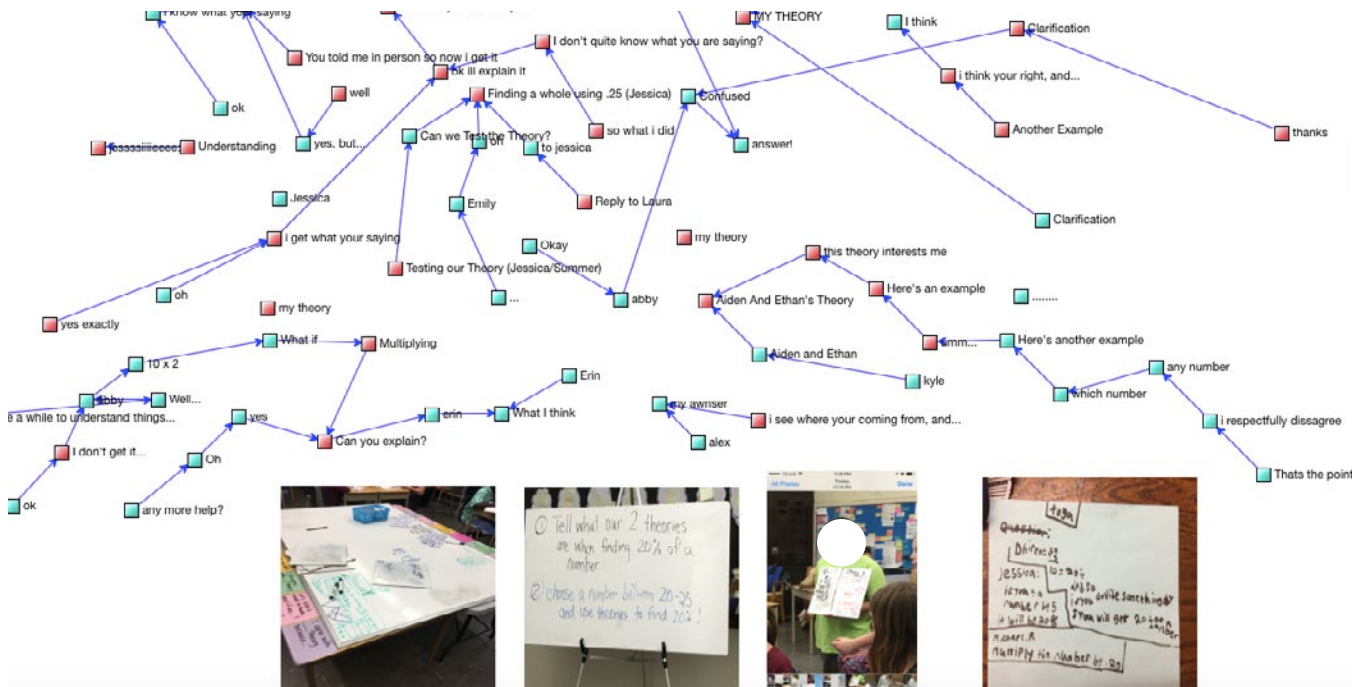
Word cloud based on expert vocabulary from authoritative sources.



Word cloud based on students’ online discourse.

Move 6. Assessment and Evaluation

Using data collected from **assessments** such as Student Journal Reflections, and KB Circle/Number Talk observations, Suzana provided feedback to students on an ongoing basis. She met with guided groups to explicitly teach concepts students were struggling with, as identified in journal entries, observations, and conversations that took place both in KB Circles/Number Talks and on Knowledge Forum. (The assessment tools Suzana used can be found at the end of this case study.)



Students discussing their Decimal Theories on Knowledge Forum. The red and blue squares represent notes that open up when clicked. Red notes have been read, while blue notes are yet to be opened and reviewed. Images from classroom work are lined up along the bottom to spur ideas and thinking.

NEXT STEPS

Suzana's next step will be to focus on increasing **Democratization of Knowledge** by fostering greater student-to-student connectedness in the KB community. Student achievement will increase in mathematics as she continues to provide opportunities for her students to connect math pervasively. KB in mathematics will expand so that it not only involves the single subject with the set particular group of learners. Involving experts, parents, and even students in the greater global community will deepen all stakeholders' knowledge, understanding, and values in mathematics.

***See following two pages for assessment tools referenced in this case study.**

What was your "Aha!" moment?

Releasing the responsibility during Knowledge Building discourse was a great moment. Allowing for students to find their own place in the Knowledge Building community was something I had to learn to be patient with by allowing for it to naturally occur. I had modelled, encouraged and lead the students to this point of discourse, and didn't quite let go until another educator, Denis Maika, pushed my thinking when he suggested the idea. The students reveled at the idea of engaging in the KB circles without my presence. As I stepped out, students were able to further explore theories around the mathematics. The transition was seamless, and this proved that the Knowledge Building community was advancing knowledge effectively.

ASSESSMENT TOOLS

KB CIRCLES/ACCOUNTABLE NUMBER TALKS RUBRIC

Criteria	Level 1	Level 2	Level 3	Level 4
Student demonstrates knowledge of math content during Number Talks	Student demonstrates little understanding of number concepts when sharing information during Number Talks	Student demonstrates some understanding of number concepts when sharing information during Number Talks	Student demonstrates an understanding of number concepts when sharing information during Number Talks	Student confidently demonstrates an understanding of number concepts when sharing information during Number Talks
Student expresses mathematical thinking with clarity and logical organization when communicating in number talks	Student expresses thinking with clarity and organization with limited effectiveness	Student expresses thinking with clarity and organization with some effectiveness	Student expresses thinking with clarity and organization with considerable effectiveness	Student expresses thinking with clarity and organization with a high degree of effectiveness
Student communicates orally to justify a mathematical solution, or express a mathematical argument, using mathematical vocabulary	Student communicates using mathematical vocabulary with limited effectiveness	Student communicates using mathematical vocabulary with some effectiveness	Student communicates using mathematical vocabulary with considerable effectiveness	Student communicates using mathematical vocabulary with a high degree of effectiveness

ASSESSMENT TOOLS

KB CIRCLES/ACCOUNTABLE NUMBER TALKS – STUDENT REFLECTIONS

Criteria	Level 1	Level 2	Level 3	Level 4
Student expresses mathematical thinking with clarity and logical organization when communicating about number talks in written form	Student expresses thinking with clarity and organization with limited effectiveness	Student expresses thinking with clarity and organization with some effectiveness	Student expresses thinking with clarity and organization with considerable effectiveness	Student expresses thinking with clarity and organization with a high degree of effectiveness
Student communicates in written form to justify a mathematical solution, or express a mathematical argument, using mathematical vocabulary	Student communicates using mathematical vocabulary with limited effectiveness	Student communicates using mathematical vocabulary with some effectiveness	Student communicates using mathematical vocabulary with considerable effectiveness	Student communicates using mathematical vocabulary with a high degree of effectiveness