KNOWLEDGE BUILDING IN ACTION
PRIMARY (K–3)

Knowledge Building in a Grade 1 Math Class

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Bringing IDEAS to life!

1.4 KNOWLEDGE BUILDING IN A GRADE 1 MATH CLASS

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INTRODUCTION

At the time of this case study, Cindi Chisholm was a Grade 1 teacher at Herman Street Public School in Petawawa. Heather Fleming was the Student Success Teacher with the Renfrew County District School Board, assigned to the school to support teachers in professional growth to deepen the learning in the classroom. Heather worked closely with Cindi to implement Knowledge Building as a new way of learning that helped make student thinking more visible. The class consisted of 19 students, including three students with specials needs working on an Individual Education Plan.

STARTING WITH KB PRINCIPLES

The team targeted four KB principles and aimed to:

- Engage **Real Ideas and Authentic Problems** in math.
- Find ways to get everyone involved by **Democratizing Knowledge** and building **Community Knowledge** through activities that promoted **Collective Responsibility**.
- Encourage the use of new math language through **Knowledge Building Discourse** in KB circles.

KB PROVOCATION

The decision to do Knowledge Building in math was based on the board-wide focus on math. It was felt that many students were not engaged in their learning, and behaviours had become apparent. Learning of Grade 1 expectations as foundational blocks was not happening for all students, and retention of concepts along with transfer of knowledge (making the connections between concepts) was often not apparent.

STRATEGIES TO SUSTAIN IDEA IMPROVEMENT

Move 1

The first activity was based on the work of Marion Small and comprised the presentation of a single math question to students: "Take 20 counters and separate them into 3 piles. One pile must be double another pile. What are the possibilities?" Partner turn-and-talk was used to provide opportunities for idea sharing and to practice the use of Accountable Talk. Students were encouraged to explain their thinking and the strategies they used with each other. Student conversations were videotaped. Teachers listened for use of math vocabulary, insights and misconceptions. Upon reflection, it was evident that the original problem was not authentic to the students.

Although front loading had been presented, students did not connect the frontloading activity to the problem. The students were confused by the way the problem was worded and had difficulty with the language "doubles" versus "twice as many." This caused some disengagement. The videotapes of peer-to-peer discourse helped pinpoint where things broke down, namely the struggle of understanding the difference in math concepts that resembled each other in students' minds, such as concepts like double of, twice as much and splitting. The decision to scaffold the activity to work on clarification of math language was made, with check-ins in place for every student.

What was your greatest challenge?

Getting students to think deeply and resolve the problem themselves. Even at such a young age, some had already learned that the answer would be given to them eventually.

As part of the learning experience, the team was then left with the following thoughts:

- When do you intervene to guide students who have misconceptions and how much do you tell them?
- It is important to stand back, but bring in timely intervention by using questions that support student thinking and encourage them to improve, such as "What is your thinking? What is your strategy?"
- A math journal helps students record the thinking, which in turn also helps them to reflect on their thinking.

What surprised you?

- How difficult it is for students to make their thinking visible.
- How much thinking/processing is going on in some of the quieter students and those not necessarily deemed strong in math.
- How some of the 12 KB Principles surfaced throughout the activities.

Move 2

The second activity was built around three improved ideas: Give more opportunity for students to participate in dialogue and use new math terms; make the problem more authentic to the students; and engage students in spatial reasoning by focusing on geometry and visualization of shapes.

What was your deepest learning?

- The importance of setting a growth mindset in a classroom where everyone "can."
- Misconceptions ¨ are built on, and if not corrected, could cause students to believe that they are "not good" in math.
- Through community knowledge where everyone contributed, voices were heard and acknowledged, and students were able to think about their own thinking.

Working individually, students were given four 3D cubes and asked to create as many different shapes as possible with the cubes. They were encouraged to show different ways of placing cubes together to form different keys by placing the cubes in different formations. Students were asked to describe to the student beside them how they approached

the task. Students could build on their repertoire of possibilities through the sharing of shapes formed by their elbow partner. When it was evident that the group was starting to get stuck, all the students went for a Gallery Walk to look at their peers' structures and talk about how each had built their keys. Students then went back to their own desks to improve their designs by building their keys in new ways.

Through this activity, students learned how they could grow their own ideas through community knowledge, and how others in the class possess knowledge that can help them as well. Reflections from this activity:

- Lots of modelling is essential.
- Allowing time for the students to do the thinking, and ensuring the teacher does not jump in to rescue the students is critical. When answers are given, students learn to expect them without doing any work or thinking.
- Accountable Talk between students reveals incredible amounts of information about the thinking and allows for timely and meaningful intervention from peers.

Move 3

This activity was designed to scaffold on the previous math problem. It involved students working with 2D tiles. Students were presented with the following problem: "We need to make keys for the tooth fairy's treasure box. How many keys can you make?"

For this activity, students were partnered up again and were given a set of keys that were hidden from view. Each partner took turns creating five different key shapes from the 2D tiles, in efforts to try to create one that might be included in the set that they were given. The other partner then duplicated the shape. As a team, they then had to find out which key was in the pile and compared the masters to their own. They worked until most of the keys were assembled. Following this, the class discussed all the different configurations of keys.

It was during the community sharing circle that discussions arose about keys being the same but made in different directions. As a result of this discovery, math language emerged to express the position of the tiles, such as flips and turns. Each student was then given a large piece of grid paper and five tiles and asked to construct different keys and to draw them onto the grid paper. Students were given back their pieces of grid paper with feedback showing whether keys were duplicated and how many other possible configurations there were. Students were then grouped together strategically in teams of four so that each group contained students who had created a different amount of keys (e.g., one person with ten keys, one with seven, one with five and one with four). Students compared their work, shared ideas and drew more keys. The shared goal was to have everyone possess all 12 keys for the tooth fairy.

KEY FINDINGS

- We realized the importance of authentic problems and of frontloading expectations.
- We were able to stand back and bring in timely individualized interventions by using questions that facilitated student thinking and encouraged them to improve on each other's ideas.
- We realized the importance of not rushing in to rescue students but allowing them to successfully work things out by talking problems through with their peers.
- Students were more focused, involved, and engaged, and demonstrated perseverance throughout the process.
- Activities allowed for differentiation. The task was open-ended, which allowed an entry point for every student. They were able to move at their own pace and process in different ways to solve the problem.

What did you learn about yourself in the process?

I assumed that when a problem was presented or even read together that students understood what was asked of them. Now I realize that it is essential to read the problem together in order to ensure that all students understand the problem and what is asked of them.

NEXT STEPS

- Introduce the same concept of flips and turns with a different story to affirm transfer of knowledge.
- Continue to build on the importance of community knowledge through communication of their thinking
- We would like to try this activity again in the spring to see what was retained through the process.

RESOURCES

Small, M. (2012). Great ways to differentiate mathematics instruction. New York: Teachers College, Columbia University.