Mathematics and Social Justice in Grade 1

How Children Understand Inequality and Represent It

M. Shaun Murphy

Social justice might be considered too complex a topic to address with 6- and 7-year-olds, particularly through mathematics. How, we might ask, would first-graders understand social justice (Allen 1997; Boutte 2008)?

The young children in my classroom in a western Canadian city had complex understandings of power and trust based on their experiences as family members and children in school and the various organizations to which they belonged. As their teacher, I believed they could bring the same understandings to social justice issues by focusing on inequality in relation to power and access to resources, freedom, and diversity. I thought this was especially true when diversity intersects and clashes with structures that limit children's ability to engage in curriculum making that respects their diverse lives (Brooks & Thompson 2005; Clandinin et al. 2006). Two ways children can deepen their understanding are through experience and literature. Engaging children in a mathematics project around issues of social justice could provide experience and also allow me to understand the children as mathematicians.

Illustration by Sandi Collins

Developing the project idea

It was May in my grade one classroom, and I began thinking about a final project in mathematics that would provide opportunities for the children to demonstrate the various levels and the breadth of their mathematics knowledge. The project needed to be open-ended, with multiple entry points and room for a variety of interpretations among the children so that they could show their knowledge in diverse ways (Clandinin et al. 2006).

I was a primary teacher with 20 years of experience, mostly with grades one and two, and at the midpoint in my career. I was reading Eric Gutstein's (2006) book on social justice and mathematics at the same time the first-graders were using Cuisenaire rods to solidify their work with number representation, operations, and complements. Gutstein highlighted the importance of reading and writing the world through mathematics. This aligned with my belief that mathematics is a language necessary to describe

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Photos courtesy of the author.

experience. So, how could I use Gutstein's ideas about social justice and mathematics in a grade one project using Cuisenaire rods (Hajar 1997)?

Mathematics education for young children

The mathematics focus I established for the year was having the children identify themselves as mathematicians. Support for this goal came through the children's skill attainment, problem solving, and ability to see and name the mathematics ideas occurring in the world around them. Our mantra, "Math is everywhere," became a common phrase in our discussions. At the start of the year, when Kayla, a successful student in kindergarten, announced she did not want to come to first grade because she would not be able to do mathematics, I decided on the identity focus.

What mathematics experiences had Kayla had in kindergarten and what stories had she heard about grade one mathematics to cause her anxiety? To change some of the fears and notions surrounding mathematics, I decided at first to call the subject *maths* (later, at the children's urging, we used *mathematics*). My decision was based on the way we educators talk about language arts, which is not seen as a monolithic subject and typically is taught as separate areas—reading, writing, spelling, and so forth. Math, on the other hand, did not seem to be treated as a plural subject. I knew the children could describe themselves as "good" in reading while experiencing difficulty in writing or, even more specifically, as "poor spellers" but "good writers." But they never talked about mathematics the same way. If they struggled in math, they told the story as just that—"I can't do math." I hoped, if they understood the plurality of mathematics, that they might begin to talk about how they struggled in one area of math but were skilled in another and that they would understand maths as not just one skill.

Another choice I made, something I had been slowly doing more of during my teaching career, was to stop teaching mathematics in discrete chunks. I had typically begun the grade one year teaching about patterns. But my new decision would mean that I would also teach patterns in June. As I introduced each new math concept, I found ways to include the previous ones. Like teaching language arts, I taught skills simultaneously in each area of math throughout the year. Number recognition needed to be taught this way, all year long, as did all of the mathematics concepts addressed in the province-mandated curriculum.

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In Considering a Program of Maths . . .

- Use the language of mathematics to describe experiences.
- Practice using mathematics as a language of comprehension and description through the common experiences that children's literature provides.
- Wonder alongside children about why they are using specific mathematics.
- Look at math as a plural subject . . . *maths* versus *math.*
- Challenge children to represent mathematics other than just with numbers.
- Imagine what it would be like to teach spelling for only one month of the year, then consider what that means for the mathematics strands we focus on in isolation.

Children's talk about mathematics

One day, as I walked across the classroom to help a child during writing, Jack stopped me. I wrote the following field note to capture the moment. (Field notes were composed on conversations I had with the children rather than dialogues written out as we talked.)

> "Mr. M., did you know that people are mathematical?" he asked.
>
> "Yes, they are, Jack," I replied, continuing to walk.
>
> Jack stood up, "No, people are mathematical," he said again.
>
> "Yes, they are, Jack. Good noticing!" I was obviously not getting the message. In my mind, I was thinking that it was good he knew people could do mathematics. "Yep, you're right, Jack, people can do all kinds of maths."
>
> "No, Mr. M., *people* are mathematical," he said.
>
> Luckily at this point some voice in my head told me to stop, that this was more than a comment about skill. "What do you mean, Jack?" I asked.
>
> "Well when you are born, you are adding and when you die, you are subtracting."

Jack understood that people are fundamentally mathematical. He knew himself not just as someone who could do mathematics, but as an embodiment of mathematics.

How then could I consolidate all of our work for the year? How could I make a space for children to show just this kind of thinking? I wanted a way to represent the kind of thinking we had engaged in all year—something as simple as looking for patterns in numbers to the way Kerry, a 6-year-old girl in our class, explained that hope is like mathematics because it goes from something small to something larger and in mathematics that is about less to greater. This is where Gutstein's (2006) work, *Reading and Writing*

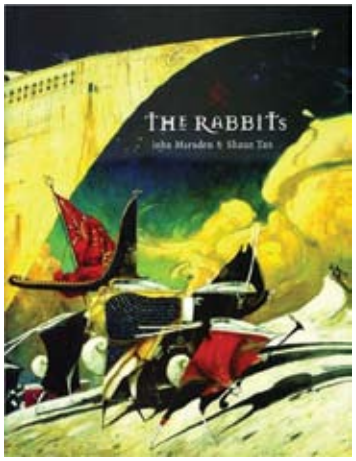
the World with Mathematics: Toward a Pedagogy for Social Justice, was important. He used mathematics with middle school students to understand social justice issues. Could grade one children do mathematical work that addressed social justice issues with a focus on power at their level (Monkman, MacGillivray, & Leyva 2003)?

The mathematics of power: Grade one's project

As a class we often read books and talked about the mathematics in them. One favorite author/illustrator, Shaun Tan, provided the idea for the first-graders' final project in math.

A picture book and mathematics

The Rabbits, written by John Marsden and illustrated by Tan (2003), is an allegorical work about the colonization of Australia. Kangaroos represent the indigenous people (called Aborigines in Australia) and rabbits, the colonizers. It shows the ways European colonists destroyed and replaced the Aborigines' traditional culture and relationship with the land.



The illustration that most held the children's attention shows the rabbits looking Napoleonic and holding banners that read, "And stole our children." In the background, kangaroos in a line lift their arms to the sky where their children are being taken away in box kites tied to airships. After I read the page, Kayla, the previously reluctant grade one student, exclaimed, "That's just like in residential schools," referencing something she learned during our schoolwide Aboriginal Awareness Week. A residential school system was used in Canada as a strategy to assimilate Aboriginal children by removing them from their families and schooling them away from their homes and communities. A discussion ensued among the children and me about the similarities between Australia's and Canada's residential school programs.

I wondered if the children could use their mathematical understanding to explore the power issues they'd read about in *The Rabbits*. Earlier the children had been working extensively with Cuisenaire rods, and I thought they might be able to use these manipulatives to explore the social justice issues in the book. Without using the words *social justice,* I asked the children if they could use Cuisenaire rods to show what they understood from the book.

I did not ask the children to illustrate the mathematics in the book. I assumed that they would express their mathematical knowledge through the inherent mathematics in the Cuisenaire rods (Hajar 1997). Throughout the year we had always talked about the mathematics in any book we read; it was one of the ways I expected the children to demonstrate comprehension of the text.

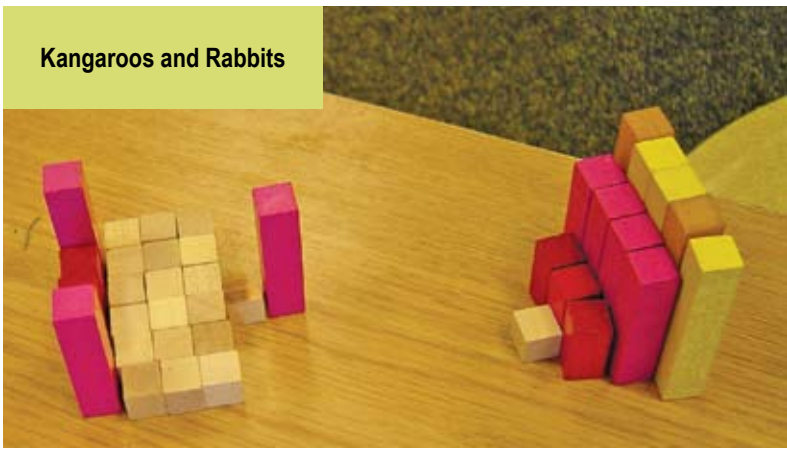
Could grade one children do mathematical work that addressed social justice issues with a focus on power at their level?

Representing comprehension by using mathematics

The children's work amazed me. In their first attempt at using the Cuisenaire rods to represent their mathematical knowledge, Kerry tried to show the relationship between power and amount (see "Kangaroos and Rabbits"). I asked her to talk about what she had done.

Kerry explained how she was trying to show that the rabbits had more power than the kangaroos. She talked about the group on the left, first saying that the Cuisinaire ones units (natural color) were the rabbits because there were more of them. When I asked her to count up how many there were, she counted all 25 rods (including the 3 pink and 3 red rods) as objects. I asked if all the rods were worth the same amount. She paused and looked at her work. "No" was her reply, and upon reflection she altered her explanation to say that the group on the right (natural, red, pink, and brown/yellow) had more power because those 13 rods were worth more. Then she related how that was like the rabbits: there were fewer of them, but they had more power. I asked her what this had to do with the book, and

Kangaroos and Rabbits



Rabbits Steal the Children

she told me how it showed that power didn't mean you had more people.

As I moved around the class, I stopped at Darcy's desk. His work was very intriguing because he had used the complete surface of his desk (see "Rabbits Steal the Children"). Darcy had a strong identity as a mathematician and enjoyed doing math activities. He said his representation showed how the rabbits stole the kangaroo children. This theme was explored over and over in many children's work. I asked if he could explain.

> "Well, the 15 tall rods are the rabbits," he told me. I wondered how they could be so tall when we knew rabbits were smaller than kangaroos. "But they have more power," he said, "so I used the eights, nines, and tens rods [orange and other dark colors] for the rabbits."
>
> "What," I asked, "are the ones units [natural] doing on top of the rabbits?"
>
> He replied, "Those are the [kangaroo] children being stolen by the rabbits."
>
> "Who are the pink fours units [on the left], and why are they in a line?" I pursued.
>
> "They are the [kangaroo] parents," he told me, "and they are watching their children being taken away, and they cannot stop the rabbits."

On a subsequent day we reread the book and talked about what the children had already done to represent the ideas of power in the book. I asked them if they could think more specifically about power in math terms and use Cuisenaire rods to show this.

Melissa made her mathematics explicit. She showed the kangaroo children being kept within a rectangle formed by 6 black rods (see "Kangaroo Children"). This rectangle represented a boat, referring to the ship on which the rabbits had originally arrived. The blue rods around it represented water. The ones units (white and natural) represented the kangaroo children being guarded by the rabbits, shown by the orange tens rods (2 horizontal and 2 vertical). Melissa also represented the kangaroo parents (a distance away on the left), using 5 red twos rods. The following field note from that day describes my conversation with Melissa.

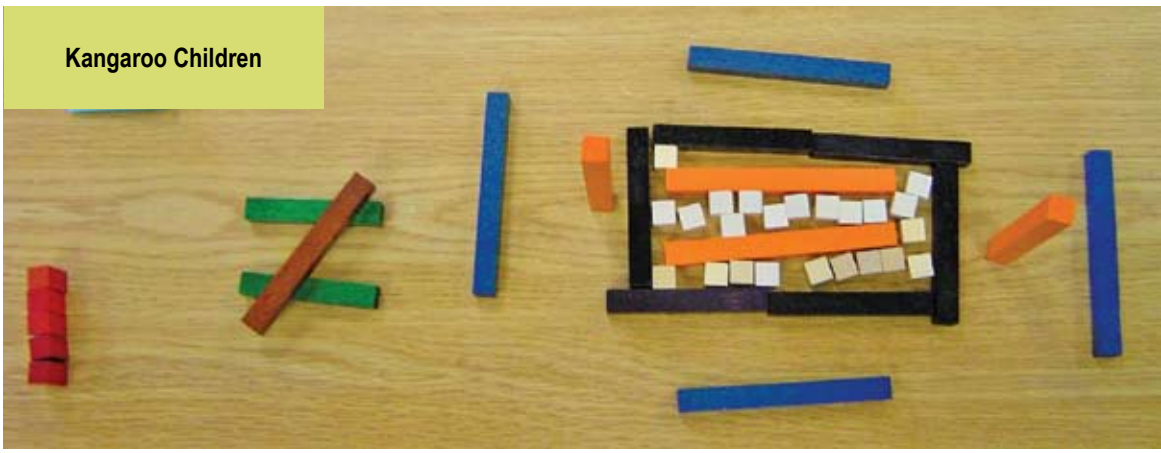
> Melissa described the rabbits as bigger because they had "lots of power." To make sure I understood the imbalance of power, she made an unequal sign [≠] between the kangaroo parents and the boat. Interestingly, the children in the class always seemed to put the parents (kangaroos) in a row, standing side by side and watching.

Melissa loved to use the unequal sign in her work. Often, when she made an error adding or subtracting, instead of changing the numbers, she just put a line through the equal sign. "Now that makes it right," she would tell me. This was based on our work around the idea of equality, informed by Falkner, Levi, and Carpenter's (2002) article on children's understanding of equality.

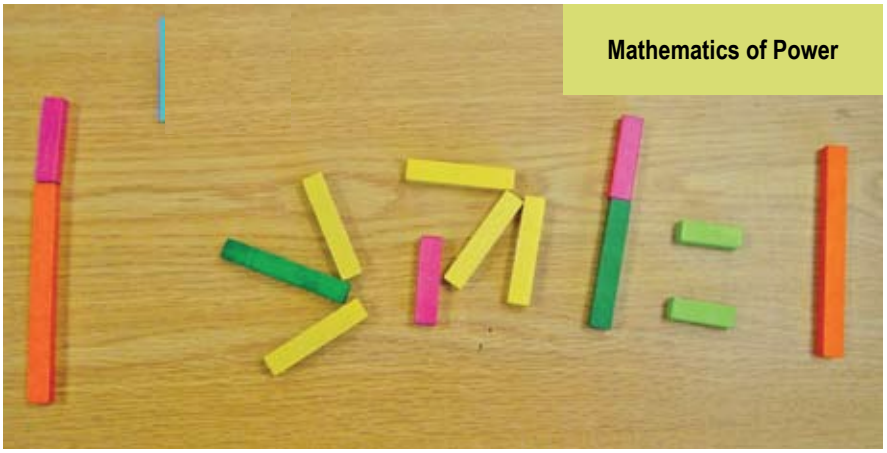
On another day, when we had read *The Rabbits* again, one of the children suggested that maybe the ending was not so bad. The closing page is a dark, monochromatic, bordered drawing showing one rabbit and one kangaroo looking into a small dark oval. The text reads, "Who will save us from the rabbits?" I commented that I did not think it looked very good for the kangaroos. The following field note captures the moment and the children's insights:

> Some children told me it wasn't all sad because the kangaroo and the rabbit were there together, and they could figure it out together. So we talked about the idea of hope, and I recalled our previous work and discussions about hope based on Shaun Tan's *The Red Tree*. We talked about why having only two individuals made it more hopeful than did a whole bunch.

Kangaroo Children



One boy said that the one rabbit could be the boss rabbit who could change everything. When I wondered aloud what it would be like if the rabbit was not the boss, the same child told me the rabbit could go to the boss who has all the power and who could then make a change. The children seemed to understand that power is held in one location. I told them I wasn't sure how to use Cuisenaire rods to show how power works. I told them that I couldn't think of a way but that I wanted them to use the rods while thinking about power.



Mathematics of Power

Jack showed us how he understood this idea of power. His construction (see "Mathematics of Power") first showed a combined value of 14 as an orange tens rod and a pink fours rod. Then two arrows indicate a 4 being taken from 14 to form a new combination (we often used arrows to show transitions). Jack joined the pink fours rod to the green sixes rod, making 10. Finally he showed that the green and pink rod combination, which equals 10, subsequently equals the one tens orange rod. The arrows are important here so that Jack was not bound by making the equation equal while using addition or subtraction symbols. What was interesting is how he used rods to indicate value amounts but arrows to tell the story of the transfer of power and his mathematical process.

I talked to Jack about his work, because the children's ability to explain work was as important in the class as showing the work. This is an example of the ways discourse contributes to our understanding of concepts (Kazemi 2002). The following field note captures the conversation.

> Jack told me that he chose the green rod because it could help the pink rod add up to 10. It had to add to 10, because 14 could take away 4, leaving 10, and 4 could be added to the 6, creating 10. When he started the process he had a white/natural ones rod because that showed how much power the kangaroos had, but he traded it for a green rod because that would work with the pink to make 10. He chose a pink fours rod instead of a yellow fives because it would make him have an extra 1 in the end. He chose a fours rod because what he needed had to be even and not odd, as the even's start with 2.

Jack's work showed me that ideas of sharing power could be represented mathematically using the Cuisenaire rods. Many of the other children were also able to show how they understood issues of power and social justice through their work with the Cuisenaire rods.

Learning mathematics alongside children

According to Trumbull, Nelson-Barber, and Mitchell, "individual students construct an understanding of mathematics concepts on the basis of their experiences within a community" (2002, 2). My experience in this project supported this way of thinking about the construction of understanding and also allowed the children to construct an identity as mathematicians, as individuals who used mathematics to describe their experiences. This approach aligns with the NCTM's principle for learning, "students must learn mathematics with understanding, actively building new knowledge from experience and prior knowledge" (2000, 20).

The children and I returned repeatedly to *The Rabbits* to continue our exploration of the ideas Marsden and Tan challenged us to consider. It was important that our first-grader community have a deep understanding of the themes in the book. After every reading, before our follow-up work, we had extensive conversations about the story and how the children could understand this in their own lives.

Conclusion

All year the children amazed me as they took up the plurality of mathematics. They helped me become a better mathematics educator. They taught me much about their knowledge in mathematics when I helped shape a space for their experience in mathematics to be more complex. I specifically use the word *complex,* which is something different from *complicated.* A complex mathematics classroom allows for the experience of diverse children. Jack's words about how deeply people are mathematical, Melissa's

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expressions of equality and inequality, and Kayla's shifts in identity have certainly shifted my understanding of the possibilities in mathematics education with young children.

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In Using Manipulatives to Represent Math . . .

- Challenge children to be complex in their use of manipulatives
- Ensure that conversations with the teacher or other children occur alongside manipulative use
- Establish ways of capturing manipulative representations by more abstract means sometimes
- Trust children to be clever
- Make conversation an integral part of your mathematics program
- Allow children to surprise you

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