Learning Through a Penny Jar

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Having worked with communities of children for years, I know how competent and capable young children are. Recently, the work of the infant and preschool programs in Reggio Emilia has attracted the attention of educators across the globe to the notion of a competent and capable child—a strong child who is able to interpret his or her knowledge and experiences of the world (Edwards, Gandini and Forman 1993). As well, the North American Education for Young Children (NAEYC) association describes young children as having informal experiences that are the foundation for school learning when we help them to connect previous experiences with curricular outcomes (NAEYC/NCTM 2002, 2008). Yet, it is through our action as teachers that we communicate and make decisions to create a learning environment that either recognizes or ignores the capabilities and competencies of young children as contributors to their learning communities.

Underlying the tangible objects that adorn the classroom walls and shelves is a belief system about who the teachers are and who the learners are. Perceptible or not, this belief system is foundational to the creation of a learning environment. The Reggio Emilia environments are noteworthy in their use of natural materials: woven baskets, light, shadow, and spacious, airy environments that extend beyond the classroom walls and invite children to explore, create, invent and interpret the world (Edwards, Gandini and Forman 1993). Eagerly, these elements are transplanted into classrooms and elsewhere, assuming that the materials reflect a strong and capable image of the child. When materials are chosen without understanding our own beliefs about teachers and learners, the materials clutter our space and time, and consume our energy and budget dollars. The materials do not communicate our understanding of teachers and learners. Rather, it is in our knowing that the roles of the learner and the teacher evolve into dynamic, collaborative and unconventional ways that determine the intentional selection of meaningful materials that provoke engagement and interaction between those who live in learning spaces together. Through this belief I begin with groups of children, as a teacher and as a learner, to create an environment that reflects the knowledge that each child is competent and capable in the creation of our learning experience together. I do this through the process of pedagogical documentation. This process positions me as a learner working to understand what children already know and what the possibilities are, and as a teacher striving to deepen the children's creative invention and interpretation of their experiences in the learning community through asking questions that will invite children to make meaningful inquiries.

"Will We Count the Pennies?" Children's Initial Counting Strategies

In September, as I placed a penny jar on a window ledge at the children's height, I wondered, How will the children use these pennies? What kinds of ideas will be prompted? Where will those ideas take us in our learning together? Then I waited. It was December before I noticed that the children were interested in the jar. It was Sophie's question that awakened me to the children's interest in the pennies. She asked, "Will we count the pennies?" Her question came just days before the winter break—a busy time in the classroom as we prepared for a community celebration. I held on to the question, not wanting to dismiss it in the flurry of activity.

In January the regular pace of classroom life resumed and, with it, Sophie's question echoed in my mind. I decided to bring the question back to the children.

"Sophie, do you remember before winter break when you asked me about this penny jar?"

She remembered. "Yes, will we count the pennies?" With the question restated, a conversation

developed with the morning class about how we could count the contents of the jar.

"You can skip count. Count by twos: two, four, six, eight," offered Rachel.

"We can each take some and count it," added Esther.

"We can make a pile and move the counted into another pile and call it the counted pile," reasoned Flynn.

"We can count all of the jar!" Garrett exclaimed.

"We can count some and then he (pointing to Cole) can count some and he (pointing to Pablo) can count some until it's all counted," confirmed Errol.

"How many do you think are in the jar?" I asked, wanting to extend this conversation further.

Flynn: "Two million."

Nikos: "A kazillion."

Pablo: "One thousand."

Rachel: "One hundred."

Garrett: "Nine."

Following this initial conversation, I considered possible next steps. I was surprised that the conversation engaged few children. MacNaughton and Williams (2009, 116) explain, "When you listen to someone ... you concentrate on what is said and what is not said; you note what they are saying and not saying and think about it carefully." With this in mind, I prepare counting mats (11 × 14-inch construction paper), a camera and note paper to gather further ideas about counting from the group. I thought that perhaps the children could demonstrate their ideas for counting more easily than articulating their strategies in words. The following day, I invited them to talk about their counting strategies once again.

Devon: "Count one, two, three, four until they are counted."

Nikos: "Share the pennies and everyone count them."

Flynn: "Move the pennies that you count."

Rachel: "Give the same to each kid and everyone count."

Garrett: "One, two, three, four, five, six, seven, eight, nine, ten."

Pablo: "Count to a hundred."

Errol: "Split into groups and move your pennies when you count them."

Malak: "Each take a penny and take turns until all the pennies are counted."

Tatum: "Take them out and put them in a line, then count."

Sophie: "Take groups of pennies. Then count them. Then add them up."

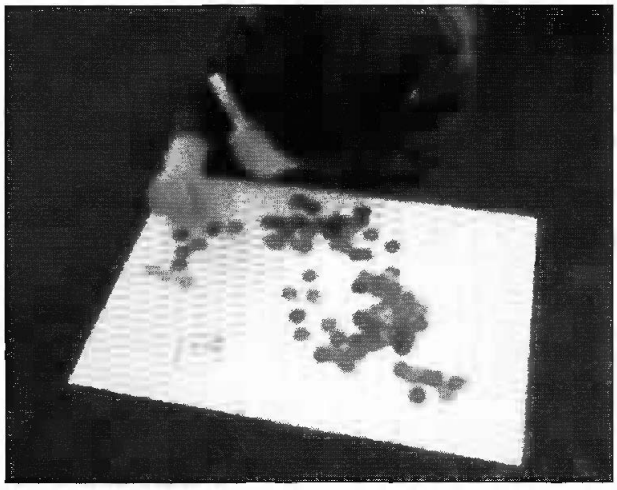
After a few more children expressed their ideas, I asked them to show me how they count. I assured them that there was no wrong way and that I was really interested to learn about their way of counting.

Eagerly, the children began. As promised I photographed and took notes, recording how each child approached the task. The following examples demonstrated a variety of approaches children used to count an unknown group of pennies:

Figure 1. Counting in 10s.

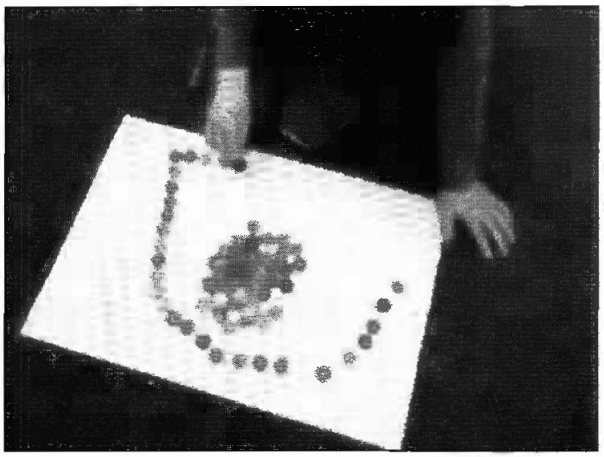
Jared explained, "I can count to 10." He drew the number 10, and then drew 10 circles (Figure 1). He placed a penny in each circle, sliding them across the paper into a pile on the right side. He then repeated his "counting 10" process until all the pennies were in the pile on the right side.

Figure 2. Using estimation.



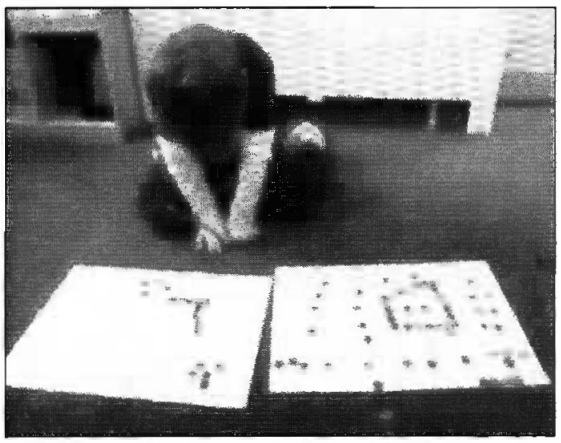
Mark estimated how many pennies he had in his pile. He recorded 100 on his counting mat (Figure 2). He counted each penny as he slid them across his paper. He ended his count at his estimated number.

Figure 3. A solution to a problem.



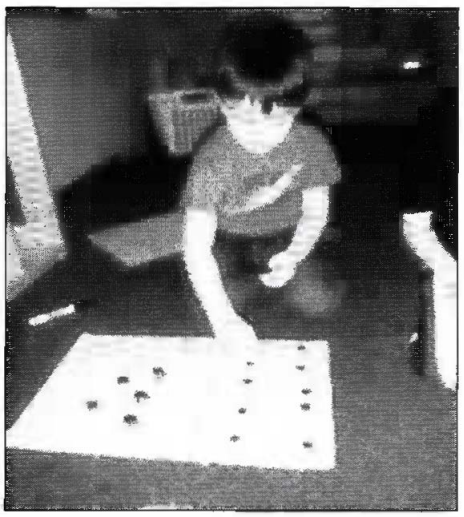
Tatum began by numbering each penny as she slid them into a line (Figure 3). Getting to number five, she recognized, "I don't know how to write five." I encouraged her to think of a way she could solve her problem. After several moments, she began a new strategy by lining the pennies around her paper. Once she had the pennies lined up, she began touch counting. As she neared her starting point, she stopped, thoughtfully placed her other hand across the approximate place she started and continued her count to 33.

Figure 4. Drawing and counting.



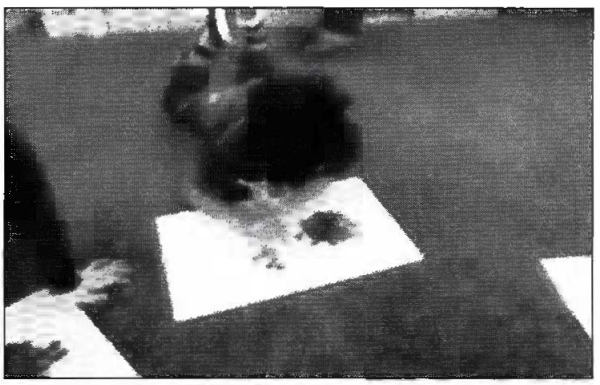
Garrett made a square shape with some pennies and drew a square around those pennies (Figure 4). He placed two pennies at the bottom edge of the square and drew a circle around each. He named it, "penny car." He drew another shape he named, "a tower" and placed pennies inside the tower. He drew an airplane and placed pennies inside the airplane. He repeated this process, drawing many shapes, filling each shape with pennies until he had a very small pile of pennies. He counted the pennies in his pile, 1 to 11, drew an "island" and placed all 11 pennies on the island.

Figure 5. Expanding on another's idea.



After listening to Jared explain his approach to counting 10 (Figure 1), Mark was excited. He drew 10 circles on one side of the counting mat he had divided in half (Figure 5). He placed a penny in each circle, collected the group of 10 and placed them on the other half of his mat. He drew a circle around the group of 10. He repeated this process making 9 groups of 10 pennies. He asked, "How many pennies do I have?" Together, we counted by 10s.

Figure 6. Counting in Portuguese.



Nikos slid each penny from one pile into another pile and counted in Portuguese (Figure 6).

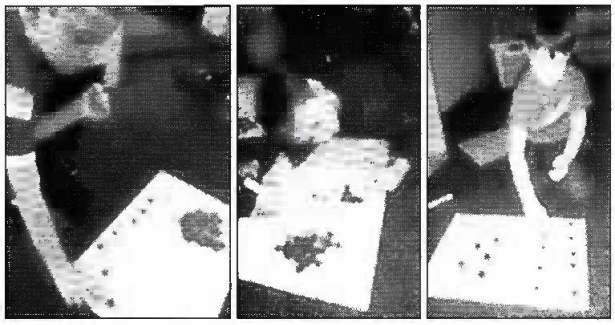
To move forward with the children in their meaning making, I reflected on their engagement with materials and ideas. I was reminded, "When we document we are co-constructors of children's lives, and we also embody our implied thoughts of what we think are valuable actions in a pedagogical practice" (Dahlberg, Moss and Pence 2007, 147). My reflections on what I have listened to—hearing and seeing how the children have counted (shown in the Figures 1--6)—contribute to my understanding of the big ideas that will frame further learning. I know that what I have observed

and listened to is limited by my own lens. I am looking and listening to the children's mathematical thinking. Through another lens, I might see and hear something else. In the context of pedagogical documentation Forman and Fyfe (1999, 240) explain that "the curriculum is child originated and teacher framed."

Exploring Mathematical Possibilities with the Children

I framed several mathematical possibilities for further exploration, as shown in the photos and children's documented words in Figures 7–10.

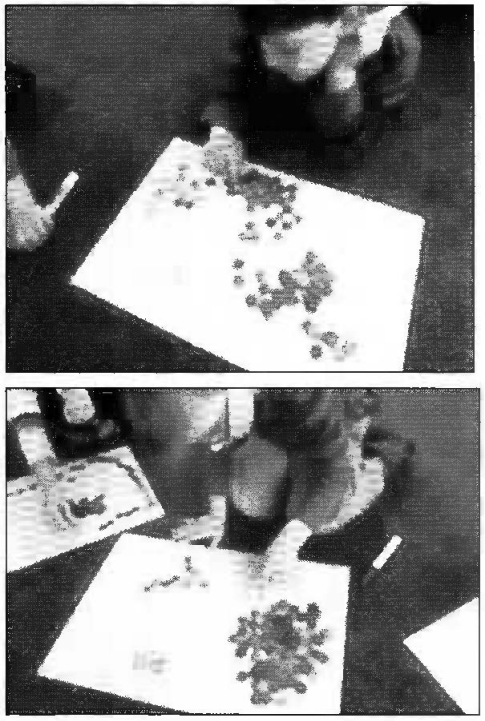
Figure 7. Emerging ideas of skip counting.



Rachel: "I counted by twos: two, three, four, five, six, seven."

Josh: "Skip count, like two, four, six, seven, eight, ten."

Figure 8. Emerging ideas of estimation.



Sophie: "One million."
Sophie: "One hundred."
Safi: "Twenty."
Tatum: "Two million."
Malak: "One million, one hundred."
Errol: "Nine hundred."
Spencer: "One million."

Figure 9. Emerging ideas of place value thinking.

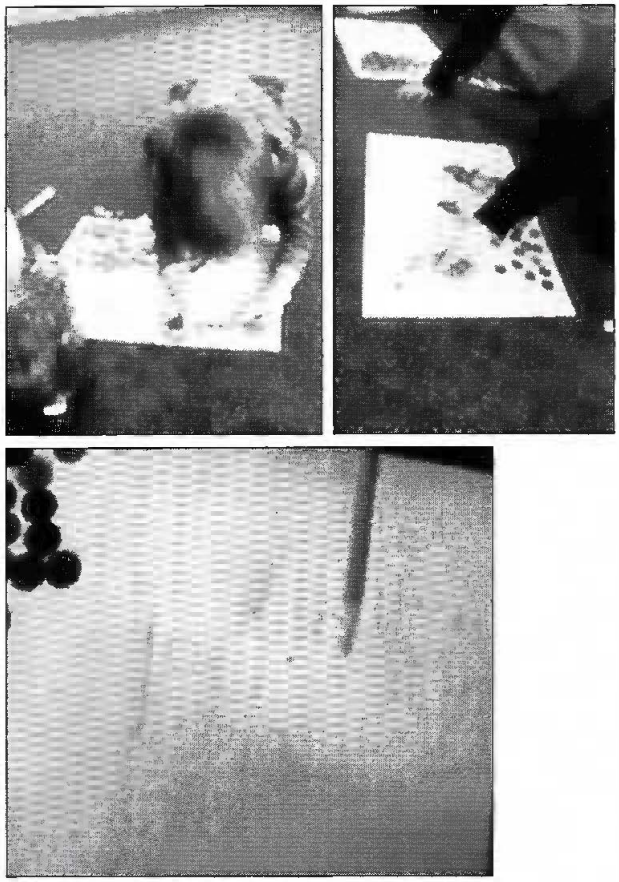


Figure 10. Story of 12.

While ordering the numbers on the February calendar, the children searched each other's calendar number cards to locate the number 12. To support their search, I explained as I wrote on the whiteboard, "Twelve is a ten (1) and a two (2)." Devon laughingly commented, "Lee, you said a ten and a two, not a one and two."

In addition to my learning about each child's approach to counting, my learning through a master's level math course had implications for deepening the learning experiences in the classroom. My awareness of how mathematical ideas are communicated between teacher and learner has been heightened;

Moseley (2005, 385) uses the term *math-mediated language* to describe the process that occurs between teacher and student(s) in creating and communicating mathematical understanding. Through understanding the children's mathematical theories and my knowledge of pedagogical documentation, I form a question. The pedagogical question sets the stage for children to explore, create and think aloud as they make meaning and build personal knowledge in meaningful ways. Although framing questions guide further exploration and learning paradoxically, the questions limit the lenses through which we observe and listen. Therefore, as I ask a question that furthers children's mathematical learning, I recognize that I might not hear beyond the boundaries of my question.

Pedagogical activity can be seen as a social construction by human agents in which the child, the pedagogue and the whole milieu of the early childhood institution are understood as socially constituted through language. However, this perspective also implies that this activity is open to change; if we choose to construct pedagogical activity in one way, we can also choose to reconstruct it in another (Dahlberg, Moss and Pence 2007, 144).

By intentionally listening to the children's engagement of counting strategies and revisiting the collection of data (Figures 7–9), I became aware that the pedagogical question can take many avenues. I might have formed a question that focuses on children's knowledge of object counting, skip counting or estimation; however, as the children ordered the numbers for the February calendar (Figure 10), my curiosity was ignited. I decided to proceed with further learning in the pedagogical question, "What do children know about place value?" In doing so, I considered the possibilities for learning that can occur for the whole group:

- Object counting and skip counting are concepts that the children will explore as we investigate their understanding of place value.
- Experience counting groups of objects will help the children develop an understanding of estimation.
- Alberta Education's program of studies (2009) does not include place value formally until Grade 3.
- Alberta Education program of studies for kindergarten (2009) focuses on number and spatial sense through developing children's personal meaning and competencies in "communication, connections, mental math and estimation, problem solving, reasoning, technology and visualization" (p 17).

As well, children arrive in kindergarten having had an abundance of mathematical experiences that we can and should build upon:

> Children's confidence, competence, and interest in mathematics flourish when new experiences are meaningful and connected with their prior knowledge and experience. At first, young children's understanding of mathematical concepts is only intuitive. Lack of explicit concepts sometimes prevents the child from making full use of prior knowledge and connecting it to school mathematics. Therefore, teachers need to find out what young children already understand and help them begin to understand these things mathematically. (NAEYC 2008, 4)

Teachers must understand the complexities of the concepts that they explore with children. My own investigation of place value helps me to understand that many children "fail to differentiate between the face value of each symbol in a number and the complete value of the same symbol" (Varlas and Becker 1997, 265). As well, Clements and Sarama (2009) highlight language as a factor in understanding base 10 numbers. Whereas English language users use the suffixes "teen" and "ty" to identify 10, Chinese language users read numbers 10-1, 10-2 and so forth, which is more helpful for children's conceptual understanding of numbers beyond 10.

Can Kindergarten Children Understand Place Value? Challenges Presented by Numbers 11 and 12

Understanding the conceptual difficulties of place value learning and language meaning, I considered a way to invite children to explore the number 12. With Devon's approval to share the story—the exchange between him and me during the building of the February calendar (Figure 11)—I gathered the penny jar, counting mats, audio recorder and cameras.

I wrote the number 12 on the whiteboard. "What is the one in 12?" I asked.

Many of the children called out, "One."

I pointed to the two and explained that two means two, holding up two fingers. "If two means two and this one means one—we know that one plus two equals . . ." I paused.

The children confirmed, "Three."

I wondered aloud, "What is the one in 12, then?"

"It's one of something," Cole offered.

"Yes it is, but what is the something?" I wondered.

"We can discover what the one is. Let's each take 12 pennies," I explained as I modelled with the pennies. "We know that the two is two, so I am going to move these two pennies to one side. Now I have some pennies left; what do you think I should do?"

"You can count them," Devon offered.

"Okay, let's all try this." With a counting mat and 12 pennies in hand, the children set about to think and explore the 1 in 12. I take on the role to facilitate children in their exploration, observe their processes, record what they do and say using digital photography, audio and video.

Reviewing a recorded videoclip of Errol and Mark working beside each other, I see that each has two pennies off to one side and another group of pennies in the centre of his mat. Mark told Errol, "Count them" (referring to the group of pennies in the centre of the mat). Errol touch counted as Mark looked on, "One, two, three, four, five, six, seven, eight, nine, ten."

Mark remarked, "Let me count them." He counted, "One, two, three, four, five, six, seven, eight, nine and ten."

Continuing to take the video footage, I prompted, "What does the one mean?"

Mark paused momentarily, "Hum, 10! It's 10!"

He reasoned, "One means 10 and two means two."

I asked, "What is 10 + 2?"

Mark concluded, "Twelve!"

Videos, photos and recorded dialogue archive the children's exploration. The images and recorded children's words in Figure 12 allow me to see that some children had been exploring number composition. A few children continued to explore object counting and a few children were beginning to understand that the 1 in 12 was, in fact, a 10.

Spencer: "Look five and seven make 12."

Sophie: "It makes 10 if I take two."

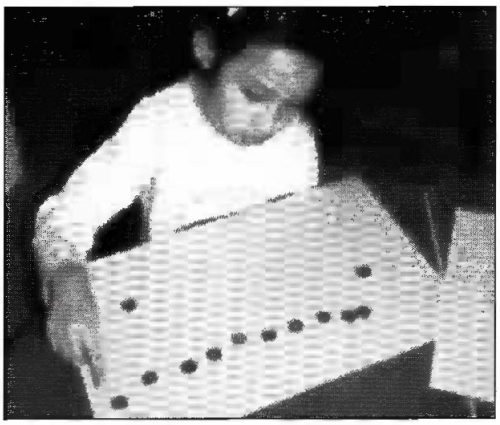
Shivani: "Six and six are 12."

Flynn: "I took two away and made 10. The one is first."

Malak: "I put all the pennies in a row and counted them. They were 10."

Garrett: "I counted 12."

Figure 11. Exploring the 1 in 12.



I knew that another opportunity to explore two-digit numbers was important. The following day, I asked the children about number 11. In much the same way as I posed the problem of 12, I wondered what the ones in 11 represented. Through this exploration, only one child demonstrated an understanding that 11 is a 10 and a 1. The responses of many children, as shown in Figure 12, left me wondering if place value was an appropriate direction for their mathematical learning.

Figure 12. Confusion with 11.

What Is Two in Twenty?

Reflecting on the children's confusion over number 11, I considered that the double 1s in 11 were problematic. It is confusing to think about the numeral 1 as both a 10 and a 1 this early in the exploration. With this in mind, I considered exploring number 13 with the afternoon class. Before we could begin, Isaac declared, "I want to do all the numbers up to 20!" As I introduced the number 13, Minh confidently explained, "The 1 is 10 and the 3 is 3!" I then wrote 14 and the children chanted, "The 1 is 10 and the 4 is 4." I wrote 15 and again the children chanted, "The 1 is 10 and the 5 is 5." I wrote 20 and asked, "What is the 2 in 20?" The children paused. I explained that like the 2 in 12, which means 2, the 0 in 20 means 0. I suggested that the 2 in 20 means 2 of something the same, and that if they drew a line down the middle of their counting mat that might help them to think about 2 numbers the same.

Once again, I am observer, recorder and facilitator of the children's engagement with the challenge of 20. This time, I collect the children's thinking processes in video, and they record their ideas on their counting mats as seen in Figure 13.

In the recorded videoclips of the children's exploration of 20, the following interactions are documented:

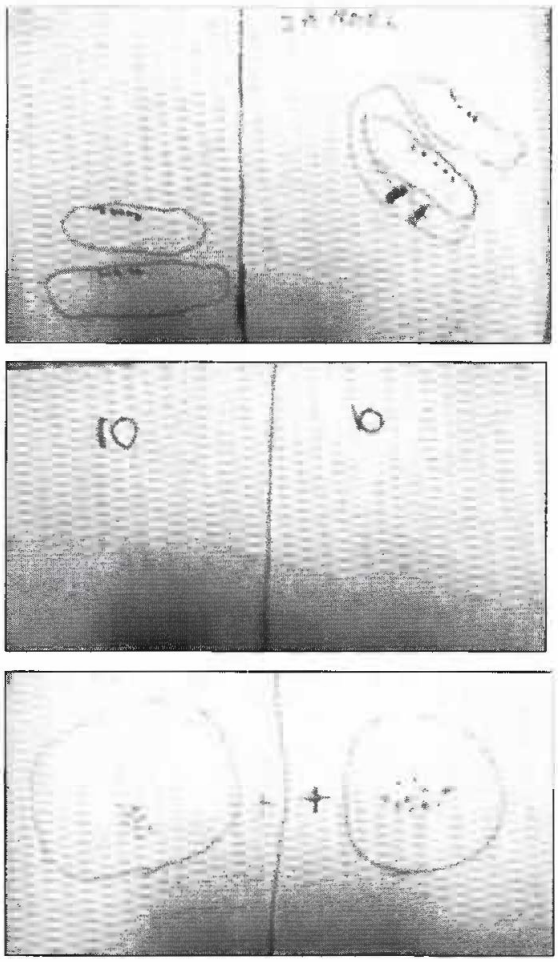
Josh draws my attention: "I figured it out."

I asked him to explain his strategy to another group working at an adjacent table. He explained, "I tried to make 10 on each side."

I prompted, "Can you tell Jared?"

Jared explained, "I got nine plus nine."

Figure 13. Exploring 20.



I asked, "What is nine plus nine?"

Jared replied, "I don't know." He begins to count the pennies on his mat.

Josh interjected, "Eighteen."

Josh explained to Jared, "If you put 10 on each side, you make 20."

Jared explained, "No if I put 10 on this side then they aren't the same. It will be 10 and 1, 2, 3, 4, 5, 6, 7, 9. It would be 10 and 8."

Realizing that perhaps Jared was only working with 18 pennies rather than 20, Anh (a colleague) helped him to adjust his pennies to 20, and I moved over, asking Mark what he has discovered.

Mark explained, "I got 10 on each side."

I asked, "What is the 2 in 20?"

Mark searched, "Two zeros, two tens, two pennies?"

I wondered along with him, "Two pennies?"

Daveed exclaimed interrupting us, "Ten here and 10 here."

I inquired, "What does 10 plus 10 make?"

Daveed replied, "Twenty."

I prompted, "What does the 2 in 20 mean?

Daveed and Josh, confirmed, "Ten!"

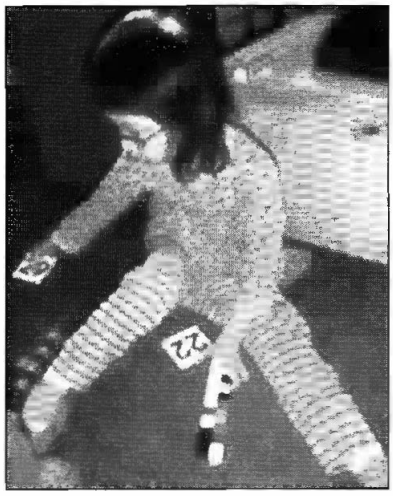
In another videoclip I see Daneel working. He has two circular shapes drawn on each side of his counting mat. He explains, "Five plus here, five plus here, five plus here, five plus here. Five plus five makes ten. Ten plus ten makes twenty. Only two tens and no more."

After I revisited the collected documentation, I came to believe that the afternoon group of children had developed an understanding for place value 10. The morning group of children had been exploring several concepts, including place value, composition of numbers and object counting. In both groups, I felt that my question (What do children know about place value?) and the manner in which we explored those queries engaged every child in a way that challenges them and engages their thinking within the scope of meaningful learning. My next thoughts were on generalizing the idea of base 10. Could the children recognize tens in other numbers? I introduced the hundreds chart, which prompted Minh to explain his theory about two-digit numbers. As he pointed to the number 83, he explained, "The first one has some tens in it and the second number doesn't—it's the regular number."

Building Numbers

To further explore this idea, I introduced an idea to build numbers. Using familiar materials explored in previous contexts, the Unifix blocks and calendar numbers 11 to 31, I proposed a game called building numbers. The rule of the game is that you cannot build a tower taller than 10. I imagined that children would want to build towers as tall as possible, so I stipulated a limit to promote the concept of place 10. Many of the children explored this game as I imagined, as seen in Figure 14.

Figure 14. Building numbers.



A videoclip of the activity revealed that the teacher–child interaction challenged the tension between what we intend and what children interpret.

I directed my attention to Sophie, "Can you show us what you have?" Sophie counted a tower of nine. In response, I asked the whole group, "What should Sophie do?"

Cole said, "Add one more." Removing a single block from another tower, Sophie added the block to her tower in question, making a tower of 10 blocks. I explained, "Sophie's number is 31. Sophie, tell us what your next tower is."

She counted, "Eight." She then counted her next tower, "One, two, three, four, five, six, seven. Seven." She counted her last tower, "One, two, three, four, five, six." She looked at me.

I summarized for the whole group, "Sophie made a tower of ten, a tower of eight, a tower of seven, and a tower of six." I probe further, "Can she make any more towers of ten?"

Sophie responded, "No, because it would make more (than 31 blocks). She then counted the blocks in each tower to confirm her count.

I concluded, "Sophie made her number 31 a different way. Cole made three towers of 10 for the number 30, and Sophie made 4 towers, 10, 8, 7 and 6 for 31."

Sophie commented, "Almost the same."

In another videoclip, Isaac explained, "I got 31." Together we described, "Ten plus 10 plus 11 makes 31."

Although not documented in the penny jar experience, through dialogue with colleagues I noticed my use of evaluative language as I described the children's engagement with the pennies. Unintentionally, I used evaluative language to describe the children who were exploring number composition or object counting and the children involved in working through

the problem of place value. "The afternoon children are showing a strong understanding of place value, but most of the morning children are only exploring composition of number and object counting." Evaluative language places importance on one in relation to others. Taguchi (2008, 272) explored "deconstructive talk as a tool in the displacement of dominant or taken-for-granted ways of thinking and doing." Her goal was to "search for ways to understand childhood and learning that work with and make use of—rather than muting—the complexities, diversities and multiplicities arising from different contemporary theoretical perspectives on childhood, child development and learning." Listening to myself in dialogue with colleagues gave me an opportunity for learning and challenged me to attend to my use of evaluative language and clarify my ideas—my perspective reflected in my practice with children.

Interactions with Children: Reflections on My Teaching

The opportunity to revisit documentation gave me a backward glance to listen to my interaction with Sophie and her construction of the number 31. Moments of teacher–student interaction captured in video allowed me to see another hidden bias. I saw myself working with a young girl who had built 4 block towers that amounted to 31. In this learning experience, I had proposed a game for the children to build numbers using connecting blocks, with the stipulation that the towers could not be more than 10 blocks high. My intention was that children would build as many towers of 10 as each number allowed. This particular child had built towers of 6, 7, 8 and 10 blocks to construct the number 31. I saw in my tone and probing questions that I viewed her solution as lacking, even asking the whole group, "Can she construct any more towers of 10?" By reviewing this example I recognized that, in fact, she had achieved an original solution to the game that I had posed to the group, yet my response had not celebrated her creativity. Looking back on the video I saw my bias. I valued the children's responses that correlated with my question and undervalue a solution that was different from the one I had in mind. Upon further reflection, I have come to understand that the pedagogical question is the teacher's question. When teachers ask pedagogical questions, we cannot necessarily assume that the children will take up the question along with us.

Returning to Sophie's question, we counted the pennies in the jar. Interestingly, as we began this phase of the work with the penny jar, the children gave estimates, no longer fantastical in nature, but rather predicative, such as, 1,000, 600 and 960.

In the months that followed the penny jar exploration, I continued to notice the presence of mathematical language in the children's conversations each day. Upon our return to school in April after spring break, Nikos mused, "What is the 3 in 31?" Cole and Flynn took up the challenge and reported back at the end of the morning. On another day, Sophie and Flynn watched as Devon recorded the day's temperature on the whiteboard. As he wrote +11, Sophie commented, "One, one." Flynn reminded her, "No, remember it's a 10, 1, it's 11. Plus 11." Sophie replied, "That's right. It's 10 and 1. That makes 11."

Taguchi (2008) reports that the teachers with whom she worked to explore deconstructive talk realized that there was no going back to old ways; rather, they were "ethically obligated to re-examine [their] practices, always looking for better ways to 'do good' for the particular children with whom [they] were working" (p 280). Deep in my knowledge of who I am as a classroom teacher, this is true for me. Remarkably, in 1963, Sylvia Ashton-Warner described a teaching practice we continue to strive for—a practice that begins with and focuses on the cultural experiences of children. At a time when dominant Western European views were imposed on cultures considered less developed, less desirable, Ashton-Warner was a teacher of the five-year-olds of the Maori infant rooms. I am inspired by Ashton-Warner's approach to generating a "key vocabulary" inviting each child to contribute personally significant words toward creating a classroom vocabulary list. These words became the material for developing printing skills, handwriting and reading skills, and eventually created Maori readers. I consider Ashton-Warner to be both skilled and courageous—a teacher who listened intently and created a curriculum that connected children, their lived experience and their learning experience. As well, Paley (1997) speaks of one particular kindergarten student, Reeny. Through developing a deep connection for Leo Lionni's story character Frederick, Reeny breathes life into each newly introduced story character through a class study of the author's work. Reeny's passion propels each class member to take up the journey along with her, which transforms the class identity. Paley observes,

> I too require passion in the classroom. I need the intense preoccupation of a group of children and teachers inventing new worlds as they learn to know each other's dreams. To invent is to come alive. Even more than the unexamined classroom, I resist the uninvented classroom. (p 50)

I share Paley's sentiments—a classroom that breathes originality and creativity is a listening classroom—listening with intention to learn, to create and to invent. It is in these classrooms that the would-be readers that Bruner (2000) speaks of find themselves in the world of possibilities. When we attend to children's experiences in school and to their experiences in the world, we create together that which cannot be packaged and duplicated elsewhere.

Teaching and learning are highly complex processes, and it is through closely attending—through listening with intention to learn that which is not yet known—that it becomes an art, complex and evocative, mindfully open to possibilities. It is this notion that I take with me, into the classroom with children, listening for possibilities, with a keen awareness of how the context, materials, learners and teachers are entwined in the process of creating multiple interpretations. Pedagogical documentation situates me, the teacher, as a learner—willing to reflect on and refine my practice toward understanding what each child knows and can do and how I determine further learning experiences for children, with children.

Upon opening this article I focussed on the potential superficiality of transplanting the Reggio Emilia context into a North American classroom. This is a real hazard when our goal is understanding our own beliefs about children and learners and how classroom practice communicates our beliefs. I hold the highest regard for the work of the teachers and children of the infant and preschool programs of Reggio Emilia—not for what I can duplicate, but for what I can learn about my own practice through what they have shared about theirs.

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