THE GIFT OF ERROR

Mary Hynes-Berry
United States

Rebeca Itzkowich
United States

Mary Hynes-Berry has 30 years experience as an oral storyteller in school settings as well as doing professional development with teachers about how to build rich, engaging curriculum out of stories, with a focus on the primary and pre-primary grades. For the last 12 years, she has been exploring the same issues as a faculty member at Erikson Institute for Early Childhood. Her background also includes extensive textbook writing, primarily in language arts; project managing a major primary math program (which included stories) for Encyclopedia Britannica; and work in biblio-poetry therapy, for which she is co-author of what is considered the key text in the field.

Rebeca Itzkowich has worked with young children and their families for over 15 years as a bilingual classroom teacher and program director. For the past 10 years she has been a faculty member at Erikson Institute teaching courses in emergent literacy for new language learners, family and culture, and preschool curriculum. She has been working with preservice teachers in schools helping them develop engaging developmentally-appropriate curricula and culturally-responsive practices.

Introduction

In all the years we have enjoyed working with young children and their teachers, we have noticed that exceptional classrooms are those in which both teachers and students are engaged in the creativity, excitement, and sense of purpose that we believe characterizes lifelong learning. To use Duckworth's eloquent expression, the teachers in these classrooms are 'havers of wonderful ideas' (Duckworth, 1987). Specifically, we are thinking of their wonderful ideas about how to facilitate students' active participation in constructing meaning. These teachers do not look for right answers, but for windows into children's current thinking. The most delightful misconceptions and errors of new learners are received as gifts—as keys that will help unlock the windows and give teachers greater insight into effective ways to deepen children's understandings.

'the most delightful misconceptions and errors of new learners are received as gifts—as keys that will help unlock the windows and give teachers greater insight into effective ways to deepen children's understandings'

Our understanding of error as a gift reflects the word's etymology; it comes from the Latin 'errare', meaning 'to wander'. As any good knight errant knows, wandering is not purposeless; it is an attempt to find a path that will lead us to our goal. For the knight, to do one good deed and then another and thus continually prove himself; for

the learner, to arrive at deeper understanding about something and then something else again.

In the City College of New York's *Mathematics in the City* project, Fosnot and her colleagues have replaced the traditional linear model of the learning trajectory with one they call the 'landscape of learning' (Fosnot & Dolk, 2001). They describe it in terms that are amenable to both wandering and wondering.

When we are moving across a landscape toward a horizon, the horizon seems clear. Yet we never actually reach it. New objects—new landmarks—come into view. So it is with learning. One question seemingly answered raises others. Children seem to resolve one struggle only to grapple with another. It helps to have horizons in mind when we plan activities, when we interact, question, and facilitate discussion. But horizons are not fixed points in the landscape; they are constantly shifting. Fosnot & Dolk, 2001, p. 18

> 'unfortunately, in all too many classrooms, we see teachers doing unto children as they were done to in their early schooling'

Unfortunately, in all too many classrooms, we see teachers doing unto children as they were done to in their early schooling; activities are programmed in a highly linear fashion and errors treated as mistakes to be corrected instead of important opportunities for the learning that can result from cognitive dissonance. Consequently, over the years, we have invented for ourselves what Lilian Katz in her opening address to the Working Forum called the principle of congruity, that is, the way we teach teachers should be congruent with the way we want them to teach. This principle harmonizes with workshops and classes with preservice and inservice teachers we have built around activities that will help the participants rediscover themselves as learners.

> 'the way we teach teachers should be congruent with the way we want them to teach'

With this in mind, we invite you to please play the following quiz, knowing that your responses will be neither collected nor graded. In fact, do not look for an answer key written upside down at the bottom of the page or the end of the article. We did not give one, because the point is not the correct answer but the process. If you can get someone to play with you, all the better. This *Shepherd's Counting System* is displayed at South Wolds' Historical Village Life Museum in West Sussex, England.

We should have the space to question. As an evolving society we need to encourage and empower our students to question.
Marek Tesar

How well can you count?

Until the middle of the last century, shepherds in southeastern England used an unusual numbering system. The number names of this system from our 1 to 20 are given in the chart below:

Something to do

1. Write the Arabic numeral next to each number in the left column.

2. Consider the number names:
   - What pattern do you see in how these number names?
   - Do they operate on the same system as the base 10 system we use?

- Can you see any natural rationale for the shepherd's number system?
- Draw tan-a-figgit sheep. Try to configure them in a pattern to make counting easier.

3. Suggest a name for 25 and then write the names for 26 and 29.

Bonus Challenge

Make up numerals for the first 10 numbers, using the far right column. You can use base 5 notation or make up number signs of your own.

	Yan	
	Tan	
	Tethera	
	Pethera	
	Pimp	
	Yan-a-pimp	
	Tan-a-pimp	
	Tethera pimp	
	Pethera pimp	
	Dik	
	Yan-a-dik	
	Tan-a-dik	
	Tethera-a-dik	
	Pethera-dik	
	Bumpit	
	Yan-a-bumpit	
	Tan-a-bumpit	
	Tethera bumpit	
	Pethera-bumpit	
	Figgit	

Now reflect a bit on the experience of the quiz for you

Did you find this activity:

Intriguing Fascinating Fairly pointless Other

Difficult Easy Somewhat challenging but interesting Other

What might have contributed to how you experienced this quiz:

I enjoy/don't enjoy trivia and puzzles The questions were confusing

I do/don't feel comfortable with math Other

We came up with this quiz in the developmental stage of Erikson Institute's Early Mathematics Project—an initiative funded by McCormick Foundation and the Chicago Mercantile Exchange Trust. It grew out of an activity we had developed earlier to re-create for adults the highly complex task a child faces when beginning to develop alphabet knowledge. We could see that an equivalent situation holds in mathematics: adults—or even most 12-year-olds—do not see that rational counting is no simple task; it calls for orchestrating three quite separate systems, each confusing in a different way:

Number names

Once we have learned them, we tend to forget that number names are arbitrary. In English, there are particular problems:

- Some number names have homonyms (*two, too, to*), while others are easily confused because of the very similar pronunciation of very different values (*thirteen/thirty; fifteen/fifty; sixteen/sixty*) (Ginsburg, 2002).
- The number names of the tens in English are irregular. Logically we should say *ten-ty-one, ten-ty-two* (as we say, for instance, *twenty-one, thirty-two*), so that the names reflect the pattern of our number structure, as they do in Asian languages. Research indicates that the English number names are a factor in the difficulty young children can experience in understanding place value (Miura & Okamoto, 1999). In contrast, the *Shepherd's Counting System* is not a base 10 but a base 5 system; in fact interestingly, the number words do not include zero but show place value by changing the number word. *Tethera-figgit* (equal to 23 in base 10) could be represented as 43 in standard base 5 notation.

In many languages, however, reciting the sequence of number names is often a rote memory task. As you may have experienced with our quiz, in order to represent *tan-a-figgit* sheep, you had to translate it, as it were, back to *twenty-two*. So, too, even after they have attained fluency, second language learners tend to conceptualize number values using their first language.

> 'even after they have attained fluency, second language learners tend to conceptualize number values using their first language'

But perhaps the greatest confusion comes from the way children are encouraged to recite the number names in sequence without any reference, that is, without actually using them to count objects. For example, a teacher we know tapped each child on the shoulder to indicate the line order. *You are 1,* she would say, *You are 2; you are 3....* One child in particular would protest angrily, *I am not 3!* and refused to join the line.

The teacher found this behavior inexplicable until our discussion of the Shepherd's counting quiz helped her realize that when the child heard *You are 3* she did not take it to mean she was *third* in line; rather she understood the teacher to be saying that she was 3—which in a young child's world translates to *3-years-old*. As a newly turned 5-year-old, being told she was two years younger was very upsetting. In any case, her confusion about having cardinal numbers used as ordinals is perfectly appropriate developmentally, as is her assumption that the expression *You are 3* had a well established conventional meaning unrelated to number sense. Imagine, for example, the snickers if we counted around a group using the shepherd's system as we got up to *pimp* or *dik*.

As teacher educators, if we model all-knowingness perhaps we may convey to student teachers that their role as teachers is to reside over the learning experience so as to bring conclusiveness and certainty, rather than inconclusiveness and uncertainty to the learning.

Editors

As teachers we may want our children to be innovative and creative. As teacher educators we may want the same for our student teachers. As program leaders, do we create spaces for innovation and creativity?

Editors

Numerals and number symbols

If you tried to come up with number symbols for the shepherd's system, you may have experienced how young children can find it challenging to tie a number name or value to the written symbol, just as they may find it difficult to differentiate and remember letter shapes. It is instinctive to try to make some connection that will help fix a meaning to the graphic symbol. For some, that leads to an understandable confusion between numerals and alphabet letters. Think, for example, how easy it is to confuse *S* with *5*, lower case *L* with *l* and *0* (zero) with the letter *O*.

This story dictated by two 4-year-olds to describe a game they called *Ants on a Line* is a wonderful example of quite another way of seeing the graphic symbol as a way of representing a meaning that has nothing to do with number value.

And so the whole bunch of ants walked on the ruler but they could only go up to 10 because their moms said 'Only go up to 10 and then you have to come back to O.' And they came back to zero and they felled in the hole because zero is nothing and it has a big hole in the middle. The End. (by Michael and Angel)

For these two, 10 is clearly up from—*more than*—zero, because it is the limit beyond which their mommies say they cannot go. They have some sense that zero is nothing; however, it is the graphic representation—that hole in the middle—that does in the ants. For all the richness of this story, the boys are not really counting. The numbers marked on the ruler are treated as locations rather than as the representation of 'how many'.

Number sense and numerousness

In recent years, brain research has indicated that infants do have a capacity to sense quantity (Holt, 2008; Mix, Huttenlocher & Levine, 2003, 2002). It seems, however, that this early intuitive ability only goes up to about the quantity of three. Somewhere between five and six, children begin to develop true number sense for quantities from 5-100; initially, they link quantity and name/symbol for lower values; however, by age six, many not only grasp higher numbers, they also have begun to naturally explore and develop natural arithmetic procedures such as adding (Ginsburg, 2002).

> 'in recent years, brain research has indicated that infants do have a capacity to sense quantity'

Yet parents and teachers seem so proud of the way young children can perform the rote aspects of number recognition (names and numerals) that they may fail to see that many preschoolers count without counting, that is, they use number names and symbols without understanding that their function is to express how many. It takes multiple experiences and maturation to develop these fundamental understandings:

- The quantity represented by 5 is always the same—it does not matter whether the objects being counted are huge (elephants) or tiny (ants on a ruler), 5 of them means there is one more than 4, one less than 6.
- Our number system operates with a base 10 structure; in two and three digit numbers, the position of a number indicates its value so that in 23, (*tether-a-figgit*), 2 represents twenty (two tens) and the 3 stands for three units. In 10, 200, or 5000, the zeros all have holes in the middle but they are not nothing—they are place holders that indicate values in tens, hundreds, and thousands.

Young children's confusions about how number names, numerals, and quantity are connected can be seen as either a mistake that needs to be promptly corrected or as a gift that needs to be considered seriously. Their imperfect understanding is perfectly appropriate developmentally; furthermore, it is a key opportunity for learning, as we alluded to earlier. We believe then that the more precisely student teachers appreciate the developmental trajectory and the tricky issues that novice learners face, the more effectively they can structure ways to deepen the child's understanding.

> 'children's imperfect understanding is perfectly appropriate developmentally; furthermore, it is a key opportunity for learning'

Let us revisit the experience of the *Shepherd's Counting System* activity. If we were successful we reduced you to feeling like a novice, paralleling the experience young children often face. Instead of handing you a linearly programmed activity, we asked you to accept the gift of error, with its wandering and wondering. At the same time, you may have had some insight into the complex processes involved in learning and into all that must be considered in order to respond accurately and effectively as a teacher.

> 'Katz's principle of congruity requires that we teach teachers in ways that call for the adult to engage in processing material in a way that is parallel to the child's processing'

Engaging in this kind of exercise is an example of what we call 'parallel processing'. Katz's principle of congruity requires that we teach teachers in ways that call for the adult to engage in processing material in a way that is parallel to the child's processing. For us, this term puts emphasis on the processing that is at the heart of all learning. The processing involves two distinct parallels:

- Parallel 1—If I am conscious of what it means to be a novice in a given area, I can recognize and promote how young children move through the landscape of learning, from confusion to misconception to understanding.

If you engaged in the counting activity, you may have felt bewildered as you looked at the unfamiliar names on the chart, just as very young children can be by such number names. At first, you may have even been frustrated by the trial and error process of matching numerals and names and then taking on the more challenging tasks. If you reflect back on the steps you took to arrive at your point of understanding, you can probably see different stages at which you had some partial understanding of the problem. An error that was examined closely became the stepping stone that helped you arrive at a more accurate understanding of the way you needed to proceed. Hopefully, those feelings were replaced by excitement and satisfaction as the penny dropped, and you experienced the benefits of persistence as you broke the code and mastered a new numerical system.

In effect, the process of successfully breaking the code of the *Shepherd's Counting System* results in an experience that meets all the characteristics that define play: that is, it is:

- engaging and personally satisfying. You are absorbed; maybe having fun but taking what you are doing seriously.

> Academic learning and skill development can be taught in a short time. Intellectual dispositions and attitudes take much longer.
>
> Lilly Wong

- intentional. You chose to be doing it.
- creative problem-solving. You are thinking about what you want to do, trying out strategies including negotiating and making meaning.

If you had the opportunity to do this exercise with other people, there is a good chance that you may have broken the code sooner. Research tells us that the greatest cognitive learning occurs in social settings, where more experienced people can scaffold our ideas through guided participation in trying to solve the problem at hand (Schaps, Battistich, & Solomon, 2004; Charney, 2002). Once again, we could be talking about play as well as work. Contrast this authentic exercise to a more traditional professional development training exercise that uses a simulated situation. The adults are given an activity designed for children and asked to respond as would their young students. Because the adults are secure in the knowledge that is required to successfully accomplish the activity, they tend to mimic what they imagine children would do and say.

> 'the greatest cognitive learning occurs in social settings, where more experienced people can scaffold our ideas through guided participation in trying to solve the problem at hand'

The loss is double. First of all, they are not themselves actively engaged in authentic problem-solving. At the same time, they operate on unexamined assumptions about children's thinking. The result may be enjoyable; the group goes home with a make-and-take activity. However, they leave without important insights into what happens when young children persist through misconceptions and partial understanding to construct knowledge.

> 'adults may operate on unexamined assumptions about children's thinking'

As adults, we have beliefs about the way things are that limit our vision like blinkers on a horse; they prevent us from being in a true learner mode—we cannot see beyond what we believe to be the right answer. Errors are seen as mistakes instead of as opportunities to reap the benefits of cognitive dissonance. The power of parallel processing is rooted in the authenticity of the exercise, which gives it the power of play. When adults re-experience themselves as new learners, they bypass their competence as adults and move closer to the consciousness of the young child who experiences learning in a more organic fashion through play. Like the child or the knight errant, they wander through the landscape of learning, with its shifting horizons.

> 'errors are seen as mistakes instead of as opportunities to reap the benefits of cognitive dissonance'

We talked months later to teachers who have participated in exercises like the *Shepherd's Counting System* or the activities we designed around Paul Cox's *Abstract Alphabet: Book of Animals* to help understand the complexities of becoming a reader. They report how profound these experiences have been in terms of helping them rediscover themselves as learners. As a result, their pedagogy has been transformed. Several have felt compelled to bring the activity to parents and colleagues.

- Parallel 2—As teachers, we must be careful listeners and observers of children so that we can learn where they are in their current understandings and what might be an effective way to continue their progress through the landscape of learning.

Think of the two boys playing *Ants on a Line*. Teachers who understand learning as a constructive process can see that their game is not just a cute story but an engaging, intentional attempt to solve the problem of what it means to count up and down from zero to 10, taking into account the graphic representation of number symbols. They know that to address the misconceptions by correcting this story serves no purpose. Rather, they see this story as a wonderful gift, an insight into the children's current thinking. They now have a clue about how to scaffold children's thinking to the next level of understanding. *Ants on a Line* is the kind of problem that teachers who are lifelong learners love to play with. They look at it through three different lenses:

I. Conceptual understanding of the content area

In this case, this refers to number sense. More specifically, teachers should be aware of the four principles of rational counting—fixed number sequence, one-to-one correspondence, order irrelevance, and cardinality—and look for evidence to establish where the child is in terms of mastery. Michael and Angel do know the sequence for counting and are showing one-to-one correspondence as they move their ants from one marker on the ruler to the next. Since the line is established on the ruler, it is not evident that these 4-year-olds have good understanding of the last two principles—and we know that these understandings often do not develop before age 5 or 6.

II. Developmental trajectory in early childhood

Young children—and octogenarians as well—move from understanding the concrete (hands-on), to the pictorial (schematic), and finally to the symbolic level. Furthermore, the younger the child, the more important it is to have repeated concrete experiences. As we indicated above, only as children begin to move through the shift in the ability to reason and abstract that typically occurs between the ages of 5 to 7 can they abstract enough to develop good number sense of two and three digit numbers. The *Ants on a Line* game focuses heavily on the concrete and somewhat on the pictorial. There is little indication that the boys closely link the number symbols with a good sense of the quantity represented by the O in either 10 or the numeral for zero.

III. Unique qualities of the child

One of the rewards in being an early childhood teacher is that children see connections and spin conceptions that reflect their own unique perspective and experiences. These two boys are very aware of how mommies often set boundaries (only go to 10) and of how the world is full of perils such as that hole in zero and finally of how *The End* may precipitously assert itself. The better we know the children, the easier it will be to spot and appreciate this kind of unique insight or processing.

> 'young children—and octogenarians as well—move from understanding the concrete (hands-on), to the pictorial (schematic), and finally to the symbolic level'

Good teachers know that teaching and learning are complex interactive processes. It is essential to keep shifting back and forth between the three lenses to get a good read on each wonderfully unique learner. In other words, both teachers and learners need to play with understanding. Teachers in training bring to the classroom their own experiences as learners and use them as a compass, as guiding principles for their own teaching practice.

If as teacher educators we want to encourage experiencing the consciousness of new learners, we might want to think carefully about the impact of our assessment practices on student teachers' relationships with their learning.

Editors

All teachers should have to have knowledge

Liliana Sitnikowski

Given that teachers in training bring to teaching their own experiences, the uniqueness of each student teacher underscores the complexity of teacher education, and of the challenge in deciding what it is to be a 'good' teacher.

Editors

Teachers who view learning as a constructive process that occurs within social contexts are likely to provide a curriculum that fosters meaningful learning, and a classroom environment that promotes seeing error as a gift that provides opportunities for new, richer understanding.

References

Charney, R. S. (2002). *Teaching children to care: Classroom management for ethical and academic growth, K-8.* Turners Falls, Massachusets: Northeast Foundation for Children.

Cox, P. (1997). Abstract alphabet: a book of animals. San Francisco: Chronicle Books.

Duckworth, E. (1987). *The having of wonderful ideas & other essays on teaching and learning.* New York: Teachers College Press.

Fosnot, C. T., & Dolk, M. (2001). *Young mathematicians at work: Constructing number sense, addition, and subtraction.* New York: Teachers College Press.

Ginsburg, H. (2002). *Learning to count. In Children's arithmetic: How they learn it and how you teach it* (pp. 3-42). Austin, TX: Pro-ed.

Holt, J. (2008, March 3). Numbers guy: Are our brains wired for math? *The New Yorker,* 42-48.

Mix, K., Huttenlocher, J., & Levine, S. (2002). Multiple cues for quantification in infancy: Is number one of them? *Psychological Bulletin, 128*(2), 278-294.

Mix, K., Huttenlocher, J., & Levine, S. (2003). Quantitative development in infancy and early childhood. *Infant & Child Development, 12*(1), 110-112.

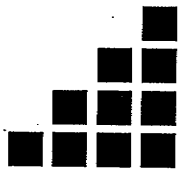
Miura, I. T., & Okamoto, Y. (1999). Counting in Chinese, Japanese, and Korean. Support for number understanding. In C. A. Edwards (Ed.), *Changing the face of mathematics: Perspectives on Asian American and Pacific Islanders* (pp. 29-36). Reston, VA: NCTM.

Schaps, E., Battistich, V., & Solomon, D. (2004). Community in school as key to student growth: Findings from the Child Development Project. In J. Zins, R. Weissberg, M. Wang, & H. Walberg (Eds.), *Building academic success on social and emotional learning: What does the research say?* (pp. 189–205). New York: Teachers College Press

Conversations on Early Childhood Teacher Education

Voices from the Working Forum for Teacher Educators

Andrew Gibbons and Colin Gibbs, *Editors*



WORKING FORUM
FOR TEACHER EDUCATORS

2009

World Forum Foundation
Redmond, WA