

## Chapter 2

# Swimming Upstream in a Torrent of Assessment

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**Abstract** Growing attention to preK mathematics and increased focus on standards in the US may be leading policy makers, administrators, and practitioners down the wrong path when it comes to assessing young children. The temptation to rely on standardised assessment practices may result in misguided understandings about what children actually know about mathematics. As part of a larger study of professional development with teachers focused on culturally and developmentally responsive practices in preK mathematics, we have found that our understanding of children's mathematical knowledge varies greatly depending on the form (what), context (where), assessor (who), and purpose (why) of assessment. Drawing on findings from three cases, we suggest that in the transition to school, shifting to more a formalised 'school-type' assessment is fraught with obstacles that vary greatly by child.

### 2.1 Introduction

This chapter would have been a story situated in a particular time and place—of the challenges involved in helping teachers learn new things about their preK students' mathematical experiences. However, the story we'll tell here is slightly more complicated. In the process of urging teachers to traverse boundaries—between classroom and home, preschool and elementary school, parent and teacher, formal and informal—we realised that our story of mathematics and transitions is essentially a story about assessment. It is about understanding children and our capacity to take up what they know in ways that are culturally responsive and mathematically rich. It is about using that knowledge to help students as they transition from one

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institutional context to another. It is about finding out more than what they show us in static classroom contexts. And, it is about swimming upstream.

Determining what counts, and what does not, as evidence of young children's development has become an increasingly complex issue for early childhood educators. A broad range of stakeholders in the education of young children, from parents and teachers to administrators and policy-makers, have their own views about how children develop and how learning should be supported and assessed. (Casbergue 2011, p. 13)

We begin by describing the context for our work, a time of transition for early childhood programming and for the use of assessment. We recognise that this is a U.S. centric story but we are confident that many of the threads salient in the telling are relevant in international contexts as well (Black and Wiliam 2001; Perry et al. 2014).

Programming and curriculum in early childhood contexts have changed dramatically in the last 50 years, with higher proportions of children attending preK programs and multiple pressures on teachers and administrators to escalate learning. The traditional kindergarten curriculum has migrated to preschool and kindergarten has become a colorful version of first grade, focusing on literacy and mathematics (Graue 2009). This escalation has sped up in the last decade with standards-based curriculum and assessment systems benchmarking what had previously been soft developmental expectations due to the sanctions schools would suffer if their students missed proficiency. Play-based pedagogy, a critical attribute of traditional teaching in the U.S., is fading, seen as a waste of time in schools that are measured in terms of the gains their students make on academic tests (Miller and Almon 2009).

The tenor of escalation has taken on a new urgency in the current U.S. policy context. In an effort to affect education reform, the federal government recently offered funding to states to join an unprecedented movement to: a) establish a coherent set of expectations for students across the nation, and b) build data systems that would allow local, state and federal governments to follow student progress across time. These two actions were unusual because the U.S. constitution frames education as a local responsibility, and until recently national standards were antithetical to the local control aspects of education (Bagnato et al. 2011). Data systems were also new to the early childhood community as services for young children were scattered across multiple agencies and assessing children younger than five was seen as fraught with problems. These two trends, national standards and development of data systems, have changed how early educators conceptualise their practice; their work dictated by later achievement goals rather than the needs of the child. The developmental approach that framed early childhood as a process has given way to a more assessment-driven, intervention-mediated, and content-oriented curriculum (Sophian 2004).

At the same time, mathematics' role in early learning has received significant attention in the research community, with recognition that children are capable of learning 'everyday mathematics' that includes abstract and concrete concepts (Ginsburg et al. 2008). This learning potential is often minimised by limited opportunities to learn mathematical content, particularly compared to home and school practices that support literacy. Most early childhood curricula have thin threads of mathematics and teachers often have little support to transform these into rich experience for children (National Research Council 2009). As a result, mathematics is often a secondary and less intentional theme in teaching.

It is within this national (and global) context that we tell our story of how local preK teachers are swimming against this rush of assessment to teach in developmentally and culturally responsive ways.

## 2.2 Background

In 2011, a medium-sized school district in the Midwestern United States implemented a public preK program for 4-year-olds (4K) following a national shift toward a preK-12 system. The teachers in this new program included early childhood educators with years of experience teaching preschool and veteran elementary teachers interested in play-based pedagogy. Based on this wide range of expertise and research suggesting that mathematics is a greater predictor of future academic success than early literacy skills (Duncan et al. 2007; Romano et al. 2010), we partnered with the district and designed a professional development program (PD) to provide culturally and developmentally responsive teaching and learning in counting and number.

Working to develop professional learning communities of preK teachers, we created courses that integrated best practices in early education, funds of knowledge, and early number. Teachers met weekly to discuss readings from these three domains and engaged in a series of reflective activities. One of these activities was a child study project that required each teacher to learn about a child in multiple contexts, including the home, over the course of a school year. The goal of this exercise was to support teachers to identify and understand the multiple mathematical resources children access from their families and homes. Teachers conducted home visits, interviewed families, developed instructional plans based on home practices, and regularly observed the focal child to identify mathematical activities as they emerged in play.

Public preK programs are relatively new transitional spaces in early education, a bridge between the private realm of home and child-care and the public realm of official school. Our goal was to support teachers in making preK a gentle launching pad for children to enter the world of school mathematics. To smooth this transition, we worked with teachers to link mathematics content with children's home experiences using play as the primary site for learning. This required teachers to create a play-based environment, make connections to home resources, and mathematise children's everyday activities. These elements formed the foundation for culturally and developmentally responsive early mathematics when teachers used them simultaneously to build on children's experience.

## 2.3 Teachers and Researchers Transitioning to New Reasons for Assessing

One of the transitions we experienced in planning and implementing the PD was a shift in the purpose of assessments. Our conceptualisation of assessment was to communicate with families and plan for instruction, yet new mandates from the lo-

cal district shifted the purpose to performance reporting. We were asking teachers to take a holistic approach to assessments that reached across the boundaries between home and school by learning about children's funds of knowledge and mathematics engagement in play. In contrast, the district was requiring teachers to use the standardised assessment sold for use with the commercial curriculum product, Creative Curriculum Gold, and to complete quarterly progress reports that were used to report to families and to identify children for supplementary education programs. As a result, the teachers felt pressure from the district to provide detailed assessment data using these unaligned tools, and our focus on culturally and developmentally responsive mathematics practices seemed at odds with the district's multi-layered and multi-purposed assessment requirements. The teachers felt as if they were swimming upstream. They were trying to reach the goal of responsive practice but had so many assessments to do they were often diverted.

To complicate matters, our grant advisory board asked us to add an assessment component to document children's learning of counting and number and provide evidence of the PD's efficacy. In response we did number interviews with six children in each teacher's classroom in the fall, and then conducted the same interviews in the spring. We asked the teachers to use a similar assessment with their focal child.

The PD was designed on the assumption that children bring to school a diverse set of resources. Further, culturally and developmentally responsive practices require teachers to draw on these multiple mathematical resources. We define children's multiple mathematical resources as experiences in homes and communities, play experiences that provide natural engagement with mathematics, and children's mathematical thinking (Wager and Delaney 2014). Understanding these elements requires teachers to engage in a variety of assessment practices that provide a more holistic picture of the child and learning so that they can do assessment-informed instruction and communicate with families. These assessment practices extend from working with families to recognising the resources from home (funds of knowledge) to ongoing open observation narratives (learning stories) to conducting skills-based assessments (such as interviews).

*Funds of Knowledge*, defined as "historically accumulated bodies of knowledge and skills essential for household functioning and well-being" (Moll et al. 1992, p. 133), is an anthropologically-based process for recognising the rich knowledge in low-income and minority households (González et al. 2005). Teachers access funds of knowledge through interactions with families during home visits and interviews. Although, not historically described as an assessment tool, the knowledge that teachers gain about the ways children are involved in daily activities can help illuminate the ways that mathematics is central to everyday family practice (Moll et al. 1992). We argue that this process is a form of assessment as it provides information to be used to modify teaching and learning activities. When the evidence is used to inform teaching, it is a kind of *formative assessment* (Black and Wiliam 2001)

*Learning Stories*, a narrative assessment tool, were developed by Margaret Carr and Wendy Lee (Carr 2011), as a way of adapting the oral documentation traditions of Maori people (Dreaver 2004; Reisman 2011). Grounded in trust in children's agency in the learning process, learning stories are narratives that document children's learning within the context of their learning community and the play

environment. More traditional assessment approaches that use checklists based on developmental benchmarks decontextualise children's learning and only represent part of the whole learning process (Reisman 2011). In contrast learning stories are designed to document the teaching-learning process and focus on how the child displays and develops learning dispositions.

*Clinical interviews* are flexible questioning practices that assess children's mathematics knowledge. They were developed by Piaget to understand unanticipated responses and "establish the child's cognitive competence" (Ginsburg 1981, p. 4). Drawing on Piaget, Ginsburg argues that clinical interviews have three possible goals: discovering, identifying, and evaluating. Our initial goal for the clinical interviews was to respond to our advisory board's request for a measure of PD efficacy by measuring growth in children's understanding of early number (evaluating competence). However, they also provided insight into understanding the cognitive activity in which the children were engaged during the interviews. The interviews we designed reflected the mathematics focus of the PD and incorporated selected story problems from the problem-solving interviews developed through the research in Cognitively Guided Instruction (CGI) (Carpenter et al. 1989) and some basic counting skills. In CGI, teachers use interviews to understand how children construct and solve problems as well as typical misconceptions they have. Teachers then use this information to plan instruction.

## 2.4 Methods

Fifteen teachers participated in the PD, but for this story, we are focusing on Birdie, Wanda, and Marley<sup>1</sup> and their respective focal children Tommy, Mikey, and Bernadette. We selected these three teachers and their focal children as representative of various ways in which children's understanding is evidenced. We have drawn on multiple sources of data to explore these children's assessment experiences, including number interviews, teachers' interview narratives, learning stories, and reflections on home visits.

To measure changes in children's knowledge, we developed a protocol to interview six students in each of the 15 teachers' classes in the fall and spring. The same questions were used in the fall and the spring. The eight-question interviews assessed the following skills: rote counting, one-to-one correspondence, counting out, cardinality, comparing two sets, and problem solving of selected problem types (separate result unknown, multiplication, and partitive division). For purposes of this chapter, we are focused on five questions from the protocol (verbal counting, one-one correspondence, and three CGI problem types). Although these problems may seem advanced for 4-year olds, we wanted to understand what was possible rather than only assess what might be expected. The children did not know the interviewers who were members of the research team.

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<sup>1</sup> All names used in this chapter are pseudonyms.

We asked the teachers to conduct similar interviews with their focal child in the fall and provide a narrative reflection of the interview. The form was much like the one developed for the clinical interviews but allowed teachers to modify the problems. Teachers transformed the interviews into learning stories to capture interview observations, what they thought that meant about the child's understanding, and how they would support future learning.

Data also included a learning story that teachers completed in mid-fall to document an observation of their focal child's mathematical interactions during play, and a reflection on a visit to their focal child's home. These reflections documented each teacher's experience during the visit and what she learned about the child's experiences in the home.

We aggregated the data into a table organised by type of mathematical understanding (rote counting, one-one correspondence, etc.) and type of assessment (number interview, teacher reflection on interview, observation of math in play, and reflection on home visit). Two of the authors examined data to identify evidence of children's mathematical understanding across data sources. We then developed narratives articulating where, what, how, and with whom children provided information about their understanding. We then compared the narratives to identify themes and develop case narratives.

## **2.5 What [Do] Assessments Tell Us About Children's Mathematical Knowledge?**

We first present findings from the number interviews of all the students to provide a context for the three cases. We then provide a narrative of each case study child based on our analysis of the data from the interviews and the teachers. The narratives include: (a) background information on the child, school, and family; (b) information about the child's skills with regard to counting and story problems; and (c) a brief summary of the connections between the child, home, school, and assessment.

### **2.5.1 *Number Interviews***

The results from the number interviews are presented to provide evidence of the often unexpected change in responses from fall to spring. Our purpose here is to raise questions about the use of these instruments as evidence of children's mathematical understanding rather than attempt to unearth the reasons for unexpected changes in individual children's responses.

#### **2.5.1.1 *Counting***

The first thing children were asked was to count aloud as high as they could. We assumed that the combination of development and learning would produce a higher

**Table 2.1** How high can you count? Aggregate result

Change from fall to spring	Number of children	Percent (%)
Counted higher	34	65
Counted lower	9	17
No change	9	17

**Table 2.2** One-one correspondence

	Fall		Spring	
<i>Object placement</i>		Random	Linear	Neither
Random	36 (69%)	32	4	–
Linear	7 (13%)	5	–	2
Neither	9 (17%)	3	3	3
Total-spring	–	40 (77%)	7 (13%)	5 (10%)

number in the spring than the fall, yet in comparing the results we discovered that 17% counted lower in the spring and 17% saw no change (see Table 2.1).

To assess one-to-one correspondence we asked children to count the number of checkers randomly arranged on a paper. If their answer was wrong, they were then asked to count the number of checkers arranged in a line. Table 2.2 sets forth the number of students who demonstrated one-to-one correspondence based on object placement (random/linear) in the fall. Results from spring are shown based on students’ fall results. For example, of the seven students able to count using a linear arrangement in fall, two were not able to use either arrangement and five were able to count using a random arrangement.

**2.5.1.2 Story Problems**

We purposefully selected a range of story problems to explore how 4-year olds responded and whether there was a change in their response over the year. We found that students who got the correct answer in the fall sometimes got an incorrect answer in spring, especially for separate result unknown problems. The number of correct and incorrect responses for each problem type in fall and corresponding responses for spring are provided in Table 2.3.

**2.5.2 Children’s Stories**

In this section we provide a narrative of Tommy, Mikey, and Bernadette and compare the information about each child’s mathematics learning available from various sources.

**Table 2.3** Story problems

		Fall	Spring	
Problem type			Correct	Incorrect
Separate result unknown	Correct	18 (36%)	9	9
	Incorrect	32 (64%)	13	19
			22 (44%)	28 (56%)
Multiplication	Correct	19 (38%)	17	2
	Incorrect	31 (62%)	8	23
			25 (50%)	25 (50%)
Partitive division	Correct	7 (15%)	5	2
	Incorrect	40 (85%)	14	26
	—	—	19 (40%)	28 (60%)

### 2.5.2.1 Tommy

Tommy is a 4 year old boy who takes ownership in being 4. He tells me almost daily, ‘My number is 4. I am 4.’ while holding up 4 fingers. (Birdie)

Tommy is a White boy in Birdie’s 4K classroom in a large public elementary school that serves an ethnically and linguistically diverse population of students, 80 % of whom are designated as low income. Tommy lives with his mother and father and a younger brother in a single-family home they rent near the school. Tommy’s family believes it is important to follow routines and to spend time together playing games, exploring the city, and being outdoors.

During a home visit Birdie learned that Tommy’s parents worried that since he often played alone in his room, he wasn’t learning to share his toys and that he displayed some tendencies toward obsessive compulsive disorder. Tommy was very focused on lining things up and would notice when toys were missing. He was such a rule follower that he often worried others were angry with him if he didn’t get things right. Some of the mathematical practices that Birdie noticed in the home included playing games that required counting, comparing numbers, and cooking. His mother shared that Tommy had always been interested in numbers. Birdie wrote in her home visit reflection,

He learned to recognise numbers from magnets on the fridge, a toy wooden clock his grandfather made, and flashcards. Since he was a little over a year old he has liked to line up his toys and cars and count them. ...His mom said he counts everything—toys, stickers, candy, fingers, toes, spokes on bike wheel, etc. His mom thinks part of his interest in counting comes from a show he watches on Nickelodeon called Team Umizoomi which does a lot with counting and shapes.

Birdie observed that during her home visit, Tommy counted the teeth on his toy dinosaur and pieces from a game he played with his dad. Tommy’s enthusiasm for numbers and counting is reflected in Birdie’s interview narrative and learning story.

*Counting* Birdie often noticed Tommy spontaneously counting in class. When she interviewed Tommy she noted,



**Table 2.4** Tommy’s counting

	Number interview	Teacher interview	Classroom observations	Home visit
Counting	23	20	Counts spontaneously; has counted to 39	Counts regularly
One-one correspondence	Random	N/A	Both	

**Table 2.5** Tommy’s story problem interviews

	Research Team	Teacher
Separate Result Unknown	No	Yes
Multiplication	No	Yes
Partitive division	No	No

When asked to rote count he spoke softly and was pointing to something. When I realised he was trying to count the vehicles in the bucket, I hid the bucket and then asked him to count out loud in a loud voice. The second time he was able to rote count to 20 before getting confused. He started saying numbers such as 23, 21, 22, 40, 60, 70, 80, 21, 30–60, 100. However, during other observations I have seen him count as high as 39 correctly.

Although Birdie had witnessed Tommy counting at home and his mother had shared the many things he counts, when she asked him what he counted at home Tommy said, “fire trucks, school buses, and race cars”. Birdie was “unsure if he understood the question about what do you count at home because it sounded like he was just naming off vehicles and possibly trying to recall what was in the bucket of vehicle counters.”

Birdie observed Tommy’s use of cardinality in play and during her interview. When Birdie asked Tommy to count out a set of nine, Tommy was able to count out the correct amount and immediately answer how many were in the set without recounting. Birdie also noted in her learning story that after counting how many friends were at the art table, Tommy counted five and then told her “five” without recounting.

In comparing the results of the data collected in the fall (Table 2.4), we notice when the task is natural and meaningful Tommy is more likely to utilise his number skills.

*Story Problems* When Birdie posed the problems during her interview, she changed the context “to helicopters and landing pads because that is what he was interested in that day.” She had to provide support by modeling how to set up the problems but Birdie found that, “Tommy was able to do the Separate Result Unknown and Multiplication story problems after she showed him how to set up the problems using counters, but he was unable to do the Partitive Division problem.” In Table 2.5 we compare the results of the number interviews conducted by the research team and teacher.

Overall, Tommy demonstrated greater understanding in familiar and meaningful contexts, such as in play and at home. This could be due to any number of things. As Tommy is transitioning to school and school-like assessments it may be that

familiarity with the interviewer, problem context, or approaches to questioning affect the mathematical understanding he demonstrates. Further, his teacher's awareness of his interests and willingness to scaffold him enabled him to feel successful in responding. One thing is evident: a clinical interview alone would have provided a limited window on Tommy's mathematical understanding.

### 2.5.2.2 Mikey

Mikey loves to take things apart and put things back together. His mom told me that he took all the knobs off the door and put them back on. (Wanda)

Mikey is a 4-year-old White boy in Wanda's 4K classroom. Their school is ethnically diverse and 70% of the students are designated as low income. The school is set in a neighborhood with single-family homes and apartments, and is predominately working class. Wanda chose Mikey as her focal child because he frequently offered to help out in the class and Wanda wondered what that reflected about Mikey's experiences at home. Wanda learned that Mikey lived with his mother, father, sister, and cousin. Mikey's mother runs a home daycare so there are often other children in the house during the day for whom Mikey helps to care. Although there was no explicit mention of mathematics, Wanda learned from her home visit that Mikey was a tinkerer and was always exploring things. Mikey's parents described him as a people pleaser who frequently offers to help.

*Counting* Unlike Tommy, Mikey did not seem to randomly count things at home. In her reflection on her interview with him Wanda stated,

When I asked Mikey what he could count at home, he responded with, "I count numbers." I felt like I needed to guide him more with an example. When I asked if he ever counted his toys, he said, "No, I don't know how." After I suggested that he could take one of his bins off his shelf and count how many toys were in it, he gave me other ideas of things he could count in his house.

During his interview with Wanda, Mikey counted to 19. Wanda said she noticed in other contexts that he had the general idea of one-to-one correspondence but during the interview, she had to show him strategies such as moving objects as he counted them. Wanda also observed Mikey's approach to number during puzzle play. The goal was to match the numeral on one piece with the correct set of objects on the other. Mikey, the tinkerer, had another plan.

He sat down across from me and picked up some pieces. "I don't need to count them, I look at the pieces," Mikey says as he grabbed a piece with a number and one with the object pictures. He tried to fit them together without looking at the number or objects on the two pieces. The pieces did not fit together, so he put one down and grabbed another. Mikey did this many times without success. He was obviously not counting the objects pictured on the piece, but was looking to match the two parts together at the edge.

To Mikey the goal of the activity was to match the edges of the puzzle pieces—a skill important for a puzzle-doer—and a component of developing spatial awareness. The assessment task in Wanda's mind was matching numeral to set. To orient him to her task, Wanda suggested that Mikey try counting the pictures, which he did

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