Introduction

My first job interview as a prospective teacher was for a position teaching 3rd grade at a K–5 school. Thinking to highlight the progressive pedagogies I'd learned in college, I talked in great depth about my ideas for including science centers, the arts, and block play in the daily curriculum. After listening for a minute or two, the principal held up his hand to silence me.

"Look," he said. "That all sounds great, and if I was looking for a kindergarten teacher, I'd be interested. But every school has a grade where the fun stops, and here, it's 3rd grade."

At the time, I was outraged, but now, remembering this story after nearly 20 years in early childhood education, I find myself wishing that more principals today shared my interviewer's philosophy. Nowadays, fun doesn't even *start* at many elementary schools, and it certainly doesn't wait until 3rd grade to stop.

In our age of standards, tests, schedules, formal observations, scripted curricula, and checklists, many teachers feel that play is a luxury they cannot afford in their classrooms, particularly in schools that serve historically marginalized students—where testing pressure is often highest.

While doll corners, sand tables, and building blocks used to be common tools in early mathematics education, now even 4-year-olds are increasingly engaged with formal assessments of their academic performance in reading and mathematics (Graue, 2006; Miller & Almon, 2009). As Gullo and Hughes write, "The emphasis has become content-oriented, skill-based instruction and learning that teachers assess using conventional measures. Worksheets and other paper and pencil teacher-made tests have become customary practice for determining what specific skills and knowledge children have acquired" (2011, p. 324). In studies commissioned by the Alliance for Childhood, researchers found that kindergarten teachers in New York and Los Angeles reported spending 2 to 3 hours daily on literacy, mathematics, and test preparation and

less than 30 minutes each day on "choice" activities, and in Los Angeles a quarter of teachers said there was no time at all for play in their classrooms (Miller & Almon, 2009). In addition, many teachers also know that too many of their students are stressed, miserable, and failing to meet the academic expectations set for them.

This book is for teachers caught in the tension between meeting increasingly high expectations for children's mathematical performances and providing children with humane and happy spaces in which to learn and grow. My goal is to provide you with concrete strategies to foster play, recognize mathematics in play, and design formal lessons that build on children's explorations during play.

One misconception that many have is that providing time for play is in opposition to new expectations that even the youngest children reason abstractly and solve mathematical problems. In truth, much more than in typical lessons, play offers students opportunities to solve nonroutine problems, to persevere, and to make connections among mathematical ideas.

Consider the following interaction from a public school preschool classroom that serves predominantly low-income and minority children: During choice time, Cliff and Ivan return to the block corner, where they play 2 to 3 days a week. On this day, they work together to fill a large square Dulpo board with blocks (see Photo 1.1). In the beginning, pieces go on quickly; however, after not too much time, only a few oddly shaped spaces are left open. Ivan, realizing that it will be difficult to fit in any additional blocks on the first level, begins to build upward; however, Cliff stops him, saying: "No, I'm doing something here." Cliff removes Ivan's tower and then chooses a narrow rectangle and rotates it to fill an

Photo 1.1. Cliff and Ivan Work to Fill in a Large Square with Lego Blocks

open space. He then looks up at Ivan, who is watching, and asks if he wants to help. Ivan agrees, and after watching Cliff for another minute, Ivan removes a block along the perimeter and repositions it so he can place a block in the newly enlarged space.

Now, take a moment to think about the following questions:

1. What makes Cliff and Ivan's interaction play? In other words, how was this engagement different from the other sorts of activities in which students routinely engage during school?
2. Where is the mathematics in this play (if any)?
3. Why might it be important for Cliff and Ivan to encounter this mathematics during play rather than only in formal lessons?

The rest of this introduction discusses these questions in some depth before briefly outlining the rest of the book.

WHAT IS PLAY? OR DO YOU KNOW IT WHEN YOU SEE IT?

On the surface, it may seem unnecessary or even ridiculous to spend any time defining *play*; however, in working with classroom teachers and administrators I have found that a surprisingly wide range of activities are claimed as play. For example, all of the following have been described to me as play:

- Using teddy bear graham crackers to make a graph during a lesson
- Playing kickball in PE
- Painting in Art
- Acting out stories as part of Writer's Workshop
- Playing "Go Fish" and other card games in math class

All of the above activities are probably enjoyable for many children, actively engage their minds and bodies, and promote learning; however, none of those activities would be considered play, according to most definitions, because none of the activities were freely chosen by the children involved. Although there is some disagreement about how precisely to define play, almost all researchers agree that an activity must be voluntary in order to be considered play.

For example, Lifter and Bloom write that play "consists of spontaneous, naturally occurring activities with objects that engage attention and interest" (1998, p. 164). Burghardt (2011) offered five criteria for recognizing and defining play in both people and animals. He wrote that play is spontaneous or pleasurable, functional, different from similar serious behaviors, repeated, and initiated in the absence of stress. Again and again, researchers emphasize similar qualities in play, calling it voluntary, pleasurable, and varied.

These definitions highlight an important quality in Cliff and Ivan's interaction that may not have been immediately apparent. It occurred during choice time. In this preschool classroom, students had about 45 minutes each day when they could choose to engage with a variety of materials, including Lego and wooden blocks, art supplies, dolls, puzzles, kitchen toys, and cars. Furthermore, they could choose how long to spend with any material and with whom to work. Unlike fun activities during formal lessons, they had the power to choose the task, the materials, their companions, and the goal.

This opportunity to make choices is critical. In part, Cliff and Ivan persevered to finish a difficult task because it was *their* difficult task. Cliff, in particular, demonstrated a commitment to completing the task that he had set out and not adapting it because it became challenging. In addition, unlike many school tasks, even those that appear pleasurable, Cliff and Ivan's goal was not simply to be done with the task as quickly as they could so they could go on to the next activity set by the teacher. Because their time was their own to spend, they could be fully in the moment with the task. Even when they disagreed about the goal of the activity, Ivan remained engaged, trying to determine Cliff's agenda, and Cliff invited Ivan to play again after correcting him. Neither of them ended the activity as a result of the disagreement or as a result of its increasing difficulty; nor did they call on a teacher to mediate their disagreement.

Other characteristics of play evident in Cliff and Ivan's interaction—but not in many of the activities in the bulleted list—are the repeated nature of the play and the absence of stress. Although, as far as I know, Cliff and Ivan had never before worked together to fill a square mat, both boys had played with blocks many times before the episode described above. By playing with blocks routinely over the course of the year, the boys built competencies with the materials and developed more complicated play scenarios. So, for example, when Cliff set a task

like trying to entirely fill a blank square, he and Ivan could draw on mental images of various sized blocks to successfully complete the task. Similarly, other children began the year by primarily building towers, but by the end of the year would create enclosures and models of other objects, such as cars and airplanes. In his popular book, *The Power of Play*, David Elkind (2007) says that repeated experiences with materials are essential to developing creativity and also to learning perseverance. He argues that when children move rapidly from toy to toy, they do not have the opportunity to explore all the possibilities a material offers or to invent solutions to their own boredom.

With the possible exception of acting out stories during Writing Working, many of the activities in the bulleted list occur only over short periods of time. In PE, the class moves on from kickball to soccer. In Art, the lessons go from painting to sculpting, and in math, graphing and counting lessons are replaced by geometry and measurement. This variation exposes children to many new ideas, but does not allow them to deeply explore all of the possibilities present in a given material. In fact, it is often when children are bored with a frequently used toy that they make a new discovery about how it can be used.

Choice and repetition go hand in hand. When children are allowed to make choices about how to spend their time, not only do they choose activities that they find pleasurable, but they also have opportunities to develop richer understandings over time, provided that the materials are complex enough to support such deep explorations. Similarly, the knowledge that the materials can be returned to again and again removes stress from the situation. Not only is the task at hand not being set or assessed by an adult, but also there is no risk of not getting to finish or not being able to do all that one wants with the materials. Cliff and Ivan can persevere with filling the board today, in part because they know that tomorrow, if they want to build airplanes, they can do that too.

Finally, in addition to considering the qualities that must be present for an interaction to be classified as play, it is also worth considering a few qualities that may be present, but are not essential. For example, the interaction between Cliff and Ivan is an example of social play; however, play can also occur with just one child. In fact, both Cliff and Ivan spent significant amounts of time during their preschool year playing in the block corner independently. This time allowed them to experiment with their own ideas, and also take a break from the continuous social interaction of the busy preschool classroom.

Some people might assume that only interactions that do not involve adults can be considered play; however, this is also not the case. Although in play, children must be free to make choices about what they do and how they do it, adults can participate in a playful manner. That is, by following children's leads rather than by dictating terms. In fact, in Ivan and Cliff's classroom, the teaching assistant in particular was frequently drawn in to play by the children, who would ask her to take on roles in make-believe scenarios or to contribute to a structure they were creating. In fact, adults can make children's play deeper and more meaningful if they intervene carefully. For example, one study found that when adults talked to children about their block structures, children built more complex structures (Gregory, Kim, & Whiren, 2003).

Cliff and Ivan's play provides an example of one kind of play, often called construction play, which supports the learning of mathematics. However, there are many other types of play as well, including pretend play, rough-and-tumble play, rule-based play, and play with the arts (Burghardt, 2011). All of these kinds of play provide some sort of benefit to children in their growth and development.

WHERE'S THE MATH?

Hopefully, you are now convinced that Cliff and Ivan's interaction was different in important ways from other enjoyable experiences that occurred in school, but you may still be wondering about the relationship of their play to the learning of mathematics. After all, neither boy used any mathematical vocabulary in their time together. They did not identify shapes or count—two common mathematical expectations for young children in mathematics. They did not even sort the blocks by shape or color.

Even so, important mathematical learning happens during block play. Broadly, recent research has demonstrated that complex block play in the early years can positively impact spatial reasoning on standardized tests years later (Wolfgang, Stannard, & Jones, 2003). More particularly, we can see direct connections between play like Ivan and Cliff's and the mathematics children are expected to learn in the new Common Core State Standards (National Governors Association Center for Best Practices, 2010).

These new K–12 standards, which currently have been adopted by nearly all U.S. states, name both content and practices that children

must learn. The mathematical practices, which are the same in all grades and shown in Figure 1.1, are both habits and ways of thinking necessary to being successful in mathematics. Play can be an important context for children to develop these ways of thinking. For example, when Cliff rejected Ivan's tower, he modeled persevering to solve a problem and as a result Ivan re-engaged with a challenging task. Together, they were able to successfully fill the square and therefore learn that even if a task seems difficult, it can be completed.

The task of fitting in blocks to fill exactly a given space also encouraged the boys to attend to precision. As they worked together to ensure that all of the board was filled and that none of the small pieces hung over the edges, they had to think about which blocks would fit perfectly. Although play, this was not a task where close enough was good enough.

Similarly, the boys had to use their available tools strategically. For example, when Ivan removed a block to create a larger hole, he had to think about the sizes of the available blocks and create a space where one would fit exactly. Early on, when the boys simply snapped blocks onto the board, no strategic thinking was involved. However, as the task neared completion more and more planning was required, along with comparison between the spaces that needed to be filled and the available blocks.

Like this task, play settings often provide children with far more genuine opportunities to engage in these mathematical practices than in formal lessons. Because in lessons, teachers have clear goals about what they want students to do and understand, they are able to nudge students in subtle and obvious ways to complete the task. ("Ivan, why don't you see if you can make the smaller rectangle fit?") In providing these

Figure 1.1. Common Core State Standards for Mathematical Practice

MP1: Make sense of problems and persevere in solving them.

MP2: Reason abstractly and quantitatively.

MP3: Construct viable arguments and critique the reasoning of others.

MP4: Model with mathematics.

MP5: Use appropriate tools strategically.

MP6: Attend to precision.

MP7: Look for and make use of structure.

MP8: Look for and express regularity in repeated reasoning.

hints, teachers often take over a good deal of the mathematical reasoning, while also cutting down on children's opportunities to persevere on their own. Because teachers are (legitimately) concerned with classroom management during formal lessons, they frequently do not want to allow students to become bored and thus to experiment to find their way out of a problem. Play provides a space where children can take lots of time to engage in mathematical practices, without teachers becoming anxious about their ability to stay on task or to complete an assignment at roughly the same time as others.

In addition to opportunities to engage with the mathematical practices, play like Cliff and Ivan's block task also provides opportunities to engage with particular mathematical content. For the primary grades, the new Common Core State Standards emphasize number and operations, but also include standards for geometry, measurement, data, and algebraic reasoning.

Cliff and Ivan's block play most closely relates to standards in geometry. In kindergarten, children will be expected to "describe their physical world using geometric ideas (e.g., shape, orientation, spatial relations) and vocabulary" and "use basic shapes and spatial reasoning to model objects in their environment and to construct more complex shapes" (www.corestandards.org, p. 9).

Cliff and Ivan's play required that they notice and work with the properties of particular shapes (in this case, rectangular prisms). They needed to note which ones were longer or shorter, wider and skinnier. In addition they needed to recognize when rotating a block was necessary to fill a space. These experiences will provide a rich knowledge base later as Cliff and Ivan work with representations of 2-D and 3-D shapes on the printed page and as they solve problems involving rotation and orientation.

More broadly, Cliff and Ivan's play allowed them both opportunities to develop symbolic thinking, which is vital for future work in mathematics (Vygotsky, 1962; Piaget, 1962). Activities like building with blocks, emptying containers, and representing the world through artistic representations allow children to develop ideas related to quantity, comparison, and composition and decomposition of shapes (Lakoff & Núñez, 2000). In addition, the pleasure children find in these play activities is a critical motivator in inspiring children to engage in the work needed to move from one developmental level to the next. As children become tired of a particular kind of play (often as a result of becoming

skillful), their desire for new experiences inspires them to engage in more demanding play (Vygotsky, 1962). Adults can support children in deepening the quality of their play.

From this perspective, the role of adults in deepening and extending play is quite important. Although Cliff and Ivan's work provides an important context for developing mathematical ways of thinking and content knowledge, it is important to recognize that this sort of play is not the same as learning mathematics content. In other words, Cliff and Ivan will need to learn to put words to their experiences with the blocks and to generalize beyond the particular task. The learning of both mathematical vocabulary and of creating abstractions (big ideas) from particular experiences is an important role played by formal mathematics lessons. To elaborate, Cliff and Ivan will need to learn, among other things, that a block is called a rectangular prism, that it shares particular features with other rectangular prisms in the world (8 corners, 6 faces, etc.), and that 3-D figures, such as rectangular prisms, can be represented in 2-D on the printed page (but should still call to mind the actual 3-D figure).

We make a mistake if we assume that by playing with toys like blocks, Cliff and Ivan will learn these things automatically. However, we also make a mistake if we do not give Cliff and Ivan the opportunity to develop rich experience bases on their own before intervening as teachers. This is the challenge addressed throughout the rest of this book—figuring out how to provide ample time and productive materials for children to engage in open, exploratory play *and* how to design formal lessons that fully take advantage of the mathematics children have already uncovered during their play.

The following chapter provides strategies for recognizing and drawing on the mathematical play in which children engage outside of the classroom, while Chapter 3 offers ideas for organizing time and space in the classroom for productive play.

Chapters 4 through 7 make connections between the mathematics described in the new Common Core State Standards and common play contexts in early childhood classrooms. The final two chapters before the conclusion look at ways that formal lessons and assessments can be designed to build on children's experiences during play.