"See, Two Yellows Make a Rectangle!": Constructing Meaningful, Emergent Learning Moments in a Structured Special Education Program

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in a Structured Special Education Program

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Submitted in partial fulfillment of the requirements of the degree of
Master of Science in Education
Bank Street College
2017
Abstract

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This paper explores the relationship between emergent, child-driven learning and the structured curricula of a special education program. Relying on current research and theory as driving forces, the author designed and implemented a series of math lessons with a small group of kindergarten students in a self-contained, special-education setting. The paper begins in narrative form, detailing the author’s journey to her current line of inquiry. Empirical research and educational theory about both emergent, child-driven learning and math instruction are then summarized. The following two chapters chronicle the author’s work with her students. These chapters are presented as both narrative documentation and retrospective reflection. Finally, the author synthesizes her year’s work. Stemming from the research and these teaching experiences, the author draws several conclusions about the inherent value of emergent learning, the relevance of structured, content-driven curricula, and—of paramount significance—the vital and unparalleled role of the teacher as the creator and facilitator of meaningful learning experiences. The paper concludes with a statement on progressive education and the role of current early childhood special educators.
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This paper details my work, as a practitioner and as a researcher, investigating the ways in which young children comprehend mathematical concepts. In the following paper, I examine the relationship between a Reggio-inspired form of teaching and the prescribed curricula of a special education program. I began with the question: how do I balance emergent learning with the structure that is required in special education?

In the first chapter I narrate my journey as a teacher. I examine the ways in which my experiences in a Reggio-inspired general-education program and as a special educator in an independent special-education school have shaped my beliefs about teaching. I explore the structural differences between these programs, their philosophies, and my teaching practices within each. Further, I examine the ways in which these two experiences drove and changed my beliefs and my practice as a teacher.

In the second chapter I examine the research. I provide empirical support for emergent, child-centered curricula in early childhood settings. Additionally, I look at research about math instruction. I summarize a body of work that points to the importance of child-initiated mathematical learning, as well as to the value of quality math materials. Of utmost importance, I look at research that suggests that it is the role of the teacher—and not the curriculum itself—that defines quality math instruction.

Using the research as a guide, I embarked on a year of exploration. Over the course of my year’s study I developed, implemented, assessed, and reflected on a series of math lessons and explorations, conducted with a small group of kindergarten students.
In the third and fourth chapters I narrate, describe and reflect on these teaching experiences. Through my concentrated and closely documented explorations with these children, I came to a deeper understanding of the ways in which these children formed their mathematical knowledge, and the ways in which I could support their learning.

In the final chapter I synthesize my findings and reflect on my teaching practice at present. From these experiences I aimed to find a balance between the seemingly very different ideologies of emergent learning and a structured special education program. In seeking to find this balance I discovered that they can—and should—exist simultaneously. I rediscovered the importance of embedded, contextual, and child-driven learning, while also reaffirming the value of explicit, structured teaching in a special education setting. Ultimately I conclude that the fundamental core of teaching is found, not in the curriculum, method, or materials, but in the flexibility and creativity of the teacher; in the teacher’s understanding of child development, children’s thinking, and his/her keen observation of individual children’s strengths and needs.
Chapter 1

From Reggio to Special Education

This chapter tells the story of my teaching experiences. It travels from the emergent and project-based explorations of a Reggio-inspired classroom, to my current practice as a kindergarten special education teacher. I examine the path that led me to my current research question: how do I balance emergent learning with the structure that is required in special education?

Upon a move back to New York City several years ago, I found myself, somewhat inadvertently, teaching kindergarten at a school for children with language-based learning disabilities. Prior to the move I had been teaching pre-kindergarten at a Reggio-inspired preschool in Washington, DC. In my several years in DC, my understanding of education grew exponentially, though the growth was often upstream. At first I doubted and rejected this notion of “Reggio,” and emergent, child-driven curricula. Having previously been an assistant at a lovely, but rather traditional preschool program, in which the teachers pre-planned each and every activity a month in advance, “child-driven” seemed synonymous with “unprepared.” Wasn’t it the job, after all, of teachers to dictate learning? Wasn’t that my purpose in the classroom? To design, implement, and control the learning process of my students?

Over the course of my time in DC I came to understand, respect, and embrace “Reggio.” What ultimately reversed my initial disdain was the recognition, which came to me over time, that Reggio is not a method, but a philosophy. Developed by Loris
Malaguzzi in Italy after World War II, this philosophy is built on the tenet that children possess “one hundred languages” (Malaguzzi, n.d.). In his descriptive poem Malaguzzi articulates the foundation of the Reggio perspective, one in which children are strong, unique, and capable of self-expression:

The child has

a hundred languages

a hundred hands

a hundred thoughts

a hundred ways of thinking

of playing, of speaking.

Inherent in this ideology is the belief that, “the cornerstone of our experience, based on practice, theory, and research, is the image of the child as rich, strong, and powerful … [Children] have potential, plasticity, the desire to grow, curiosity, the ability to be amazed, and the desire to relate to other people and to communicate” (Rinaldi, as cited in Malaguzzi, 1993). Within this framework it was no longer my job to control my students’ learning, but rather to excite, engage, and enhance the learning process. In lieu of monthly lesson plans and prescribed activities, I could provide provocations in the form of a story, a material, or a question. As the teacher, I provoked, guided, responded to, and scaffolded learning experiences, but the children’s interests and curiosities drove the explorations. Their excitement provided the motivation to learn, while I provided the structure for those learning moments to occur.

Of the many extended explorations that our pre-K class undertook in DC, perhaps my favorite was our calendar curriculum. Fascinated by birthdays, holidays, and
countdowns, our Morning Meetings often diverged from the planned routines, and instead wound their way through discussions of months, days, and years. We ripped apart store-bought calendars, pinned twelve months up on the classroom walls, counted all 365 days as a class, and plotted our birthdays. In the art center, students started drawing, painting, and collaging calendars of their own. We embarked on a class project of designing our own Morning Meeting calendar, with days and months spelled inventively, numbered cards handwritten, and illustrations to depict holidays, events, and weather for each month. It was an experience that showed me how a simple curricular topic—calendars—could foster deep and extended learning. The students’ interest drove them to sound out words, count to higher numbers than they had ever done so before, and to engage and cooperate with one another. Their motivation was the driving force behind so much growth, both as individual learners, and as a classroom community. In this experience I observed the Reggio philosophy at work, and I recognized the great potential of a teaching practice that invited and celebrated children’s curiosity.

And then, three years ago, I found myself plummeted into the vastly different educational world of a self-contained, special education classroom, in a well-resourced independent school, with its own set of expectations, methods, and rules. In my first days in my new position, before the children even entered the classroom, I found myself confused, unconfident, and at times dejected. When my co-teacher asked me to set up the Morning Meeting section of the classroom and I pulled out the pre-packed, plastic calendar straight from Lakeshore Learning, I recoiled. I saw this as an opportunity to bring some of my background into this new classroom of mine, and I excitedly suggested
to my co-teacher that we have the kids make their own calendar. She looked at me and said, “Our students can’t do that.”

In my first weeks at this new school I saw Reggio—and progressive education in general—as diametrically opposed to special education. I heard the phrase, “our students can’t do that” as the epitome of a deficit model, one that did not see students—learning-disabled or not—as “rich, strong, and powerful.” The highly structured curricula of the Orton-Gillingham reading, Judy Hochman writing, and Saxon mathematics programs felt suffocating and void of creativity. Where was “the ability to be amazed, and the desire to relate to other people” in such a methodized form of teaching?

After several months, however, I began to recognize the value and purpose of the curricular decisions being made on behalf of these children whose learning disabilities had brought them to this specialized setting. My Reggio-inspired activities often fell flat. I learned quickly that the materials, provocations, and methods by which I had previously taught would not be received in the same way in this new setting. Whereas my former student quickly and effortlessly made the connection between the /j/ sound of his name Jonah and the /j/ sound of the month January, the students at my new school were there precisely because they could not generalize in that way. My old teaching methods weren’t sufficient to meet the needs of my new students.

In response to this newfound understanding I threw myself into the structured reading, writing, and math curricula. I read through the manuals, internalized the language, and enacted lessons as they were outlined. I quickly saw evidence of the value of a program like Orton Gillingham when a student, struggling to think of the letter associated with the /c/ sound—in spite of the fact that his own name began with this
sound and letter—scrunch up his face, then suddenly reached out in front of him to “skywrite” the letter’s shape, then transferred this graphomotor pattern to the paper in front of him. Incredible!

But this, too, felt inadequate. Though skywriting and daily dictation were visibly beneficial to these students’ technical reading and writing development, I left each day’s reading, writing, and math lessons feeling uninspired and uninspiring. I missed the creativity and open-endedness of an emergent curriculum, in which lessons could twist and turn and morph into something entirely new and unanticipated. I missed the excitement of students when their own ideas and comments spurred explorations and unplanned activities. I felt that there could—and should—be space for this sort of learning in a special education setting.

But I struggled—really struggled—to find a balance. I could not understand how to integrate the tenets of Reggio that felt so meaningful, and I left each lesson feeling that I had either succeeded in child-driven learning or in implementing the structured curriculum of special education. Rarely did I feel I had achieved both simultaneously.

The start of my second year at this school coincided with my final semester of conference group at Bank Street. I identified immediately the focus of my semester’s work: the balance between emergent, Reggio-inspired learning and special education. I drew up lesson plans, seeking ways to blend creative learning with the grounded structure of a special education program. In the process, I discovered ways of uniting a phonemically focused reading curriculum with an imaginative and fun shared literacy experience. I experimented with the limits of open-ended learning when my reading group delved into a month’s long exploration of *The Gingerbread Man*. As the
culminating activity, my six students and I acted out our favorite version of the story, in an experience that I felt combined the structure and predictability that these students needed, with a creativity, open-endedness, and unpredictability of a truly child-driven learning moment. For one student in particular, this experience seemed to enliven in him a confidence and social connection that we had not observed earlier. He spoke of this activity for the remainder of the year, and today, over a year and a half later, “Foxy,” a name given to him during his portrayal of the fox character, remains his nickname.

The most challenging moments of that semester came when I attempted to find this balance in the math curriculum. Our school used a self-described “bad” math curriculum, Saxon, that was universally disliked amongst the teaching staff. Though its merits seemed few and far between, the administration required us to follow, at least to some extent, its structure and language. There was recognition that the math curriculum needed an overhaul, but for that year, Saxon was the plan, and for the sake of Committee on Special Education (CSE) reporting, deviations from the curriculum needed to be tempered. Unlike my experiences of infusing emergent learning into the reading curriculum—a curriculum that quickly exposed its value—I struggled to find an entry-point in the Saxon math program. The spiraling curriculum introduced new concepts in unimaginative ways, moved on to an entirely different topic, then spiraled back to the first topic weeks or months later. Though it was intended as a whole learning approach to math instruction, in practice—particularly with students with language-based learning disabilities—the outcome was an unfocused, surface-level learning that seemed inaccessible to many of the children. Within the first months of school, the kindergarten curriculum turned to skip counting. For a group of students with language delays, one of
whom had not yet developed one-to-one correspondence, the concept of “skip counting” was developmentally inappropriate. Though two of the students in the group were able to memorize the rote sequence of counting by tens, there was little to no conceptual understanding within those recited numbers.

One afternoon, at the end of math group, a student commented on the absence of one of our group members, but misstated how many people remained in the classroom. To help this student visualize the number of group members, I quickly drew a stick figure of each group member on the board (Figure 1). Immediately, the whole group—and then my co-teacher’s math group, as well—became interested in counting how many people we were all together. Then one student asked how many pairs of pants we all had on. Then how many shirts, shoes, and fingers! I had found my entry-point.

Over the next several weeks we explored our bodies, those familiar places where so many numbers could be found. We put stickers on our ten fingers, tapped our two legs, two arms, two hands and two feet, and created collages of our bodies. In the process, the children naturally recognized patterns, and this paved the way for a contextualized and meaningful reason to count by tens. After all, wasn’t it faster to figure out how many fingers we had altogether by simply pointing to each person and saying, “10, 20, 30, 40, 50!” rather than counting by ones? How many legs do we have altogether? Let’s count by twos!
This exploration and others felt like small, but important successes. With every lesson and reflection I felt I had figured out another small piece of the puzzle, each time discovering a bit more about how to combine child-driven learning with the structure of the curriculum. But, while I ended my semester feeling confident that I had grown as a teacher, I certainly didn’t feel finished. Though I felt I had made headway in answering my overarching question - *how do I balance emergent learning with the structure of special education* - the process didn’t feel nearly complete. Math instruction in particular, still felt daunting and confusing.
As I geared up to begin my Independent Study, I knew I wanted to further my exploration and examination of this balance between emergent and structured, between Reggio and special education. I sought to further explore the question, *How can I provide meaningful, emergent learning opportunities, while also integrating the structure that my students need and respecting, valuing, and conforming to the learning environment of my school?* As I landed quite naturally and easily on this topic, my school concurrently announced that in the new school year they would be doing away with the Saxon math program. In its place would be a version of Singapore Math. As a new program to everyone within the school, the administration explained that it would be a transitional year, in which we would be expected to follow the scope and sequence of the new curriculum quite closely. However, they said, we should also be prepared to improvise, to be creative, and to modify as needed for our students. I couldn’t have asked for a more perfect scenario in which to continue my own exploration.

And thus began my yearlong adventure into math. As the year progressed and I came to learn and understand this new curriculum, I recognized its inherent strengths, as well as some of its weaknesses. And throughout the process of implementing a new curriculum, I injected my own lessons, activities, and provocations. I was as much a math student as my students were.

Looking at the new curriculum and thinking about how to best explore my underlying question, I decided upon two distinct approaches. To begin, I would design and implement a series of explorations and lessons around a specific manipulative, as research has shown that repeated exposure to quality math materials supports learning (Mustafa al-Abi and Nofal, 2010; Parks, 2015; Ross, 2005). At the start of the year, the
elementary school hosted an in-house professional development, utilizing the knowledge and brainpower of an upper school math teacher. This teacher conducted an exciting and inspiring workshop on developing number sense in the early grades. His favorite math material? Cuisenaire Rods. These brightly colored wooden rods range in size from a one unit to a ten unit, and can be used in nearly all aspects of early math education: counting, sorting, comparing, adding, subtracting, fractions. Having never used these in math instruction before, it seemed the perfect manipulative to use in my upcoming lessons, as I would truly be exploring the material along with my students. The material would be the provocation and would provide an entry point for exploring various math topics within the structured curriculum. In the second semester, I would work from the opposite angle. Rather than beginning with a material and fitting it into the curriculum, I would start with the mandated curriculum—a unit on geometry—and build a series of provocations around it.

As the year—and my students—progressed, and as I came to know them better, their learning challenges became more pronounced and more varied. Whereas the four students in my small math group initially tested at the same level of math instruction, by mid-year the variation was great, as were their needs. Two of the students in the group, Eva and Oli (*all student names are pseudonyms), consistently demonstrated strong math skills overall, and their struggles were primarily attentional and language-based. Oli exhibited extraordinary visual-spatial skills, an ability that would come to impact and drive our group discussions and explorations on more than one occasion. One student, Isaiah, was quick to internalize facts, vocabulary, and rote skills, but struggled greatly with the conceptual side of math. He had difficulty recognizing patterns and he often
perplexed me with the way he interpreted visual information. The fourth student, Oscar, exhibited an inconsistency like no other student I have ever worked with. At times he seemed to understand and internalize concepts and skills with speed and ease, while at others he seemed entirely at a loss when completing an activity he had done dozens of times before.

I recognize now that what my co-teacher meant when she said, “our students can’t do that,” was not, “they are incapable.” Rather, she recognized that the way I was approaching it—the way I had approached it with my class of typically developing pre-kindergarteners—simply wouldn’t succeed with my new population of students. In time I would understand what she meant and, more importantly, I would begin to discover that there was a place for the emergent creativity of a “Reggio” philosophy in a special education setting. I would also discover that the balance between these two was ever-changing, ever-moving, and ever-complex.

In the following chapters, I describe these two extended explorations—Cuisenaire Rods and geometry. I detail the progression of lessons, incorporate quotes that drove or derailed a line of inquiry, and consider the strengths and weaknesses of the work that the students and I did. Along the way, I made some surprising connections and conclusions. While I find myself in a very different mindset after this year of math exploration, in some ways I think I returned to place I was years ago. I rediscovered the value of embedded and contextual learning, and rethought the invaluable role of the teacher. This was a year of exploration, reflection, unexpected simplicity, and surprising complexity.
Chapter 2

What the Research Tells Us About Emergent Learning and Math

For this paper I delve deeply into two research topics. First, I examine what empirical studies have shown us about emergent, child-driven curricula in early childhood settings. Second, I look at the research about math instruction, examining the role of curricula, materials, and teachers.

Research about Emergent, Child-Driven Learning

Much writing has been devoted to the topic of play-based curricula in early childhood settings. Burghardt (2011) defines play as child-initiated activity that is both spontaneous and functional. The work of emergent curricula, such as that which Reggio strives for, can fall into this categorization, as project-based and child-driven explorations are both unplanned and purposeful. A core tenet of NAEYC’s position statement states that play gives children the opportunity to “understand and make sense of their world, interact with others, express and control emotions, develop their symbolic and problem-solving abilities, and practice emerging skills” (Copple and Bredekamp, 2009, p. 14). A host of research studies have espoused the connection between open-ended play experiences and social and emotional development. Elias and Berk (2002) found a positive correlation between self-regulation and complex socio-dramatic play. Diamond, Barnett, Thomas, and Munro (2007) found that the Tools of the Mind curriculum, which integrates scaffolded dramatic play experiences in early childhood settings, improved executive functioning in preschool students. Bergen (2002) summarizes numerous studies, stating, “there is growing evidence to suggest that high-quality pretend play is an important
facilitator of perspective taking and later abstract thought, that it may facilitate higher-level cognition, and that there are clear links between pretend play and social and linguistic competence” (p. 2). As Barbara Biber described in her 1951 paper *Play as a Growth Experience*, “(Play) is the child’s chance to lay plans, to judge what is best, to create the sequence of events. Dramatic play is one of the basic ways in which children can try out their talents for structuring life.”

Research also points, however, to the integral role of the teacher in these experiences. For example, Meacham, Vukelich, Han, and Buell (2016) noted significant variation in the responsiveness of teachers during dramatic play experiences. Their research points to the importance of teacher education and planning in fostering quality teacher-child interactions within such open-ended play experiences. As Biber (1951) explains, “If free play is to yield these values in terms of children’s growth needs, it requires a skilled guiding hand.” She continues, “Sometimes the teacher needs to be ready to guide the play … Her guidance may be in terms of her choice of stories, materials, trips, experiences. It may function through discussions. Without skillful guidance, a free play program … can become stultified.”

Despite research about the benefits of child-centered and play-based programs, American education is increasingly driven by content standards and formal assessments. With the introduction of initiatives like No Child Left Behind and Race to the Top, early childhood classrooms are ever-more academic, and play is often the first thing left behind (Christakis, 2013). In a large-scale, longitudinal study of 2,500 public school teachers, Bassok, Latham, and Rorem (2016) found striking results. Across all areas in question, teachers reported higher expectations for the academic abilities of their kindergarten
students today than they did twelve years prior. For example, in 1998, 31% of teachers felt that students should learn to read as kindergarteners. That percentage increased to 80% by 2010. While time devoted to academic subjects and direct teaching has increased, the authors found a substantial decrease in the amount of time dedicated to art, music, and science in kindergarten classrooms. Similarly, the teachers polled in 2010 were significantly less likely to incorporate centers such as dramatic play and sensory tables into their classrooms. Overall, significant increases were noted in teacher-directed instruction, while child-driven activities had decreased.

Given this stark shift in early childhood programming and the increasing emphasis on academic skills, one would suspect evidence to support such changes. However, the research has suggested quite the opposite, pointing instead to the academic benefits of play-based and child-initiated learning. For example, children engaging in dramatic play speak with longer and more complex language than they do during other activities (Cohen & Uhry, 2007). These effects are observable in special education settings, as well, where researchers have found that children with various developmental delays speak more frequently and with greater syntactic complexity during play (Trawick-Smith, 2009). For example, in a study of language use in social interactions, dyads composed of typically developing children, those with language delays, or a combination, all demonstrated greater conversational success when engaging in dramatic play (DeKroon, 2002).

The positive impacts of child-centered programs aren’t limited to the early childhood years. Research has suggested that the effects of quality, child-centered programs persist into later childhood. For example, in an experimental study in which
kindergarteners were randomly assigned to academic or child-centered preschool programs, Marcon (2002) found lasting impacts of preschool placement on later academic success. Children who had been enrolled in the child-initiated programs earned significantly higher grades in fourth grade than did their peers who had been enrolled in academic-directed programs. Similarly, block building in early childhood has been shown to correlate with higher mathematical performance in high school and on the SATs (Wolfgang, Standard & Jones, 2001).

Given the research in support of child-driven early childhood programs, and the reality of an increasingly standards-driven educational system, finding the balance between the two is paramount. Specifically, research has suggested that many children—perhaps as high as 48%—struggle in the transition from pre-kindergarten to kindergarten, and in light of the shifting expectations held by kindergarten teachers, this is not surprising (Baldwin, Adams, and Kelly, 2009; Bassok, Latham, and Rorem, 2016). One such program that seeks to find this balance between emergent, child-driven curricula and kindergarten academic preparedness is the ACCESS Curriculum Framework. Baldwin, Adams, and Kelly (2009) documented the implementation of this program at a demonstration school. They concluded that the program’s tenets—careful planning, observation, and data collection, paired with reflection and response to individual students’ mastery of content standards—are integral components of a successful curriculum. However, they also discuss the importance of both emergent learning and teacher influence. They argue that, while students’ interests and curiosities should drive curricular topics, it is the responsibility of the teacher to decide which topics are worthy of investigation.
Research About Math Instruction

Given the body of work supporting play-based and child-initiated learning, what does the research tell us about mathematics instruction, in particular? The research supports the notion that effective models of math instruction employ a constructivist method (Clements and Battista, 2009). “Knowledge is actively created or invented by the child, not passively received from the environment” (p. 6). Thus, it can be argued that “the constructivist teacher, by offering appropriate tasks and opportunities for dialogue, guides the focus of students’ attention and unobtrusively directs their learning” (p. 7). Ginsburg, Inoue, and Seo (1999) determined in a case study of a preschool classroom that 42% of the children’s play activities involved some form of mathematical experience. Thus emerges the relationship between natural exploration of math concepts, the importance of open-ended play in early childhood, and the role of teachers in constructing meaningful learning opportunities. For example, in a case study of preschool students’ experiences of math in child-initiated episodes, Fox (2005) described several instances in which patterning arose naturally in the context of play. Importantly, however, the author noted the impact of teacher involvement. In one scenario, two children creating patterns at an easel were provided virtually no teacher feedback, and the experience ended after a few moments. Conversely, in a second scenario the teacher interjected to question and extend the conversation about patterns. By the end of the exchange, three additional students had joined in the experience.

An additional body of research into math instruction points to the importance of mathematical manipulatives, materials that allow students to experience and learn math concepts through hands-on manipulation. Parks (2015) writes, “repeated experiences with
materials are essential to developing creativity and also to learning perseverance” (p. 7). She continues, “By playing with (a material) routinely over the course of the year, [children] build competencies with the materials and develop more complicated play scenarios” (p. 6). Seefeldt and Wasik (2006) suggest that teachers provide students with ample opportunities to explore manipulatives without preset objectives, as this allows children to explore questions and problems of their own. Studies have suggested that use of manipulatives increases both student engagement and student performance (Ross, 2005; Mustafa al-Absi and Nofal, 2010).

However, it is not merely the presence of materials, however well designed, that is solely important. Marilyn Burns (2000) describes the role of the teacher in meaningfully and successfully implementing manipulatives into math instruction. She explains the progressive use of manipulatives, from open-ended, free exploration, to discussion and documentation by the teacher, to planned and directed lessons targeting a specific concept or goal. Similarly, in a review of 87 studies of math programs, only slight differences emerged between the effectiveness of various curricula and textbooks (Slavin and Lake, 2007). However, what did impact students’ success were programs that targeted teachers’ instructional behaviors, suggesting that teaching practices are perhaps more relevant and impactful than differences in curricular content. Models that focused on cooperative learning and individualization were particularly effective.

Perhaps the most significant takeaway from the research into both emergent curricula and math instruction is the vital role of the teacher. Providing opportunities for dramatic play
is insufficient; the teacher must scaffold and guide those interactions (Meacham, Vukelich, Han, and Buell, 2016; Biber, 1951). Recognizing mathematical moments in children’s play is not enough; the teacher must respond and expand on these experiences (Fox, 2005). Changing a math curriculum is not adequate; the teacher must plan, assess, and respond to her individual students’ needs (Slavin and Lake, 2007). In special education in particular, in which differentiation, flexibility, and responsive teaching are especially pivotal, the role of the teacher cannot be overstated (Hocutt, 1996).

**Bringing the Research into Practice**

Given this body of research, I embarked on my year of math instruction with several key findings in mind. 1) Open-ended, child-driven experiences are valuable in a plethora of ways, from encouraging complex speech to supporting the discovery of mathematical concepts. 2) Math manipulatives are an integral and important player in the development of math skills. 3) The role of the teacher in planning, observing, documenting, reflecting, and responding cannot be underestimated. These ideas, stemming from both empirical research and theory, guided my thinking and my reflecting throughout this yearlong process. This research both drives my practice and bolsters my conclusions.
Chapter 3

Exploring a Material: Cuisenaire Rods

In the following chapter I describe the sequence of Cuisenaire Rod lessons that I developed and experimented with in my classroom. It is organized chronologically to map the progression of the activities and discussions. Italicized sections are in the form of journal entries. Written from notes and documentation from the time of the lesson, they narrate my teaching process and practice. Non-italicized portions are my personal reflections on these lessons.

Over the course of three months, Cuisenaire Rods became a staple of our math group, and from watching, documenting, and planning accordingly, I was able to weave this simple math material into numerous topics, units, and explorations. As the weeks progressed, it became apparent that this manipulative, paired with careful documentation, assessment, and responsive teaching, supported the students’ learning in a variety of ways.

Early November

*I begin with open exploration of this new material. I head out to the table in the hallway a few minutes before math begins to set up. At each of the four seats I lay out a bowl with an assortment of Cuisenaire Rods, making sure each student has several of each color. When math group begins, I invite the kids to explore. “Can we build?” one asks. Sure. Eva and Oli immediately dive in, working quickly, but with deep focus and clear intention. Oli sorts his by color, taking great care to arrange each grouping as a perfectly aligned rectangular prism (Figure 2). Isaiah, who has up to this point only*
poked at a few of the rods, watches Oli intently. He then begins sorting his collection in a similar fashion, organizing his by color, as well (Figure 3). My attention is then drawn to Eva, who immediately sets to work creating a staircase (Figure 4). I recognize the multitude of conceptual understandings that she is demonstrating in this simple effort—quantity, size, comparison. Oscar, who instantly dumped his entire pile of Cuisenaire Rods out onto the table’s surface, is spending this time building structures upwards. As his small, rickety structures fall over, he takes to piling. His fine motor challenges appear to be impeding his building, and I see frustration start to set in. Ever the retrospective optimist, Oscar declares during cleanup several minutes later, “I love these sticks!”

Figure 2. Oli sorts Cuisenaire Rods by color.
Figure 3. Isaiah mimics Oli, sorting his rods by color, as well.

Figure 4. Eva creates a staircase.
Mid-November

After several days of open-exploration, the students seem to be approaching the material in similar ways each day - sorting, staircases, towers. Their spontaneity with the material has dropped off, so I use this opportunity to begin incorporating this now familiar manipulative into aspects of the Singapore math curriculum. At this point, we are working on a unit on quantity and comparison. It is here in the curriculum that I begin to discover its weaknesses for this particular population of students. The lessons, when followed as directed, are often verbose and vocabulary-heavy. Though Eva demonstrated her innate understanding of comparative sizes when she effortlessly made a staircase of Cuisenaire rods, the language-dense lessons are incomprehensible for this language-delayed student. When I utilize the over-sized instruction book, with its visually overwhelming illustrations and lengthy poems, the kids are distracted by the goofy pictures and are unable to repeat even small chunks of the rhyming phrases that seek to teach them many words all at once: tallest, biggest, shortest, smallest, longer, shorter, same, different. Looking at one illustration of brightly colored animals of various sizes, I ask Eva, “Which one is the tallest?” Her eyes are wide as she looks at the picture; “Uhh, this one?” she says pointing to the shortest animal on the page.

Before the next series of math lessons, I create a list of the vocabulary words that I will target in our next Cuisenaire Rod exploration, and I draft the language that I will use to get there (Table 1), which allowed me, during subsequent lessons, to incorporate the new vocabulary with consistent and predictable language. For the next several days we begin each math group with Cuisenaire Rod exploration. As the kids work I insert comments and questions that target the skills and language of the Singapore curriculum.
Table 1. Language planning and target vocabulary.

Lucy: I wonder if there is a way to put rods together so they are the same length as an orange.

Eva: a blue and a white make the orange!

(Oli tries using three magenta rods. When it’s too long, he slides it down, then recognizes that it is now too long on the opposite end. He stops and looks at it.)

Lucy: What are you working on?

Oli: It’s three.

Lucy: Three magenta rods?

Oli: Yeah, but they’re not the same. It’s not the orange.

Lucy: Yeah, I agree. Three magenta rods are longer than the orange rod.

Oli: Yeah (Begins creating a staircase that lays flat on the table)

Oli: I’m seeing that they always go ... Green and green, red and red, white and white.

Lucy: Can you explain that to me some more?
Oli: Yeah, see the green is the green. It’s the same. See, is the green taller than the orange? No! Never.

Lucy: So are you thinking about how the colors are always the same length?

Oli: Yes.

In this exchange, I began rediscovering the value of asking, “can you explain that to me again?” something that had been second nature when teaching in the Reggio-inspired setting. Often in lessons and conversational exchanges at our school, we employ a rephrase and repeat method. When the kids state something in an ungrammatical, verbose, or linguistically confusing way, teachers and therapists rephrase their idea and repeat it back to them. While there is value in this technique, I am also seeing the importance of restraint. When Oli used the phrase “they always go” to describe his observation that rods of the same color are always the same length, I resisted the urge to give him the language “same” immediately. His self-discovery gave him a reason and context for communicating more clearly with me. I saw in this moment that in an emergent, flexible curriculum the kids have a desire to explain, discover, and find connections. As described by Blumenfeld, Soloway, Marx, Krajcik, Guzdial, and Palincsar (1991), emergent learning is valuable in that students “are responsible for the creation of both the question and the activities,” the result of which is that “learners are motivated to persist at authentic problems” (p. 372). In asking Oli to explain his thought process to me, he demonstrated mastery of the vocabulary term “same” on his own. However, in this moment I also recognized that my response would have been different had this conversation taken place with another student. I recognized that Oli possessed
the conceptual understanding of same and different, and I felt certain that his expressive language would catch up if I gave him the time and space. For another student, such as Oscar, for whom language structures and new vocabulary are not quickly integrated with conceptual skills, I believe the rephrase and repeat method would have served my mathematical goals better in that moment.

_The following day I begin with several prompts;_ Can anyone find a rod that is the same as the orange rod? Taller than the orange rod? _I am specific and intentional with my language, and in the process I seek to informally assess which students are internalizing and integrating the vocabulary with the manipulatives. At the third prompt—Can anyone find a rod that is shorter than the orange rod?_—_Eva and Oli quickly get to work. They each create a staircase, with some “steps” as single rods, while others are combinations of smaller rods (Figure 5). Isaiah and Oscar appear distracted and unable to manage this task. Both look to their busy peers, Eva and Oli, for inspiration. Isaiah mimics their staircase building, but seems to have missed or misunderstood the prompt to find rods that are shorter than an orange, as his staircase is composed of both shorter and taller rods. Oscar appears to be struggling with both the language component and the fine motor demands, as his disorganized vertical towers keep falling over._
Figure 5. Eva creates a staircase to show examples of rods that are shorter than an orange rod.

Before moving on to any other lessons, I feel the need to conduct a more formal lesson to assess the kids’ understanding and application of the target concepts and vocabulary. The previous day’s verbal prompts showed me that Eva and Oli had successfully internalized and integrated the new math vocabulary, but Isaiah and Oscar relied on my support. Without visual prompting to help these two students see what “tall” and “short” meant, neither student demonstrated mastery of this language. I am curious if yesterday’s support and practice solidified these vocabulary terms and concepts for the two boys. Today I provide each student with a large sheet of black construction paper and an assortment of construction paper rectangles, whose colors and lengths correspond to those of Cuisenaire Rods. Before I am able to give the intended verbal prompt to “arrange your rectangles in order from tallest to shortest,” Oli begins doing
just that. I comment on his choice, saying “Oli is arranging his papers from tallest to shortest.” Once he has finished gluing the pieces down, he grabs a handful of Cuisenaire Rods and lays them atop the construction paper rectangles (Figure 6). “They match!” Isaiah, as is his tendency, watches his peers first, and then mimics Oli’s work. Oscar moves pieces around the table and becomes distracted by the hallway environment. Left without direction, he appears unfocused. I then give the lesson’s prompt “Can anyone make a staircase that goes from the tallest stair to the shortest stair?” Immediately Oscar begins creating a staircase.

![Image](image.png)

*Figure 6*. Oli creates a staircase of construction paper, then places matching Cuisenaire Rods on top.

Here I see the need for structure. While Oli is able to identify a purpose for these materials, Oscar is not. Without the structure and clear verbal direction, his explorations are disorganized and un-purposeful. As the kids arrange and glue, I begin to ask
questions. Which ones are shorter than the green? Taller than the magenta? Are any the same? At this point, Oli and Eva consistently respond to the questions quickly and accurately. They incorporate the vocabulary into their own comments as they talk about their creations. Isaiah and Oscar continue to rely on previewing of the vocabulary as well as visual supports, such as my hand motions showing shorter and taller each time I use the terms. With these supports in place, these two are able to demonstrate their conceptual understanding of comparative sizes.

The following day I return to the concept of “same” by providing the prompt, Can you find two rods that are the same length as the green rod? Eva quickly sets to work, and in just a few moments has created a series of solutions (Figure 7). While Oscar seems to understand the task, I again see his fine motor challenges impede his work, and as he tries to arrange rods next to each other, he inadvertently knocks some over. He huffs and puffs and bangs his fist on the table. I run to the classroom and grab a grippy pad—a textured rubber mat—and place it on the tabletop, which limits the slipping. I help him by holding one rod in place near the top of the pad, and he then experiments with combining two smaller rods. It takes him numerous tries to find a combination that works, and he repeatedly tries combinations that he has already attempted.
As I work with Oscar, the other students have taken to creating staircases again. I watch as Oli stands looking at his flat staircase, moving his head around so that he’s seeing it at different angles:

Oli: This is always the same one. See, I’m going to make a rectangle.

Lucy: A rectangle? It looks like a triangle to me.

Oli: Yes, see, the triangle goes to the triangle. I’m going to make a rectangle.

(He seems to be visualizing that a triangle is “missing” and that adding another triangle of Cuisenaire Rods to the top of his staircase would create a rectangle.)
Lucy: Interesting! How are you going to make it a rectangle?

Oli: I don’t know how to do it yet. (He continues looking at the staircase from various angles.)

Oli: If you use another staircase and another staircase, it will make a rectangle.

Lucy: Oh, so you think two staircases together will make a rectangle? I like the experiment you’re coming up with.

Oliver: Yes, I’m a scientist.

The following day, breaking from the Singapore curriculum and instead building on Oli’s geometric discovery-in-process, I provide each student with a square template and the verbal prompt, Can anyone fill this rectangle with Cuisenaire Rods? Oscar throws a handful down on top and declares himself done; I rephrase the task! Can anyone figure out a way to fill this rectangle with Cuisenaire Rods so that no rods stick out of the lines, and all the white inside the rectangle is covered? Interestingly, all of the kids begin by creating a frame of rods around the outline. Oli then creates a staircase within the frame, and as I watch I’m curious to see how he proceeds (Figure 8). When this staircase is complete, leaving a white “triangle” of paper in the negative space, I watch as Oli once again circles his paper, looking at it from different angles. As he starts to find ways to complete each rod, I recognize the way in which this simple action of composing rods of equal lengths is a precursor to addition and subtraction (Figure 9). When he is done with this task, he pushes his rods to the side, and then proceeds to create two staircases next to each other (Figure 10). As he does this, I see him still wrestling with this partial discovery that two triangles combine to make a rectangle. I again resist
the urge to offer suggestions or answers, and let him continue examining on his own. I think of Park’s assertion that, “play settings often provide children with far more genuine opportunities to engage in mathematical practices than formal lessons. Because in lessons teachers have clear goals ... and (they) often take over a good deal of the mathematical reasoning, while also cutting down on children’s opportunities to persevere on their own” (p. 10).

Figure 8. Oli fills his rectangular template by creating a frame, then building a staircase within it.
Figure 9. Oli’s completed template, and the “building blocks” of number composition and decomposition.

Figure 10. Oli creates two staircases, continuing to wrestle with the idea that triangles create rectangles.
The other three students work in less methodical, though equally interesting ways. When Eva has filled nearly all of her template, she stops and looks at it, recognizing that there are several small spaces that are still uncovered. She tries several small unit rods, and I hold back the temptation to tell her to use the white one, the one unit. She does not grab for a white rod, but eventually she comes upon a solution of her own; she inserts several rods vertically (Figure 11).

![Figure 11. Eva’s solution to filling in a few, small empty spaces on her template.](image)

**November - January**

Over the next several months, I work Cuisenaire Rods into the Singapore curriculum at several points. Just when I think I have exhausted their use, I find another topic or chapter of the program that is challenging or outright inaccessible, and I attempt to use this well-used, well-explored manipulative to deepen the students’ understanding. When a unit on
measurement directs the teacher to collect or buy a variety of items for length
comparisons, I use the Cuisenaire Rods instead. The kids excitedly grab a rod and run
around the classroom gathering items that are taller, shorter, and equal in length. We sit
on the rug together making comparative statements, once again practicing the bounty of
vocabulary terms that at times elude these students.

In January, when the curriculum turns to composing and decomposing numbers,
some of the kids start to struggle. Even Oli and Eva, who conceptually understand the
concept of combining smaller quantities to make a larger one, have difficulty
generalizing their knowledge. Following the direction of the curriculum, we explore
combinations of ten using Unifix Cubes in a multitude of ways. Though the group is able
to follow along with these activities, their skills seem limited to this particular
manipulative. I expand the unit by incorporating games, activities, and crafts. It isn’t until
several weeks into the unit that I recognize and consider the ways in which Cuisenaire
Rods can be integrated.

I begin by creating a template of rectangular outlines of equivalent size to a
single, unit ten, orange rod (Figure 12). On the first day, I challenge the kids to find two
rods that will perfectly fill the rectangles. Though Oscar relies on support for fine motor
difficulties, and Isaiah needs a visual model before he comprehends the directions, all
four students approach and complete the task with relative ease. It is clear that they are
comfortable and confident using this manipulative by the way they reach intentionally for
certain colors. I see both Oli and Eva grab immediately for the orange rod, and, upon
placing it on the template, recognize that this is the size they are aiming to make. Oli then
grabs for two yellow rods and effortlessly places them together to fill the next outline. His knowledge and ability to manipulate this math material is clear.
On the second day, I present the same challenge, but this time modify the template so that the rectangles are divided into ten units of one (Figure 13). I choose to give the same prompt as the previous day, and do not make reference to the change. Almost immediately, Oli begins counting the small squares. The other three see him at work, and take on the same task. A short disagreement ensues when Isaiah assures the group that there are nine squares within each rectangle, and Eva and Oli vehemently disagree. Oli goes over to Isaiah’s template and counts it for him, showing him that there are, in fact, ten squares. Once settled, the group gets to work filling the template again. Interestingly, Oscar and Isaiah struggle once again to get started, in spite of the task’s familiarity from the previous day. Before I can reach over and visually model the task again for Isaiah, Oli walks over and does so himself, showing Isaiah, “See, two yellows make a rectangle.” Isaiah continues to watch and mimic as Oli effortlessly grabs combinations.

On the attempts that don’t immediately work, I recognize that Oli is beginning to internalize the rods’ “quantity,” as he instinctively grabs for a taller or shorter rod depending on whether he needs to fill more or less space.
On the third day, I add an additional layer to the experience, this time seeking to formalize their explorations. To the left and right of the rectangular outlines I incorporate boxes, in which the students will fill out the size of their rods, counting how
many squares each one filled (Figure 14). In doing so, my goal is twofold. First, I want the students to begin recognizing and internalizing combinations to ten, as this is a content standard outlined in the math curriculum. Second, I want to begin deepening and expanding the experience of Cuisenaire Rods, particularly for Eva and Oli. I believe that with continued exposure and scaffolded discussions, both of these students will begin recognizing the “value” of each rod, and that this knowledge – whether it be verbalized or not – will enhance their understanding of quantity overall.
As we begin, Oli and Eva watch just a moment of my demonstration before they begin completing their own templates, easily finding pairs and counting how many squares each rod consumes. Isaiah, who is struggling with the visual component of filling
the rectangles, takes to this added task easily once he watches me model the process. Oscar struggles significantly with this task, both motorically and conceptually, and he relies on consistent and maximum support to engage in the activity. Afterwards, as math group is wrapping up, I ask, “Can anyone think of two smaller numbers that combine to make 10?” Both Oli and Eva quickly volunteer responses, and I am surprised and excited when Isaiah also shouts out an answer of his own, “5 and 5!”

Though I could have used this opportunity to explicitly tell the students the “quantity” of each rod, I chose not to. “(Teachers) make a mistake if we do not give (children) the opportunity to develop rich experience bases on their own before intervening as teachers” (Parks, p.11). At this stage of their mathematical development, it was more important to me that they use, manipulate, and experience “quantity” in hands-on ways. It was less important to me to formalize the particular manipulative we were using. I believed that, given more time, experience, and scaffolding, the “quantity” of each rod would become apparent to some of the students, without explicit teaching. For the students unable to make this conceptual leap on their own, explicit teaching could come later in their math education.

Several days later I return to this activity one last time, again modifying it slightly. In this fourth version, I have already filled in the numeric value on the left hand side (Figure 15). I first challenge them to find a rod that filled that many squares. As anticipated, Oli and Eva jump into the task with little difficulty. It is clear from watching them work that they have both internalized the inherent “quantity” of the rods, as after placing the first several rods in place and counting how many squares are filled, they
complete the rest of the template without counting. They appear to intuitively recognize that in creating a staircase, they are increasing each rod by a unit of one.

Figure 15. Template #4.
Isaiah approaches the task hesitantly, and his seating choice for the day makes it difficult for him to observe and mimic the work of his peers. For the first several minutes he engages in trial and error, grabbing at a rod seemingly randomly, placing it on the template, and then counting to see if it is the correct size. I see him try the same color rod several times. Working to find a rod of unit size three, he becomes frustrated and yells out, “No they don’t fit!” Oli looks up, walks over behind Isaiah, and says, “No, no, put that one down. Put it one step down.” He proceeds to move the pink rod (unit four) to where it belongs, then grabs a green (unit three) rod and places it on Isaiah’s template, showing him, “See, 1, 2, 3. It’s three.” Isaiah continues to struggle, so I remove the majority of his rods, providing him with just one of each color. He completes the rest of his template much more easily. As he is finishing his, he looks over at Oli’s completed template and says with excitement and camaraderie, “Wait, did we do the same colors?” The boys compare templates and I see that Isaiah is making the observation that Oli had made early on, that the colors are always the same length.

I then challenge the group to find the rod that will fill each template. Oli immediately comprehends the task and sets to work, both finding the appropriately sized rod and counting and writing in its numeric value. After a few moments, Oli cries out, “Ah! 9, 8, 7, 6 … I know it’s already a pattern! 6, so this must be 5, and … this must be 5 also!” He uses his finger to trace the ascending and descending numbers on either side. “Look, Lucy! 9, 8, 7, 6, 5, 4, 3, 2, 1, 0 and 1, 2, 3, 4, 5, 6, 7, 8, 9, 10!” As he calls out his discovery, the others watch him. This recognition of a pattern spurs Eva and Oscar, who now grab more quickly for rods and call out their own “discoveries” about the pattern.
they are seeing. Eva, self-talking as she works, points to the row beginning with a unit
seven rod, and says, “I know this is 3 because 7 are blocked.”

As I look back on this series of explorations, lessons, and the documentation that came
with it, I am surprised by the fullness, depth, and breadth that a single manipulative
provided. This simplest of materials fostered these deeply intriguing explorations, which
resulted in an internalization of concepts and language that was difficult through
progression of the math curriculum alone. In an age of iPad apps and interactive Mimio
Board games, there was a satisfaction in watching the unfading interest and engagement
with Cuisenaire Rods, which, in the words of Oscar, are nothing more than colorful
wooden “sticks.” I am reminded of Rinaldi’s quote that children have “curiosity and the
ability to be amazed.” For what is more amazing than watching children discover
mathematical truths for themselves? Familiarity with this simple material, repeated
exposure and examination, and the instinctive desire to explore and create, produced
numerous instances of discovery.

Had I followed the curriculum as presented—had I stuck to the language,
sequence, and activities as dictated by my teacher handbook—I believe much of the
material would have been inaccessible to these children with language delays, fine motor
challenges, and attentional difficulties. More so, I believe more firmly now than ever, that
to eliminate the open-ended—to limit the potential for curiosity and self-discovery—
would have hindered their learning process in innumerable ways.

What was also quite apparent, however, was that for certain students, the open-
ended explorations were not sufficient. For Oscar, the fine motor challenges alone were a
hindrance that he could not overcome without modifications and support. For Isaiah, it wasn’t until the end of January, after months of exploring and working with Cuisenaire Rods, that he made the observation that came so naturally to Oli, that each color rod is always the same size. For him, the repetition, structure, and variety of exposure was necessary to make that connection. I am reminded of the study that suggested that the role of the teacher, not the curricular content, was responsible for student success (Slavin and Lake, 2007). Without assessment, careful preparation, specific language planning, and individualization, students like Oscar and Isaiah may not have made the mathematical connections that they did. Even Oli and Eva, who consistently exhibited strong conceptual skills, relied on modifications to access and demonstrate their knowledge. As Parks (2015) writes, “(Children’s) desire for new experiences inspires them to engage in more demanding play … (and) adults can support children in deepening the quality of their play. From this perspective, the role of (the teacher) in deepening and extending play is quite important” (p. 11). It is the teacher’s role to recognize the zone of proximal development and scaffold increasingly complex learning moments (Vygotsky, 1962). Parks continues, “It is important to recognize that this sort of (open-ended) play is not the same as learning mathematics content. In other words, (children) will need to learn to put words to their experiences” (p. 11). In this way, open-ended, child-driven experiences are pivotal to making mathematical discoveries. However, it is the support, guidance, and questioning of an adult that expands the child’s discovery and provides the formal language and skills necessary for true math learning.
Chapter 4

Exploring a Concept: Geometry and Some Unexpected (Re)discoveries

Studying and implementing the geometry unit in the Singapore program, I quickly discover its weaknesses for the population I am working with. I am taken aback by the quantity and complexity of information provided in this introductory chapter, and am again surprised by the onslaught of vocabulary; solid, flat, corners, edges, sides. I am curious about the program’s design—exploring and teaching 3-dimensional shapes from the first lesson. In these early lessons, I see the difficulties begin to pile up. As Oscar tries to count the edges of a foam pyramid, I see him circle around repetitively, not recognizing that he is recounting the same edge over and over, and he drops the object numerous times as he attempts the task. Isaiah is quickly overwhelmed with language, and begins confusing terms that he typically uses without difficulty, like calling the triangular side of the pyramid a “rectangle.” When I ask, “is that a rectangle?” he wrinkles up his face, taps his head with his finger, and says, “um, um, thinking ...” It isn’t until I provide him a choice—rectangle or triangle—that he quickly calls out “it’s a triangle!” Oli, who consistently demonstrates strong visual-spatial skills, also appears overwhelmed by the expressive language that he is searching for but struggling to find. Though I know he understands conceptually the difference between a flat circle of construction paper and the foam sphere I’m holding up, his explanation is verbose and difficult to follow. “It’s like not up. It’s down. But that one isn’t. There’s no lines on that one going up. It’s only down.” Eva doesn’t even attempt usage of the new vocabulary. At each question I ask she shrugs her shoulders.
I branch off from the scripted dialogue and sequence of topics, opting to break down the concepts, skills, and vocabulary into discrete lessons. We begin with 2-dimensional shapes, practicing the terms circle, square, rectangle, triangle, and hexagon by playing bingo, going on a shape hunt around the school, and sorting classroom objects. I slowly introduce the terms edge, side, and corner into these lessons, and after two weeks, the kids seem comfortable discussing and comparing 2-dimensional shapes. We then return to the exercise of comparing 2-dimensional and 3-dimensional shapes. Though the language is still disorganized, there is a marked improvement in the way the kids attempt to explain the difference between a circle and a sphere. “It’s like the same, but not. It’s going up,” says Oli, to which Eva responds, “Yeah, it’s tall. It’s not flat on the table.” Oli agrees, “Yeah, see I can hit this one down, but this one I can’t,” he says as he smacks his flattened hand on the construction paper circle, then rolls the sphere around under his palm.

To make the transition to 3-dimensional shapes, I decided to bring out a favorite classroom manipulative—Magnatiles. This decision reflected directly on our first semester’s work with Cuisenaire Rods. I observed in that series of experiences and lessons what returning to a material over and over again can do for mathematical development. The familiarity, repeated exposure, and numerous opportunities for open-ended and child-driven discovery, lent a depth and breadth to the children’s work. I found many times throughout the process that a simple material, such as Cuisenaire Rods, can serve to expand and deepen mathematical concepts, and can support the formalization of content standards. I hoped and anticipated that integrating Magnatiles would have a similar effect.
Rather than have the students count the edges, sides, and corners of the foam manipulatives, as the curriculum dictates, I ask the kids to create their own cubes and pyramids using the Magnatiles. With such a beloved and well-used construction material, all of the kids quickly create a cube. We then “dissect” the cube, discovering that a cube is made of six squares. After painstakingly counting all of the corners on each of his six squares—“There are 24 corners!” he calls out—I hand Oli my constructed cube and ask him to count the corners on my 3-dimensional shape. When he counts eight, he looks back at his pile of deconstructed squares, and begins counting again. I can see him wrestling with the conundrum that his decomposed cube has 24 corners, while my constructed cube has only eight. I am reminded of the value in allowing children to wrestle with mathematical problems on their own, before inserting my own, teacher-directed goals into the experience (Parks, 2015).

Throughout these explorations I observe that all the students have developed a conceptual understanding of 2-dimensional versus 3-dimensional shapes, and a quick sorting activity provides the assessment I need to validate these observations. The terminology remains difficult, so we spend a math class running around the classroom finding 3-dimensional objects that we sort on the rug (Figure 16). By the end of this activity, Isaiah and Oli are consistently using the terms sphere, pyramid, cube, rectangular prism, cylinder, and cone. Eva struggles with the vocabulary, but easily sorts the objects and describes similarities and differences. Oscar is struggling with both pieces of the task, both mis-sorting and mis-labeling the different shapes he brings over.
And then, in the midst of these highly planned, targeted lessons, something unexpected happens. During a day of math centers, in which my math group and my co-teacher’s math group team up to take part in open-ended, small group activities, I overhear Isaiah and a student from the other group, Otis, talking about “the glass house.” I pull my chair up to the table and watch as the two boys use a set of primary colored, 3-dimensional foam shapes to construct a building. After a moment I figure out that the “glass house” is the conservatory at the Brooklyn Botanic Gardens, a place we had visited the week before as part of our yearlong social studies curriculum on habitats. Having provided no prompts, nor mention of this field trip, I am excited to see that the
experience of visiting the Botanic Gardens is still on their minds, and that it is acting as a
source of inspiration for mathematical explorations.

They talk intently about which pieces should go where, and I hear Otis strain to
find the vocabulary term to match the shape he wants Isaiah to pass to him, a cylinder.
He first calls it a sphere, to which Isaiah passes him a red sphere, triggering an
exasperated, “Uh! No! Not that one!” Isaiah, for whom the memorization of shape names
has come easily, looks on confused and a bit intimidated. Otis, who is prone to large
reactions, continues becoming ever more irked by Isaiah’s lack of understanding, and he
seems unaware that it is he, in fact, that is making the error. I step in to mediate the
interaction. I ask Otis, “Which shape are you looking for?” He starts to point and says,
“That one. What’s that called?” I resist telling him the answer, and ask him to describe it
to us so we can figure out which one he is talking about. His description starts out vague,
“The red one. That one. Red.” I point to a series of red shapes that I know are not the
one he wants, and ask him to give us more details. His desire for this specific shape is
clearly driving his willingness to humor me, and he begins to explain, “It’s kinda like a
circle (I hold up a sphere) but no, it’s not a circle. Cause it’s tall. It goes up and down.” I
point to the cylinder, and Otis throws his hands up in the air as he says, “Yes! That one.”
I reiterate the shape’s name as I pass it to him, “Here’s the cylinder you wanted.” The
two boys immediately get back to work to complete their “glass house” (Figure 17).
Several weeks later, the class has decided to construct a life-size Emerald Tree Boa as part of our rainforest exploration. Otis, Oscar, and Eva stand with me looking at a photograph of the snake, and I ask them what shape the snake’s body is. Oscar volunteers, “It’s a long line, like this,” as he draws his hands out to either side of him. Eva continues, “Yeah, like a tube.” I see Otis becoming animated, using his hands to supplement his verbal descriptions, which are, unsurprisingly for a student who struggles so greatly with expressive language, disorganized, ungrammatical, and difficult to follow. I recognize that what he is trying to describe is a long, skinny cylinder. “It’s long, but not straight. It is up and long. But it can’t be right on the table,” he says as he runs his hand...
along the flat surface of the table. I cross the classroom and grab the red cylinder that he
had used several weeks prior when building the conservatory. I bring it over to him and
he immediately says, “Yes! Like that!” Eva says, “A cylinder!”

Over the next few days we gather materials. When the veteran art teacher, known
for having every crafting material in his arsenal, enters the classroom one morning, I
suggest that we ask him for ideas of what to use. Otis, though unable to find the
vocabulary term, excitedly describes the need for a long cylinder. I prod him on,
encouraging him to describe what this shape looks like.

Lucy: Otis, is it a 2-dimensional or 3-dimensional shape you’re talking about?

Otis: 2-dimensional. No! 3-dimensional. Wait. What one sticks out? Like not straight and
flat?

Lucy: 2-dimensional shapes are flat, 3-dimensional ones are solid.

Otis: Yea, 3-dimensional.

Bob (art teacher): Okay. And which 3-dimensional shape do you need?

Otis: You know. It’s kind of like long and straight.

Bob: Like a rectangle?

Otis: No, no, like it’s straight, but curvy. What’s it called?

Lucy: Tell Bob more about the shape you want. Part of it is straight, right? But it’s also
round? (I summon Otis to my side, where I show him the foam cylinder. I point to the top,
use my finger to trace the outline of the circle, and ask him what shape it is.)

Otis: Bob, it’s like a straight and curvy side and it’s a circle. On the top. It’s a circle.
Bob: So a cylinder, like my water cup? (He holds up a plastic cup that he is drinking from.)

Otis: Yes! But it has to be big. Way big than that. Like all the cross the room. Super big!

The conversation continues like this, and Bob says he has an idea. He comes back to the classroom several minutes later with a type of PVC tubing, essentially a metal coil with flexible plastic wrapped around it. “Oh yeah! Perfect!” Otis cries. He grabs one end and Eva grabs the other, instinctively moving in opposite directions to discover the tube’s outstretched length. Shouts of “whoa!” and “oh my god!” fill the room as the tube stretches to around 15 feet! My co-teacher and I intentionally use the vocabulary term “cylinder” over and over again as we talk with the kids; “Wow that’s the longest cylinder I’ve ever seen!” “Do you think we need to use the whole cylinder or just part of it?” “Should the snake be a straight cylinder or a curled up cylinder?” I’m reminded of the quote, “As a teacher, you’re pulled not only by the students’ thinking, but also by your mathematical goals; you’re always interconnecting these two things” (Investigations in Number, Data, and Space, 2001, p. 7). This was the perfect opportunity to blend the kids’ ideas, interests, and pure excitement, with my own instructional goals.

We then move on to similar learning moments when we discuss the need for a tail—a cone it is—and a head—must be a sphere we’re looking for (Figure 18). Throughout this emergent experience, the kids are giddy with excitement, but focused and purposeful in their actions. They exhibit a determination and drive to create this model, and in the process, using the oh-so-tricky vocabulary of 3-dimensional shapes becomes a necessity.
Their interest in the project creates a motivation that didn’t exist in the more contrived and teacher-driven lessons.

Figure 18. Creating a 3-D model of an Emerald Tree Boa.

It is during this experience of creating the Emerald Tree Boa—later to be christened “Sylvester Snaker” by way of class vote—that I have the most significant and unexpected discovery of my year’s worth of work. It is here, amidst discussions, debates, construction, and papier-mâché ingredient measuring, that I suddenly recognize this for what it is: embedded learning. It is math instruction woven into social studies and science explorations. It is cross-curricular integration of topics. It is building math standards and content goals into meaningful, contextual experiences that the children care about. “Children’s confidence, competence, and interest in mathematics flourish when new experiences are meaningful and connected with their prior knowledge and
experience” (Clements, Copple, and Hyson, 2002, p. 4). The kids were already fascinated by rainforests, so what better, more motivating, more enriching way to teach geometry, than to weave these concepts and vocabulary terms into the curriculum? A simple detail like adding hemispherical eyeballs to Sylvester (“It’s like a sphere, but you need to cut it with a knife.”) provided yet another opportunity for Otis—a student who struggles so greatly with expressive language and vocabulary recall—to engage in the challenging and tiring task of describing and naming geometric shapes (Figure 19).

*Figure 19. Otis adds hemisphere eyeballs and construction paper pupils to Sylvester Snaker.*
In retrospect, this seems rather obvious. Embed the learning of content and standards within contextual and relevant experiences. Take the skills that I—and the structured curricula—deem important and developmentally appropriate, and find meaningful ways of integrating those concepts throughout the day, rather than merely teaching the information in the 45 minute period allotted for math instruction.

As I came to this realization, I recognized that what I was discovering—or rediscovering—was a concept that had been so integral to my teaching practice in DC. Learning isn’t discrete. Math, literacy, art, social studies, science; each one of these subjects is composed of the other, and to teach one as separate and isolated would be to miss out on their many connections.
Chapter 5

Reflections and Conclusions

When I began this year of exploration I dove in headfirst to discover a balance between emergent, child-driven learning and structured, special education. In retrospect, I think I anticipated finding one “right” path; some algorithm, formula, or generalizable lesson plan that would unequivocally get me that balance I wanted each and every time. Something like: begin lesson with structured review, insert open-ended provocation, ask specific questions to guide thinking, allow time for creative expression, end lesson with structured review. While each of these components is, certainly, important and valuable, this method would be flawed, precisely because it would be a “method.”

As I look back on the past three years, I can articulate my own progression in this way: believe solely in the value of emergent learning; fail in my endeavor to transfer my teaching style to my new group of students; discard the emergent and embrace the structure; feel that something is missing; seek to find the balance between the two; discover that perhaps my understanding of progressive education was flawed all along. Perhaps it is that my understanding and working definition of emergent and progressive was limited in scope and inaccurate in representation. The materials, provocations, and environments that had been so stimulating and meaningful for the population of typically developing children I worked with in DC were no longer sufficient in the special education setting. An open-ended center or the introduction of a new material, though met with the same excitement and curiosity as I had previously witnessed, were not necessarily enough to elicit the connections and learning moments that I intended.
Certain activities are simply less accessible—for a variety of reasons—to the children I am now working with.

But this does not negate the importance of emergent experiences and project-based learning for these children and for all children. In each of the lessons and experiences with Cuisenaire Rods and geometry, I recognized the value in the open-ended and child-driven discoveries. But the value didn’t emerge in the way I was accustomed to. The children relied on different supports and different scaffolding. When I allowed for more open-ended explorations and when I recognized the many opportunities to infuse learning moments throughout the day, the kids were able to engage in a way that they hadn’t done so before.

At the start of this yearlong study I asked the question, how can I provide meaningful, emergent learning opportunities, while also integrating the structure that my students need, and respecting, valuing, and conforming to the learning environment of my school? In retrospect, I think this question highlights my misunderstanding. I went into this experience seeking a way to inject emergent learning into what I considered someone else’s objective. I didn’t view the school’s methods or curricula as inherently valuable, and instead I sought to “conform.”

During one evening’s class of the Foundations of Modern Education course at Bank Street, our group fell into a debate about how to define progressive education. As students volunteered ideas, I waited to hear the definitive answer from the professor. I was admittedly disappointed and slightly rattled when no definition was given. Rather, he said, progressive education can take many forms.
As I thought about this concept for the next several weeks, it suddenly dawned on me that this notion—that progressive education can take many, varied forms—reflected the very core of the Reggio philosophy, that there are a “hundred languages of children.” If no two children are alike—if every child learns differently, succeeds differently, and struggles differently—then why should I expect any one teaching method to work for all? In my search for a balance between emergent and structured, I had failed to integrate this simple, and rather obvious, fact.

In this yearlong process I have rediscovered some beliefs and conclusions I first made in DC, but this time, I am viewing these principles in a much deeper, more complex light, with a perspective that now much more fully recognizes the need to understand, know, and question assumptions about individual children. It isn’t that emergent curricula can’t work in a special education setting, it is that I wasn’t working the emergent curriculum appropriately. Progressive education should be based on the principle that teachers are responsive to the children they work with. To be responsive to my current students means to create, modify, and scaffold in vastly different ways. That does not, however, negate the role or depth of emergent learning. For in a school of children with language-based learning disabilities, what better ideology than one that sees children as competent and strong, and one that believes deeply in the “hundred languages of children?” Somehow this very clear and seemingly obvious connection between Reggio and special education had eluded me until I engaged in this Independent Study process.

My conclusions reflect both a simplicity and complexity of teaching. Simple, in that it comes down to the needs of individual students, complex, in that it requires responding to these individual needs of students. It means having the flexibility to
observe, document, and plan, while also having the creativity to respond, change, and modify. At the end of this yearlong process, I find myself visualizing a web in which planning, observation, assessment, reflection and response are entirely interconnected. When provocations are intentional, observations are thorough, and assessment targeted towards developmentally appropriate standards, designing the next stage of learning comes naturally. The fault, it seems, in following a pre-determined curriculum, lies in the inflexibility. Though many children may follow along and absorb vocabulary and skills with little additional support, many will not. A model of curriculum planning that eliminates the teacher’s need to constantly reflect and respond does not meet my working definition of progressive education.

But while I am reimagining emergent curriculum and am reframing my understanding of “progressive,” I am also discovering the ways that structured curricula and methodical teaching practices are integral, as well. I’m discovering that there is a constant push and pull between open-ended and structured. Just when one emergent inquiry seemed to be taking off for one or more of my math students, another student would demonstrate difficulty, reminding me of the need to incorporate that structure and explicit instruction.

Of the many lessons and experiences that I planned and responded to throughout this year of exploration, none feels as exciting or informative to my practice than the process of creating Sylvester Snaker. This project reflected both the strengths and weaknesses of an emergent learning experience in a special education setting. It highlighted the depth of engagement, curiosity, and learning that can emerge from a truly contextual exploration, and reminded me of the power of such cross-curricular projects.
But while the experience of constructing Sylvester Snaker was exactly what Otis and Eva needed to engage in the geometry unit and solidify their skills, this same emergent experience—though meaningful in different ways—was not mathematically beneficial for Oscar. The fast pace and socially demanding nature of the project seemed to thwart his solidification of math skills.

And so the balance is elusive. It is neither clear-cut, nor predictable. If my teaching practice is going to be truly reflective of the needs of the kids I work with, I will have to forgo the desire to find a method for combining emergent and structured. I will, instead, have to do what I believe progressive education should seek to always do—respond to the needs, strengths, and struggles of individual children. If I can remain open to unpredictability and if I can treat curriculum planning as an ongoing and flexible process, then I can allow for creative and contextual learning moments, while never losing sight of the need for structure and explicit planning. And therein lies the simultaneous simplicity and complexity of education. “No linear listing of principles … can do justice to the complexity of the phenomenon that is child development and learning” (NAEYC, n.d.).

This paper sought to integrate my own experiences in education with current research and theory. Though empirical research and contemporary beliefs about progressive education espouse the value of open-ended and child-driven learning, early childhood classrooms are becoming evermore driven by content standards and dictated curricula. For many teachers, their progressive ideals and creative practices become abstract notions when
brought into actual classrooms, classrooms that exist within the greater culture of schools, districts, and curricular requirements.

Throughout my year of exploration I attempted to stretch and redefine the boundaries of emergent curricula and the structure of a special education program. In the process I acknowledged the value of content standards as an organizing and supportive piece of curricular development. I recognized the important and necessary role of structured and explicit teaching, particularly when working with a population of students with special needs. However, I also rediscovered the value of emergent and contextual learning, in which students’ questions, ideas, and interests act as a driving force in teaching and meeting content standards.

In reflecting on my teaching practice from the past year and integrating these experiences with research, I end this Independent Study process with several key conclusions:

1) Open-ended, child-driven experiences are valuable in innumerable ways, from encouraging deeper and more complex conversation to supporting the discovery of mathematical concepts. Teachers should always seek ways to incorporate emergent and play-based learning into their classrooms.

2) Structured curricula and content standards are equally important and necessary. To dismiss such forces would be unresponsive and unproductive. Knowing developmentally appropriate content and incorporating explicit teaching practices will serve and support a variety of learners.
3) The role of the teacher in planning, observing, documenting, reflecting, and responding cannot be overstated. The flaw in employing a purely emergent curriculum or a singularly structured program lies in the inflexibility. The true and complete definition of progressive education should be one in which teachers are attuned to individual students’ needs, responsive in their teaching methods, and reflective about how best to achieve learning goals. It requires the openness to engage in emergent moments and the creativity to incorporate content standards in contextual and meaningful ways. It relies on the flexibility to constantly move between child-focused and teacher-driven, between play and explicit teaching, between exploration and educational goals.
References


Christakis, E. (2016). The new preschool is crushing kids. Today’s young children are working more, but they’re learning less. *The Atlantic*.


