

THROUGH THEIR EYES: EARLY CHILDHOOD TEACHERS AS LEARNERS AND TEACHERS OF MATHEMATICS

Sue Ellen Richardson
Purdue University
richa114@purdue.edu

Laura Bofferding
Purdue University
lbofferd@purdue.edu

We explore early childhood teachers' lived experiences learning and teaching mathematics with young children, adding finer-grained context and detail to broader research descriptions. We interviewed ten early childhood teachers in a university laboratory school about their mathematics training, classroom mathematics curriculum, who controls their mathematics curriculum, and their mathematics teaching and learning philosophies for young children. Analysis included coding for Bourdieu's (Grenfell, 1996) social field theory. Results highlight social factors that influence what early childhood teachers do and teach, such as standards, regulations, administration, research, university organization, parents, and children. Teachers worked with autonomy and competence; mathematics teacher educators should leverage early childhood teachers' interest in young children.

Keywords: Early Childhood Education; Teacher Knowledge; Teacher Beliefs; Pre-School Education

Purposes

Early childhood education, for children ages birth to age eight (NAEYC, 2013), is changing due to advances in neuroscience (Shonkoff & Phillips, 2000) and greater public awareness of the effects and benefits of early childhood education (Grunewald & Rolnick, 2006). In the past, early childhood teachers taught little mathematics to children, so they received limited or no professional development related to mathematics instruction (National Research Council [NRC], 2009). This left teachers with limited knowledge and experience with mathematics, mathematics pedagogy, and the mathematical processes and thinking strategies of young children (Early, Maxwell, Burchinal, Bender, Ebanks, Henry, et al., 2007; Sarama & Dibiase, 2004). Therefore, limited research exists concerning early childhood teachers' mathematics knowledge as derived from their experiences and the mathematics they plan for and identify in the activities and centers they create for children. While large-scale studies of early childhood teacher characteristics focus on teacher demographics, training, working conditions, and years and experiences in the field, finer-grained studies are required to give context to teachers' lives and work in order to inform teacher educators, policy-makers, and other stakeholders who develop training and policies for the evolving early childhood field (Early et al., 2007; NRC, 2009). In particular, researchers should examine sources that early childhood teachers draw on to make decisions and judgments about their mathematics instruction (Brown, 2005).

In this study, we examine finer-grained interview data that adds detail and context to these broader descriptions of early childhood teachers' training and that captures social and cultural influences on what teachers do and think in their teaching. In addition, we highlight aspects of early childhood teachers' attitudes, knowledge, and practice that are affected by their varied professional development opportunities and activities (Pianta, Barnett, Burchinal, & Thornburg, 2009). Our study attempts to give voice to often unheard or hidden early childhood teachers and addresses gaps regarding the mathematics that they plan for and identify in activities by recording their lived experiences and concerns regarding the learning and teaching of mathematics (Early et al., 2007; Brooks, 2007). We hope to provide a counter-narrative to one that portrays early childhood teachers as lacking in mathematics knowledge and understanding, both in their own thinking about mathematics and in their understanding of the mathematical thinking of the children in their classrooms.

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Theoretical Perspectives and Background Literature

Bourdieu's Social Field Theory

Because the knowledge-beliefs – we consider beliefs a form of knowledge – with which early childhood teachers operate emerge from social and cultural influences (Pajares, 1992), it is appropriate to look at the work and characteristics of early childhood teachers through a sociocultural lens (Edwards, 2003). Bourdieu developed a sociological perspective that can be used to objectively study early childhood teachers' relations, actions and the evolution of their dispositions for teaching mathematics (Grenfell, 1996; Grenfell, 2012; Noyes, 2004). We use his constructs of *habitus*, *field*, *capital*, *mechanisms of change*, and *structures*. Next, we describe Bourdieu's constructs using examples from early childhood education.

The field of early childhood education. A *field* is a social context involving a network of structures, relations, laws for functioning and specific institutions (Grenfell, 1996; Grenfell & James, 2004; Noyes, 2004). Fields exist on a continuum between heteronomy and autonomy based on the degree to which they can generate their own dilemmas rather than unknowingly reproduce repressive power structures or be affected by external forces. The working environment (or *field*) of early childhood teachers includes different groups of collaborators. Social structures are created between teachers, between teacher and parents, and between teachers and the children in their classrooms. Teachers *structure* the *field*, i.e., the classroom environment and activities, for the children, considering what they know about the children and the implicit feedback the children give (Cadwell, 1997).

Several authorities influence the early childhood field. The National Association for the Education of Young Children (NAEYC), professional organization for the field, provides guidance through publications, position statements, conferences, and accreditation. Those who teach young children refer to “developmentally appropriate practice,” (Bredekamp & Copple, 1997), a framework developed by NAEYC to guide those in the early childhood field, both nationally and world-wide, for the best research-based practices regarding young children's learning and development. Also, state early childhood standards play a central role in the lessons that teachers plan (FSSA, 2006). These authorities act as *mechanisms of change* (Grenfell & James, 2004) by changing, for example, what early childhood teachers are required to teach.

Ways of shaping early childhood teachers' knowledge (*habitus*). *Habitus* is a set of dispositions or tendencies that are created in and by individuals' social interactions, and shape and orient how they see the social world (Grenfell, 1996; Grenfell, 2012; Noyes, 2004). Early childhood teachers' *habitus* is influenced by professional development opportunities and their teaching experiences. Training opportunities for both in-service and pre-service early childhood teachers range from no mathematics courses, courses not specifically related to the mathematics of young children (i.e., college algebra), content courses related specifically to the mathematics of young children, methods courses focused on the mathematics of and pedagogy of teaching young children, and general early childhood curriculum courses that include some content and pedagogy for teaching mathematics (NRC, 2009). Professional development previously focused on developmentally appropriate curriculum and the importance of play (Bredekamp & Copple, 1997; NRC, 2009), but now includes research on children's thinking and learning and using technology to provide training and support to full-time teachers who are part of a large, diverse workforce (NRC, 2009; Sarama & DiBiase, 2004). Research-based interventions have also shaped early childhood teachers' knowledge for teaching (Herron, 2010; Jung & Reifel, 2011). In addition, early childhood teachers' practices are influenced by the experiences they have as teachers, such as working with children and families from different socioeconomic backgrounds and under various state requirements (Lee & Ginsburg, 2007).

Knowledge-beliefs (*capital*). *Capital* refers to different types of assets that individuals possess, such as economic, status, position, or knowledge (Grenfell & James, 2004; Grenfell, 2012; Noyes, 2004). Examining teachers' beliefs is often used to learn about what teachers do and think in their teaching (Pajares, 1992). Pajares described beliefs as created through a process of enculturation and social construction, thoroughly intertwined with knowledge. For example, teachers' beliefs changed after implementing constructivist instructional strategies, evidence that beliefs are grounded in social experiences (von Glasersfeld, 1993, as cited in Philipp, 2007, p. 276). Although we can participate in shared physical and social experiences, our individual understandings of these shared experiences are unique to each of us, not consensual (Philipp, 2007). Because teachers operate as if their beliefs regarding mathematics, teaching, and learning are true for themselves, they operate as if knowledge and beliefs are a single construct (Beswick, 2010). Therefore, as knowledge is constructed from experiences, so too are beliefs.

The literature on early childhood teachers' knowledge-beliefs about mathematics includes general survey information as well as small qualitative studies. Early childhood teachers tend to support more social-emotional development rather than the development of children's mathematical thinking (NRC, 2009). Knowledge-beliefs focus on when children are ready to begin mathematics instruction, as early as age 2 (Sarama & DiBiase, 2004). Counting, adding, subtracting, and shapes constitute the most necessary mathematics topics. Teachers ordered mathematics activities with counting first, followed by sorting, numeral recognition, patterning, number concepts, spatial relations, making shapes, and measuring. They use manipulatives, number songs, and games to accomplish their objectives, but not workbooks or software. Teachers preferred that children explore mathematics activities and engage in open-ended free play rather than large-group lessons. Misconceptions that early childhood teachers hold about young children's mathematics teaching and learning focus on which young children are ready for mathematics education and the content of curriculum, classroom environment, and mathematics assessments; and they might be overcome with sustained research-based professional development (Lee & Ginsburg, 2009).

Mechanisms of change. Change mechanisms challenge the status quo and indicate the amount of autonomy a field possesses. Mechanisms can be internal or external. In order to understand what teachers do, we need to understand both the evolving fields in which they are situated and the nature of their evolving habitus. Disjunction is a *mechanism of change* that teachers experience between the structuring of their habitus and current field, causing change in their practice (Noyes, 2004).

Structures. Structures explain how field, habitus, and capital interact, and are both the product and source of tensions, described as "structuring and structured" (Grenfell, 2006, p. 293). Because habitus cannot be seen, the relational structures that underlie practice and knowledge-beliefs must be explored (Grenfell, 2012).

Women, Their Work, and Mathematics

This study joins other studies that document women as participants in mathematical activity in their work within a traditional female context, such as sewing or caring for young children (i.e., Hancock, 2001). A goal of this study is to allow the teachers to make sense of their own thinking, and to correct the invisibility and distortion of their experiences by giving voice to their multiple perspectives and ways of knowing, creating more knowledge and a broader picture, as each woman's experience tells something different and valuable (Brooks, 2007). Lather (1988) cautioned that by attempting to explain others' lived experiences, the others' reality would be violated. In other words, we will only attempt to explain the teachers' lived experience, knowing that this is just our own understanding of the teachers, not a replica of their experience.

Research Questions

Using a portion of data from a larger research study, we investigate the following research questions: What experiences do early childhood teachers have learning and teaching mathematics? What do these experiences mean for their teaching mathematics with young children? What can their stories of lived experiences as learners and teachers of mathematics tell early childhood teacher educators, policy makers, and other stakeholders?

Methods

Participants

A purposive, convenience sample was recruited from an early childhood development laboratory school at a Midwestern state university. Ten early childhood teachers volunteered. Table 1 includes their education, years at the center, and teaching assignments.

Table 1: Participant and Classroom Descriptions

Classroom Team	Teacher	Position	Degree	Years at Center	Classrooms	
					# of Children	Ages (years)
Ducks	D1	Head	BS ECE	17	20	3 – 5
	D2	Associate	BS Child Dev	11		
	D3	Assistant	AS EC Dev	6		
Eagles	E1	Head	MS C&I/BS ECE	16	20	3 – 5
Squirrels	S1	Head	BS Child Dev	22	14	2
	S2	Student Teacher	BS ECE	Just Hired		
Tigers	T1	Head	BS Child Dev	5	14	2-1/2
Koala Bears	K1	Head	MS Child Dev	19	14	2-1/2 – 4-1/2
	K2	Associate	BS Ed Studies	1		
	K3	Assistant	CDA Credential	6		

Data Collection Process

Here, we report on one of three data collection activities of the larger study, initial semi-structured interviews with classroom participant teams regarding their experiences learning and teaching mathematics. Because teachers collaborate on planning and implementing curriculum, initial interview data was gathered from each teaching team (see Table 1). During one-hour interviews, teams were asked to describe their training related to teaching early childhood mathematics; classroom mathematics curriculum, activities, and experiences; issues related to who has control over mathematics curriculum in their school setting; and philosophy regarding teaching and learning mathematics with young children. Researchers used a semi-structured interview protocol that was developed from literature (Frid & Sparrow, 2009; Lee & Ginsburg, 2009) and prompted teachers for additional information during interviews as needed.

Analysis

Several rounds of analysis were conducted in order to gain a sense of the underlying “web” (Grenfell, 1996) of relations and tensions (Clandinin, Murphy, Huber, & Orr, 2009) that teachers experience as they learn and teach mathematics. First, each transcript from the initial interviews was divided into chunks expressing a cohesive idea focused on the same idea or activity. Each chunk was coded using Bourdieu’s constructs of habitus, field, structuring structures, capital, and mechanisms

of change, with subconstructs generated from the data (Grenfell, 1996; Grenfell, 2012; Grenfell & James, 2004); teachers' experiences learning and teaching (Early, et al., 2007; NRC, 2009); and mathematics content (FSSA, 2006). Anecdotal snapshots of each classroom were developed, and short narratives of each teacher were created that included a timeline and dominant themes found in their individual transcripts. From these pieces, we developed narratives of the teachers as learners and teachers of mathematics with young children, along with their philosophies.

Results

The data describes autonomous early childhood teachers affected by external forces as they teach and learn, through interactions with children and adults.

Bourdieu's Social Field Theory "Web"

Habitus and experiences. Teachers described experiences in their classrooms that have affected their teaching habitus (Grenfell, 2012). For example, E1 and D2 explained that they did not like geometry as students and had trouble learning it (structured structure), but as early childhood teachers, they have learned about geometry with and from the children and found engaging geometry activities (structuring structure). T1 explained that most of the children in her classroom of 2-1/2-year-olds speak English as a second language (structured structure), so she has adjusted her learning activities to use multiple media to share new words with the children (structuring structure). T1 also noted that most of the teachers at the center obtained their degrees from the university (structuring structure), which she says explains why many teachers sing the same songs and do many of the same activities (structured structure).

Social fields and power. Teachers alluded to social fields that exert power on their practice and in their classrooms (Grenfell, 2012). S1 and E1 noted that the center is part of a university, and therefore, they teach pre-service teachers in practicums and student teaching, in addition to the children in their classrooms. They also noted that the state department of education has made changes in center and teacher licensing regulations that have affected the early childhood education field in which they work; all of the teams reported that standards exert control over their practice, both in what they plan and how they record and communicate their plans. Most teachers referred to components of NAEYC that influence their practice, including accreditation, developmentally appropriate practices, and state and national conferences. K1 and T1 mentioned that parents expect their children will have fun and receive academic instruction, while D1 indicated that parents share their concerns about their children with her. Most of the teachers noted that children exert control in their classrooms in various ways, as their interests and development/age drive curriculum, and through interactions and language.

Capital and knowledge-beliefs. All of the teachers talked about learning about mathematics with young children from their methods courses, conferences, other professional development, and other teachers. They all also discussed their ideas about what constitutes mathematical activity. For example, teachers in the Duck room incorporate patterning into their line up routine. Veteran teachers appreciated the new knowledge that D3 and S2 brought to their classrooms from their recent coursework, as well as knowledge gained from early childhood research. Half the teachers (K1, S1, S2, D2, D3) described instances of gaining knowledge from working with the children. The teachers all use their knowledge of the curriculum and typically developing children to integrate mathematics into the daily schedule.

Mechanisms of change. E1 described a major event in the history of the school that challenged the status quo immensely and has caused a great deal of disjunction for her. Previously, two early childhood settings co-existed on the university campus, one providing child care and the other operating as a laboratory school that provided instructional settings for undergraduate students and research opportunities. Recently, the school and center merged, and the department under which they operated

has been subsumed into another department, resulting in less observation time with young children and fewer connections to research, both as participants and implementers. S1 also mentioned fewer undergraduate students working in the center and conjectured that the economics of working in the early childhood field affected the number of students in the program. Degree programs that an assistant (D3) and a student teacher (S2) are completing have affected activities in the Ducks and Squirrel classrooms, such as by adding mathematics to everyday contexts (mathematizing). Several teachers mentioned that they experienced change in their practice after having the opportunity to put theories learned in coursework or training into practice with children.

Interactions between habitus, field, and capital – Structuring & Structured Structures. The data also includes examples of the field of the teachers using their capital in their interactions with the children. The teachers described mathematics activities and materials they created for the children and classroom environment. These practices are the result of teachers' experiences and knowledge of young children, interacting with external forces including center rules, standards, NAEYC accreditation, state regulations, and the university. The teachers acknowledge children's reactions to the activities and materials as they provide the next activity or materials, or introduce the activity to children in a future classroom. This example of a structured and structuring structure can be explained by Maton's (as cited in Grenfell, 2012, p. 51) equation: $[(\text{habitus})(\text{capital})] + \text{field} = \text{practice}$. The teacher has power imposed on her by the outside fields, while she exercises power and capital in her classroom, all the while adjusting her practice according to feedback she receives from the children.

The teachers' experiences as *learners* of mathematics were often frustrating, leaving the teachers feeling that they were "not good at math," "math was hard," and "math was not my favorite subject." However, their experiences *teaching* math with young children have been rewarding, leaving the teachers feeling that "this math is fun," and they want the children to continue having "fun" experiences with math so they grow up to enjoy it, develop positive dispositions toward mathematics (unlike some of the teachers), and succeed as students and mathematicians. It is interesting to note that eight of the ten teachers in this study were seasoned veteran teachers, with five to 22 years of experience. However, the two novice teachers in our study reported more positive experiences learning mathematics than the veteran teachers. Perhaps their stories point to improvements in K-12 mathematics since the veteran teachers were in those learning environments.

Women, Work, and Mathematics

Double consciousness (Brooks, 2007) means that women know their own lives, work, and knowledge, but they also know the dominant culture's knowledge as well because they have to navigate between both. For the early childhood teachers, this means that they know their own experiences and thinking about mathematics. They also have a sense of the "finished product," the mathematics created by the dominant male culture the children in their care will eventually be expected to know. They work back and forth between the two different experiences of mathematics, the math that they find "fun" and "enjoyable" with and for young children, and the mathematics they know the children will eventually be expected to learn. Teachers also work between their training and experiences in child development and requirements of the standards, many stating that the standards "validate" the choices they previously made based on their knowledge of children and development.

Conclusions

Although the veteran teachers in our study described many negative and less-than-productive experiences as K-12 and college mathematics learners, all of the teachers in our study currently draw on their experiences with young children and more recent research-based professional development and

state standards in their practice as early childhood mathematics teachers. In descriptions of their work, teachers expressed autonomy, confidence, and competence. Their initial habitus upon entering the field of early childhood education has evolved during interactions with the children in their classrooms, their families, professional development activities, and state standards. Despite acquiring a negative habitus while learning mathematics, they all now enthusiastically teach mathematics with young children, planning activities based on their understanding of early childhood mathematics and the children's development and interests.

This study illuminates several social factors that influence what early childhood teachers do and teach, such as standards, center regulations and administration, research, university organization, parents, and children. Some factors affected all teachers at a center in a similar way, such as the use of standards, while other factors only affected individual teachers, such as each teacher's training. Implications are that early childhood teachers may benefit from examining their early experiences learning mathematics and the role those experiences have on their teaching. Teacher educators might ask preservice teachers to examine these early experiences and then provide tasks that support them to reflect on and integrate new information with their knowledge-beliefs developed earlier (Brown, 2005). They might also highlight the fixed nature of structures such as standards and ask preservice teachers to consider ways they could adjust their notions of practice.

The results from our study suggest that both veteran and novice early childhood teachers bring a lot of capital to their work, which should be respected by stakeholders, including early childhood teacher educators and policy makers. In addition to appreciating veteran teachers' capital, teacher educators might emphasize to their students that, although novice teachers expect to learn from veteran teachers, the capital novice teachers bring to teaching is often appreciated by veteran teachers. Our results also suggest that grounding math methods or content training in experiences *with* young children could engage early childhood teachers when they feel less competent about the training subject, such as geometry with young children. This would connect and value the work that these women do with young children with more formal mathematics.

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