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Early literacy and numeracy matters

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Abstract

The beginning of literacy and numeracy development is embedded in the everyday communications, actions, thoughts and drawings of babies, toddlers and young children. Parents and the home learning environment are critically important in the development of both. Research has also demonstrated the positive impact of attending early childhood settings on early vocabulary development, literacy and numeracy skills (Barnett & Esposito Lamy, 2006). Therefore, those who work with very young children have a unique opportunity to get it right from the start and to enhance children's literacy and numeracy today, as the above quote suggests, through rich learning opportunities. Drawing from French (2012) this paper responds to the questions: what do we mean by early literacy and numeracy, why they are important, what research and theory have revealed in relation to these topics and what are the key concepts for early childhood educators to encourage in early childhood?

Introduction

Many of the things we need can wait. The child cannot. Right now is the time his bones are being formed, his blood is being made and his senses are being developed. To him we cannot answer 'Tomorrow'. His name is 'Today'. (Mistral, 1998)

We know that the beginning of literacy and numeracy development is embedded in the everyday communications, actions, thoughts and drawings of babies, toddlers and young children. Parents and the home learning environment are critically important in setting the foundations for later learning (Dickinson & Tabors, 2002). Research has also demonstrated the positive impact of attending early childhood settings on early vocabulary development and literacy and numeracy skills (Barnett & Esposito Lamy, 2006). Therefore, those who work with very young children have a unique opportunity to get it right from the start and to enhance children's literacy and numeracy *today*, as the above quote suggests, through rich learning opportunities.

Drawing from French (2012), this paper begins by defining what we mean by literacy and numeracy. The paper highlights the importance of early literacy and numeracy, referring to the disappointing international assessments of the performance of Irish post-primary students, the subsequent policy developments and the negative consequences of a lack of skills in these areas. *Aistear the Early Childhood Curriculum Framework* (National Council for Curriculum and Assessment [NCCA], 2009) emphasises the role of the adult in providing children with experiences which will enrich their understanding of the role of literacy and numeracy in the world around them. This paper outlines what we know about the development of literacy and numeracy in early childhood and what early literacy and numeracy experiences should be provided. The paper aims to enable early childhood educators to enrich their pedagogical practice (where one individual contributes to the learning and development in another) to develop children's dispositions, knowledge and skills in these areas.

What do we mean by early literacy and numeracy?

Literacy has previously been thought to comprise of the skills of reading and writing. Today our understanding of literacy is broader than that. Before the results of three decades of research became known, formal reading instruction often began when children were deemed 'ready' for it at six. However, we now know that literacy 'emerges' gradually in the early years (Epstein, 2007). Literacy begins with learning language and looking at books in early infancy. This process continues from birth throughout the early childhood years. The definition of literacy in the National Literacy and Numeracy Strategy includes "the capacity to read, understand and critically appreciate various forms of communication including spoken language, printed text, broadcast media, and digital media"

(Department of Education and Skills [DES] 2011, p.8).

This broad definition acknowledges the impact of technology on literacy. Central to literacy is the search for meaning and understanding – stories, books, and visual, technological and cultural literacies are significant (Whitehead, 2007). In early childhood, the development of literacy involves babies hearing sounds and having them identified by sensitive adults, babbling and repeating sounds and rhymes, later sharing books or stories on DVD or TV or other information communication technologies such as computer-based texts, images, voice and music recordings or games on mobile phones – listening, looking at and talking about the pictures with others, and making marks in sand and on paper (Epstein, 2007). Literacy is therefore the integration of listening, speaking, reading and writing, for communication and learning to learn (Department of Education and Science, 2005). Literacy learning occurs during meaningful interactions, experiences with a broad range of materials, texts, digital technologies and events.

Numeracy is more than the ability to add, subtract, multiply, divide and use numbers.

Numeracy encompasses the ability to use mathematical understanding and skills to solve problems and meet the demands of day-to-day living in complex social settings. To have this ability, a young person needs to be able to think and communicate quantitatively, to make sense of data, to have a spatial awareness, to understand patterns and sequences, and to recognise situations where mathematical reasoning can be applied to solve problems. (DES, 2011, p.8)

In early childhood, the development of numeracy involves babies hearing the language of mathematics in play by singing number rhymes (one, two, buckle my shoe...), fitting ‘smaller’ boxes inside ‘bigger’ boxes, learning that some things are the ‘same’, whilst others are ‘different’, experiencing going ‘faster’ or ‘slower’ (Epstein, 2007; NCCA, 2009). Young children learn to make sense of data through practical experiences such as sorting all the yoghurt cartons into the recyclable plastics bin and the paper into the recyclable paper bin, or putting things together that have a connection, such as a cup to a saucer. Developing spatial awareness involves children moving freely in space, or filling and emptying water containers at the water table. Understanding patterns and

sequences involves children knowing what comes next in a song (pat-a-cake, pat-a-cake, baker's man...) or in a pattern on a pegboard (Montague-Smith, 2002). Babies use problem-solving skills such as trial and error, for example to make the mobile move by using a sequence of body movements to reach the mobile.

Why are early literacy and numeracy important?

In Ireland, the performance of post-primary students in the Programme for International Student Assessment (PISA 2009) conducted by the Organisation for Economic Co-operation and Development (2010) has declined in the areas of literacy and numeracy. PISA 2009 demonstrated that almost one in five of all Irish fifteen year olds and almost one in four teenage boys lacked the literacy skills to adequately function in today's society. Similarly, one in five Irish teenagers did not have sufficient numerical skills to cope with everyday life. These results have given rise to the development of a National Literacy and Numeracy Strategy (DES, 2011) and the commissioning of research reports by the National Council for Curriculum and Assessment, to support a new primary language curriculum, one of which has a focus on literacy in early childhood and primary education (Kennedy et al., 2012).

Children who do not learn to read, write and communicate effectively at primary level are more likely to leave school early, be unemployed or in low-skilled jobs, have poorer emotional and physical health and are more likely to end up in poverty and in our prisons (National Economic and Social Forum [NESF], 2009). Literacy difficulties are linked to truancy, exclusion, social consequences such as alcohol or drug abuse, increased health risks and greatly reduced life chances (KPMG Foundation, 2006; NESF, 2009).

Children with unsatisfactory literacy ability may struggle in other academic areas (NESF, 2009). This has profound negative consequences for individuals in the long term in relation to their choice of employment, as many careers call for reading proficiency. Reading failure affects school achievement, job choice and economic prosperity in adulthood (Dugdale & Clark, 2008). But it is not just an economic problem; children's self esteem may be lowered and low self esteem can have other negative effects on children's achievement of their full human potential.

Numeracy not only forms the basis of many other subjects such as physics and chemistry, it is a critical element in our everyday lives. The use of counting (e.g. shopping for specific items), ordering (e.g. turning right at the second set of

traffic lights), and quantifying measurement (e.g. estimating when to cook dishes so that all are ready at the same time) is universally recognised (Pound, 1999). Without literacy and numeracy skills, children may develop a lack of confidence in their ability to succeed.

The United Nations Educational, Scientific and Cultural Organisation (UNESCO, 2011) consider ‘Literacy as Freedom’. Every child has a *right* to a good quality education which equips them with literacy and numeracy skills for life and further learning. Literate and numerate parents are enabled to support their children’s learning in school; literate and numerate people are better able to access continuing educational opportunities; and literate and numerate societies are better geared to meet the demands of competing markets, ensure economic prosperity and societies’ well-being (UNESCO, 2011).

Communication and oral language skills of babies, toddlers and young children underpin their development of literacy and numeracy (Epstein, 2007, NCCA, 2009). As a component of basic education and a foundation for lifelong learning, literacy and numeracy are the keys to enhancing human capabilities and achieving many other rights. In short, literacy (and numeracy) carries wide-ranging benefits not only for individuals but also for families, communities and societies (NESF, 2009).

What we know about early literacy

The following, drawing on a review of the literature, summarises what we know about early literacy:

- Literacy is not rooted in letters and words initially, but in communication and language. That is, non-verbal communication (smiling, gestures, pointing) and warm reciprocal relationships. Therefore, literacy development starts from birth (Whitehead, 2007). Speaking, listening, reading and writing develop concurrently (together) rather than sequentially (one after the other) (Epstein, 2007).
- Emergent early childhood literacy skills that have been identified as strong predictors of later literacy achievement include: a large vocabulary, being capable of explanatory talk, demonstrating some letter identification before age five, understanding narrative and story, understanding writing functions, knowing nursery rhymes, and demonstrating phonological awareness (sounds of a language) (Strickland & Riley-Ayers, 2006).

- The greater children's experiences of literacy and language, the greater the chance of reading fluency (Strickland & Riley-Ayers, 2006). However, the converse is also true. The fewer experiences children have with literacy and language (i.e. vocabulary and talk), the greater the chance that they will have difficulty learning to read. A high correlation between vocabulary size at age three and language test scores at ages nine and ten in areas of vocabulary, listening, syntax (sentence structure, grammar, language rules) and reading comprehension was evidenced in one study (Hart & Risley, 1995). In that study, the size of each child's vocabulary at aged three correlated most closely to a single factor: the number of words the parents spoke to the child in the home. It follows that early childhood settings (crèches, play groups and so on) can also play a significant role in exposing children to vocabulary and talk.
- We know that children are "most likely to experience conversations that include comprehensible and interesting extended discourse and are rich with vocabulary when their parents" (and, logically, early years educators) "obtain and read good books and when their teachers provide classrooms with a curriculum that is varied and stimulating" (Dickinson & Tabors, 2002, p. 13). In a seminal research project children who were read to frequently by a variety of people, had access to a large number and broad range of books and who used a library regularly scored highest "on all three measures of early literacy (receptive vocabulary, narrative production, and emergent literacy)" (Dickinson & Tabors, 2002, p. 13).
- Language and literacy learning happens naturally during play and everyday experiences. Some aspects however depend on explicit instruction from observant and sensitive adults. Through play all of the domains of a child's development (cognitive, social-emotional, language and literacy, physical, spiritual) are interrelated and interdependent (Epstein, 2007).
- Differences in children's home language and culture can affect literacy development in each of their languages. Strategies for supporting biliteracy (children reading and writing in their first and second language) could be considered (Kennedy et al., 2012). Educator knowledge, respect and support for the diversity of children's families, cultures and linguistic backgrounds are important in early literacy development. In other words, the socio-cultural context of children's families should be included in a

literacy curriculum. This involves effective strategies for enhancing the language used in the early childhood service, together with support for the language and culture of the home (Whitehead, 2007).

- It is what parents, carers and educators *do* with children (reading with children, talking to them, sharing stories), more so than their socio-economic status, which makes the difference to children's literacy learning outcomes (Sylva, Melhuish, Sammons, Siraj-Blatchford and Taggart, 2004).

The literature has clear implications for early education practice:

- The importance of the development of children's language and communication skills from birth is recognised.
- Aspects of children's communication environment are identified, which can positively enhance children's language, communication and hence literacy skills.
- Children's exposure to a broad vocabulary range, through parent and educator-child interactions, in all early childhood settings is particularly significant.
- An appropriate communication environment can offset educational inequality to a significant extent.

What early literacy experiences should we provide?

The early childhood literacy skills that have been identified as strong predictors of later achievement include:

- **Oral language**, which includes listening, comprehension (understanding narrative and story – the process of making meaning from action, speech, and text by connecting what one is learning to what one already knows), oral language vocabulary and being capable of explanatory talk (Strickland & Riley-Ayers, 2006). Oral language is encouraged by talking to children about what is happening around them, supporting them to describe events and build background knowledge, story telling and the use of story sacks, where stories are brought to life through puppets, drama and extension

learning experiences linked to the story (Noonan-Lepaon and Ridgway, 2009). Reading stories in an interactive way also supports children's language development (Whitehead, 2007).

- **Phonological awareness**, which constitutes the general ability to decipher the sound patterns within words (Kennedy et al., 2012). Phonological awareness supports the development of early decoding and spelling ability, both of which are precursors to later reading and spelling achievement. When exposed to, and supported to repeat, a range of sounds through nursery and action rhymes and finger plays children develop an awareness of the important constituent sounds within words, such as those that rhyme, syllables and phonemes. A phoneme is the smallest unit of sound within a language. It can be represented by one letter (grapheme) such as 't' or more than one letter, such as 'th'. Phonemic awareness involves the insight that every word can be broken down into sequences of constituent phonemes e.g. 'sat' is made up of 's' /'a' /'t'. Phonemic awareness is a precursor to the understanding of alphabets (Kennedy et al., 2012).
- **Alphabetic code**, which includes alphabet knowledge (knowledge of letters) (Strickland & Riley-Ayers, 2006). Children need lots of exposure to the alphabet in their surroundings (in books, on refrigerator magnets, on blocks, in soup, in cereal, in having their names, stories, titles of paintings written for them, in their own attempts to write, in the reading and writing area; generally in ways they can physically access them in their environment).
- **Print knowledge/concepts**, which include knowledge and experience of environmental print (stories, notices, signs), how print is organised on the page, and how print is used for reading and writing. Children must learn that reading and writing (in English) follows basic rules such as flowing from top-to-bottom and left-to-right, and that the print on the page is what is being read by someone who knows how to read (Strickland & Riley-Ayers, 2006).
- **Emergent writing or mark-making**, which includes how marks are representations of ideas and can develop into letters and then words which can be read (understanding writing functions). Early writing – i.e. drawings, marks on paper, in sand, in yoghurt, on a steamed window, in gloop, a child's first attempts at letters or his name – is important. It

provides a means through which children may communicate their feelings and thoughts to others. Learning about writing – as with reading – begins in infancy (Whitehead, 2007). For young children, dictating words and ideas to an adult (story dictation) who can then read them back to the children in their own words can be a very empowering and enlightening experience. This is also known as scribing.

What we know about early numeracy

There has been a growing body of interest in numeracy in young children. Key points that have emerged are:

- The basics of numeracy are present from a very early stage. Babies learn very quickly that taking away results in less and adding results in more (Post & Hohmann, 2000).
- Traditional views of teaching numeracy based on Piagetian theory have been challenged; in particular his underestimation of children's competence and an overemphasis on classification, sorting and matching exercises. In contrast, Vygotskian theory, with its emphasis on the role of the adult and/or more knowledgeable peers in social interaction in learning and development, supports professional practice in numeracy in the early years (Barber, 1998). Therefore, numeracy development is supported by good quality interactions. Such interactions are most likely in small groups and key person systems (where an educator is responsible for a specified group of children) (Epstein, 2007).
- However, interactions based on numeracy are infrequent. They occur as part of stories and songs but not always other experiences. In one seminal study, it seemed as if educators were not aware of the mathematical potential in a shared game or meal times (Munn & Shaffer, 1993).
- Skills in counting should underpin numeracy. Large numbers (from the number ten on) should be included in counting (Barber, 1998).
- Children need to use numbers in a context that makes sense to them. Children's experiences of numeracy should be based in firsthand experiences and familiar contexts (Rich et al., 2005). An emphasis on worksheets and

colouring-in activities fails to tap into the mathematical understanding and knowledge that most young children have (Moyles, 2001).

- McCray (2007) addressed a myth about early numeracy, which is that for young children numeracy is less important than learning language and literacy skills. The widespread nature of this myth has been documented in several studies. For example Barnett & Esposito Lamy (2006, p.7) reported that “little effort is devoted to math education in preschool programs”. Kotsopolous and Lee (2013; in the paper that follows this one), cite other studies where those caring for young children prior to the start of formal schooling tend to focus more on literacy than on numeracy (Tudge & Doucet, 2004). This reality is true for both children who attend structured childcare/early learning programs and for those who are cared for in private settings (i.e., their homes or other’s homes) (Barbarin et al., 2005; Cannon & Ginsburg, 2008; Winton & Buysse, 2005).
- However, learning numerical skills early has far reaching consequences. In a longitudinal study it was found that early numerical skills not only predict later abilities in numeracy, but also predict later abilities in literacy (Duncan et al., 2007). The converse cannot be said to hold true for early literacy scores; abilities in early literacy at age five seem not to predict numerical abilities at age 10. The answer to this finding seems to be that the kinds of thinking that are involved in numeracy, such as logical thinking, abstraction and problem-solving, have broader application to learning generally than the more specific skills required for literacy (McCray, 2007).

These findings from the literature have clear implications for early education practice:

- Early childhood educators need to connect and build on the variety and range of children’s everyday experiences of numeracy in the home and early childhood settings.
- Children need to be enabled ‘to understand the value of numeracy as a mode of communication in everyday life. This is essential if young children are to see any real purpose in engaging with numeracy related learning’ (Dunphy, 2006, p. 72).

- In brief early childhood educators need to be informed about numeracy related concepts, to plan everyday experiences, communicate about those experiences, reflect on their practice and continually strive to improve their practice.

What early numeracy experiences should we provide?

The role of early childhood settings is to develop children's enthusiastic dispositions towards seeing numeracy in the world around them, having knowledge on which to draw from and develop a numeracy related language. The role of adults is to sustain motivation, to provide resources, to aid children in seeing numeracy through modelling, using the language of numbers, measures, patterns and shape and critically capitalising on interactions to enhance children's experiences. The core content of a curriculum for babies, toddlers and young children, therefore, could include concepts about (Montague-Smith, 2002):

- **Number** by hearing stories that have numbers in them (e.g. 'The Three Little Pigs') and providing materials that have numbers on them such as phones, clocks, calendars, price lists, money, calculators, keyboards and so on.
- **Counting** by providing children with opportunities for counting in many different contexts and for real purposes. When adults are observed counting out loud for a reason, children have a greater chance of grasping the abstract nature of what they see. In play, children could be asked: 'Are there enough chairs for the dolls? Let's count them.'
- **Pattern** (algebra) by bringing children on pattern walks inside to examine patterns in curtains, clothes, floor tiles and wallpaper. While outdoors notice the patterns in the pavement blocks of the footpath, the patterns on the bricks of houses and in nature (e.g. the wings of a ladybird). Play clapping games (e.g. A sailor went to sea, sea, sea...)
- **Shape and space** (geometry) by identifying, naming and describing 'shapes'. Support children to change the shape and arrangement of objects (wrapping, twisting, stretching, stacking, enclosing). Working with three dimensions (pyramids, balls and cubes) can better support children learning and explorations with shape. Organise the environment so children independently find and return objects to develop spatial awareness. Support

filling and emptying, putting in and taking out. Interpret spatial relations in drawings, pictures and photographs.

- **Measures** (making comparisons) by encouraging children to compare size, such as the biggest teddy; length, such as the longest piece of play-dough; height, such as who is the tallest; volume, such as the amount of milk that can be poured from the jug into a cup; weight, such as carrying a heavy bucket of sand from the sand pit; and time, as it may be ‘time to tidy-up’. Even complex measures including area and speed may be talked about, and if valued by the children’s settings and broader culture, will be learned.

Guiding the increasingly knowledgeable participation of children as numerical thinkers requires educators to have (Anning and Edwards, 2006):

- Knowledge of numeracy within experiences provided, aided by team planning/discussion. For example, children’s exposure to the concrete experience of dividing and naming things in halves and quarters (sharing fruit or playdough ‘half for you...’) supports the understanding of fractions. Children learn what is ‘big’ and what is ‘little’ when choosing what size spoon to eat with, or when hearing the story of Goldilocks and the three bears. Later they will use centimetres, kilograms and degrees to measure and compare. Children need many of these experiences.
- Knowledge of what specific children already understand through observation.
- Content (what we want children to understand – one-to-one correspondence, cardinal numbers, distinguishing between a square or a rectangle).
- Orientation (how we would like children to tackle the experiences – dispositions to engage numerically, for example, finding a way of remembering where they started counting, organising into sets, aiming at accuracy when measuring, learning to record, know patterns).
- Knowledge of how we pace our support (for example, while playing a card game).

Children also need to engage in certain processes such as using the language of numeracy, problem-solving and mark-making. Children engage in the **language of numeracy** by hearing those around them talk about volume, length, pattern and so forth (Barber, 1998). **Problem-solving** is not just about good ideas, it involves playfulness and creativity. It is also about deep reflection and time and space to work out solutions. Wait until children ask for assistance or until they have made an attempt at a solution and seem to be about to abandon the effort. Respond supportively and immediately to children's calls for assistance and attention. Provide many natural, open-ended materials both indoors and outdoors. Give children time to work out how to balance or attach things for themselves. They learn more by solving their own spatial problems, in any event they learn that there is often more than just one solution (Epstein, 2007). **Mark-making** is important. In order for young children to communicate numerical concepts, they must first recognise that there is a connection between the mark they make and what it stands for. For example, that a dot they made outside the circle represents one person at a table (Anning & Edwards, 2006). This learning takes time and opportunities to represent through clay, dough, paint, and all forms of artistic expression should be encouraged.

Conclusion

We now know that high quality literacy and numeracy experiences in the early years can have a beneficial impact on children's later achievement (Sylva et al., 2004). We know that children's learning and development are best supported through play and immersion in meaningful, direct, hands-on, interactive and challenging experiences. We need early childhood educators willing and able to engage in continuing professional development regarding early literacy and numeracy to keep abreast of current professional practice and latest developments. Such educators will be able to articulate the serious intellectual content of what is happening as children engage with literacy and numeracy experiences – and explain how that content is likely to pave the road to successful engagement in learning.

A whole setting approach (where all adults in the setting are informed on the importance of early literacy and numeracy and empowered to support those skills in children) could fully embrace the importance and indeed responsibility that educators have to enhance young children's life chances. Early childhood educators have a unique opportunity to get it right from the start, at such a crucial stage in children's learning and development.

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What are the Development Enhancing Features of Mathematical Play ?

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Abstract

In this research, our objective was to identify development enhancing features of play between parent-child (ages 26 to 39 months) dyads that may be more supportive for mathematical learning. While the adult in this research is a parent, the results can be applied to other early year settings where the adult may be an early childhood educator or caregiver. Emerging from a qualitative analysis of 23 30-minute naturalistic play sessions, three development enhancing features were identified: (1) reinforcing learning, (2) checking for understanding, or (3) advancing learning. Combinations (one or more) of these development enhancing features formed the basis of the conceptualization of “purposeful play.” Purposeful play is defined and potential implications for mathematical learning and parent-child play are discussed.

Key words: Learning, mathematics, number, parents, play

Introduction

Many play theorists and researchers argue that play *is* learning for young children (Broadhead, Howard, & Wood, 2010; Fisher, 2008; Hirsh-Pasek, Michnick Golinkoff, Berk, & Singer, 2009; Pramling Samuelsson & Asplund Carlsson, 2008). This view has captured the intense interest of researchers who are eager to understand the mechanisms by which children develop cognitively, socially, and emotionally. Consequently, theorists and researchers have proposed and studied

many different types of play including free or unstructured play (J. Duncan & Lockwood, 2008; Piaget, 1962; Pramling Samuelsson & Johansson, 2009; Vygotsky, 1962, 1978), pretend or imaginative play (Pramling Samuelsson & Johansson, 2009; Sawyer, 1997; Singer & Singer, 2005), play-based learning (Fisher, 2008), block play (Hanline, Milton, & Phelps, 2010; Park, Chae, & Foulks Boyd, 2008), and so forth. Research suggests that play has been shown to improve “school readiness in two broad domains: cognitive skills (literacy, math, problem solving, imagination, and creativity) and social and emotional skills” (Hirsh-Pasek et al., 2009, p. 19).

Howard (2010), however, argues that “despite decades of research, it has proved difficult to determine that play has unique developmental qualities, and to isolate the benefits of play from other causal determinants” (p. 145). Causal determinants which have been shown to have important consequences for young children may include the way in which play is structured, supported, encouraged, and perceived by adults, and the nature of participation of adults (Hirsh-Pasek et al., 2009). Other causal determinants could include family culture, gender, motivation, and personal dispositions (Broadhead et al., 2010; Chaplin, 2005).

Some suggest that play *belongs to the player* and should be exclusively child-initiated and guided solely by the child’s interests (Piaget, 1962; Sutton-Smith, 1997). Others argue that adults have a crucial role in shaping the play environment and guiding potential learning opportunities emerging out of play in ways that advance the learning of the child (Fisher, 2008; Hirsh-Pasek et al., 2009; Howard, 2010). For example, research has shown that play guided by adults who are supporting executive function skills (e.g., attention, problem-solving and inhibition) were related to improvements in mathematics and reading (Uren, 2008). Adults’ role in play is proposed to have three functions: planning for play, supporting play, and reviewing play (National Council for Curriculum and Assessment, 2009, p. 56). Across each of these roles, play is inextricably linked to assessment as the basis from which planning, supporting, and reviewing emerge.

Remarkably, little research exists examining the role of adults in children’s play in the area of mathematics learning and development. What is known, however, is that those caring for young children prior to the start of formal schooling tend to focus more on literacy than on numeracy (Tudge & Doucet, 2004). This reality is true for both children who attend structured childcare/early learning programs and for those who are cared for in private settings (i.e., their homes or other’s homes) (Barbarin et al., 2005; Cannon & Ginsburg, 2008; Winton & Buysse, 2005).

Research Objectives and Question

In this research, our objective was to examine the intersection of play and mathematical learning between parent-child dyads to identify potential development enhancing features. For the purpose of this research, “parent” will be used to denote the adult in the play. However, the adult could be a childcare provider (private home or public facility) or another significant adult caring for the child such as a grandparent. The question guiding our research was *what are potential development enhancing features exhibited by parents that support mathematical play?* We identify three development enhancing features and introduce *purposeful play* which is a form of play that has as its core features one or more of the development enhancing features that we describe shortly.

Development enhancing features are defined as those pedagogical processes used by parents that are potentially useful in furthering or advancing learning of the child. In the present research, those developmental features are also ones that are seen as particularly supportive of mathematical learning. Mathematical play is defined as play that supports the learning of mathematical concepts such as number sense (i.e., counting, identifying numbers, addition, subtraction, multiplication, division, and proportional reasoning), patterning and algebra, geometry, measurement, and data management. In the present research, we look most closely at the number sense and specifically counting and identifying numbers. However, the developmental enhancing features of play that are proposed can be potentially applied to any of the mathematical concepts outlined above.

We state at the onset that our research is admittedly preliminary. However, given the dearth of research exploring the parent’s role in mathematical play, foundational research in this area is needed and this research aims to be an early contributor.

Literature Review

Young children are cognitively capable of engaging in activities geared towards developing mathematical abilities from a very young age (Andersson, 2007; Butterworth, 1999a, 1999b; Clements, 1999; Clements & Sarama, 2009; Ginsburg, Lee, & Boyd, 2008; Sarama & Clements, 2009; 2006; Wynn, 1990). Shortly after birth, infants have been found to be able to discriminate between one to three objects (Starkey, 1980). By about six months of age, children will consistently chose two biscuits when given a choice between one or two (Feigenson, Carey, & Hauser, 2002; Feigenson, Carey, & Spelke, 2002). By nine