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Math Play: Growing and developing mathematics understanding in an emergent play-based environment.

A Thesis submitted in partial satisfaction of the requirements
for the degree Master of Arts

in

Teaching and Learning (Curriculum Design)

by

Kendra DeGroot

Committee in charge:

Alison Wishard Guerra, Chair
Cheryl Forbes
Susan Scharton

2012

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The Thesis of Kendra DeGroot is approved, and it is acceptable in quality and form for publication on microfilm and electronically:

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Chair

University of California, San Diego
2012

Dedication

I dedicate this work to all the children that I have met and to all the children that I will meet in the future as part of my classroom community. I will continue to stay inspired and enthusiastic in providing beautiful and inviting spaces for you to explore, investigate, socialize and most importantly play. I will remind myself of the important words that are found in the following poem by Loris Malaguzzi.

The Hundred Languages

No way. The hundred is there.

The child is made of one hundred. The child has a hundred languages, a hundred hands, a hundred thoughts, a hundred ways of thinking, of playing, of speaking.

A hundred always a hundred ways of listening, of marveling, of loving, a hundred joys for singing and understanding a hundred worlds to discover a hundred worlds to invent a hundred worlds to dream.

The child has a hundred languages (and a hundred hundred hundred more) but they steal ninety-nine. The school and the culture separate the head from the body. They tell the child: to think without hands, to do without head ,to listen and not to speak, to understand without joy, to love and to marvel only at Easter and at Christmas.

They tell the child: to discover the world already there and of the hundred they steal ninety-nine.

They tell the child: that work and play, reality and fantasy, science and imagination, sky and earth, reason and dream are things that do not belong together.

And thus they tell the child that the hundred is not there. The child says: No way. The hundred is there.

-Loris Malaguzzi (translated by Lella Gandini)

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Acknowledgments

I would like to acknowledge my family, colleagues, co-workers, and members of my cohort who supported my efforts in completing this project. I owe special thanks to Alison Wishard Guerra and Cheryl Forbes for supporting my journey into academic research and writing. Furthermore, I would like to whole heartedly thank my mom and dad for believing in and motivating me with loving support. It is also the beautiful little friends that I have made in my work that has driven to become a more inspired, educated, creative, and forward thinking teacher.

ABSTRACT OF THESIS

Math Play: Growing and developing mathematics understanding in an emergent play-based environment.

by

Kendra DeGroot

Master of Arts in Teaching and Learning (Curriculum Design)

University of California, San Diego, 2012

Alison Wishard Guerra, Chair

This project explores how mathematics growth and development can be supported, documented and assessed in an emergent play-based early childhood education environment inspired by the principles of Reggio Emilia. Using the California Preschool Learning Foundations, Math Play includes developmentally appropriate activities and environments that support cognitive development within the mathematics domain. This curriculum documents how a classroom's emergent themes were interwoven into activities and environments that did not oppose the practices and principles of the approach. Math Play successfully documented each

child's mathematic understanding and areas needing further growth and development. With the California Preschool Learning Foundations as a framework, teachers can use Math Play to establish a child's level of understanding which plays an important role in assessing a child's school readiness. Math Play provides examples of how teachers can use portfolios for assessment of growth and development. Math Play provides an alternative for standardized assessment that authenticates the experiences that preschool children are having while growing and developing in a Reggio Emilia inspired environment. After implementation of Math Play the following two findings were deduced: 1. Children engaged and demonstrated a range of mathematic growth and development that corresponds with the eighteen sub-strands of the California Preschool Learning Foundations. 2. Authentic formative portfolios provided an effective way to discuss individual child mathematic growth and development with assistant teachers and parents. In addition children who were involved in this research continued to grow and develop by engaging in activities that furthered their mathematic foundation after Math Play implementation.

Introduction

Introduction of Environment and Self

Early childhood education, no matter what the approach, has a universal goal of preparing young children not only for academic life but for life in general. Research shows that all children can benefit from participating in high-quality preschool programs and this idea is endorsed by the United States Department of Education (U.S. Department of Education, 2000). High quality early childhood education programs focus on both cognitive and social development, as both are crucial in the growth and development of young children.

Learning begins well before children enter kindergarten. During the first five years of life children are building the social and cognitive foundation necessary to be ready for formal schooling (NAEYC,2009; Pianta, 2005). Early childhood education programs are designed to help support the development of these skills so children are "ready" for school when they begin kindergarten. Early education is critical because children who have the right kinds of educational experiences before kindergarten do better in school (Dwyer, Chait & McKee, 2000). Early childhood education lays a foundation for future school success by creating developmentally appropriate activities and environments that challenge children both cognitively and social-emotionally. Much research has found that children who participate in early childhood education programs are more likely to experience academic success in their future (Shankoff & Phillips, 2000).

It is in early childhood education classrooms where children form their first relationships with teachers, learn how to interact with a larger group of peers and form a connection to their greater community. This is a period of time in a child's life when growth and development are greatest (Bowman, Donovan & Burns, 2001; Shonkoff & Phillips, 2000).

Prior to designing and implementing this project, I furthered my education to learn more about the growth and development that occurs in early childhood education classrooms. I wanted to be a part of creating a nurturing environment where children would explore and investigate the world around them. In this period of time in my own education I was introduced to the principles and practices that formulate the *Reggio Emilia* approach to early childhood education, a play-based approach that inspired the environment that I would soon create. In 2005 I opened Coastal Sprouts Pre-school, a Reggio Emilia inspired early childhood education program.

In early childhood education, some approaches are more academically oriented, focusing on cognitive development including reading, writing and mathematics, while other approaches are more play-based, incorporating cognitive and social development into children's play. Parallel to these approaches, some programs focus on a structured curriculum while others follow an emergent curriculum based on the developing interests of the children. Reggio Emilia supports a play-based environment where emergent themes from the children's interests are scaffolded upon to build developmentally appropriate experiences. In both academic and play-based, approaches children are growing and developing

social and cognitive skills. It is the differences in the principles that guide their practices that make them each unique.

Environments that successfully support children's school readiness strike an appropriate balance between cognitive and social-emotional development constructs. Examples of this include those presented in the publication, California Preschool Learning Foundations, published in 2009 by the state of California "to provide the child development field with research-based competencies—knowledge and skills—that we can expect most children to exhibit in a quality program as they complete their first or second year of preschool." (CDE, 2008). Some would argue that current Early Childhood Education classrooms have the scale tilting towards cognition thus placing a lack of emphasis on social development (Logue, 2006; Zigler, Singer & Bishop-Josef, 2004). When discussing early learning standards the National Association for the Education of Young Children (2009) stated in order to be effective standards must explicitly incorporate a wide range of domains including motivation, learning approaches, cognitive, social, emotional, physical, and language development, and discipline-specific domains including the arts, literacy, mathematics, science, and social studies. In a position statement the NAEYC (2009) further argued for developmentally appropriate practices (DAP's), which provide a framework for environments that foster equality, development and learning in all domains. During early childhood education children are growing and developing skills in all domains simultaneously in environments that appropriately challenge new learning. This position statement goes further on to advocate for "the

importance of a comprehensive curriculum and the interrelatedness of the developmental domains in children's well-being and success" (p.11).

My experience with Reggio Emilia led me to investigate how an emergent play-based curriculum supports early learning in all domains simultaneously through play experiences. In an emergent play-based environment a teacher builds the classroom curriculum around child initiated subjects of interest that will support both their social-emotional and cognitive growth and development. Children in emergent play-based environments engage socially with their peers while participating in developmentally appropriate emergent activities that build cognitive foundations necessary for literacy and mathematic understanding.

The California Preschool Learning Foundations presents a detailed understanding of what is typical for children to usually know before entering kindergarten referred. These, as well as those in other state standards and in child development texts and curricula, serve as guidelines for assessments (including standardized tests and informal observations) that help educators individually address areas where development is progressing and areas where further development is needed (Notari-Syverson, Losardo & Lim, 2003).

Assessment reports range from informal as seen in parent teacher conferences to formal standardized formats as seen in the Desired Results Development Record. Both provide valuable information for parents and teachers. For parents, these reports provide information that can help in guiding them how to further work with children at home to help get them ready for kindergarten. For teachers, these reports help in making conscious curriculum decisions that create

opportunities in their classrooms to address developmental needs. Informal assessments of children are ongoing in classrooms and are incorporated into the everyday functions of teaching. Formal assessment practices can be conducted in a multitude of ways depending upon the assessment. Ultimately assessments, from informal to formal, can be used as a tool for determining a child's school readiness in early childhood education.

Synder, Wixson, Talapatra & Roach (2008) stated in a article addressing assessment, "early childhood practitioners have an opportunity to embrace assessment practices that meaningfully inform instruction and are part of a larger outcomes-focused accountability system focused on alignment of early learning standards, curricular practices and child outcomes" (p.32). Unlike formal assessment reports teachers use informal assessment practices daily to help guide how they work with individual children in their classroom. Early childhood education teachers may also use formal assessment criteria to informally track a child's growth and development. Both of these practices are essential to knowing how a child is progressing and to formulating curricula that foster their growth and development. As in this example, assessment practices do not always have the goal of creating scores and categorizing children.

Assessments in early childhood education are essential; however the type of assessment used should appropriately compliment the learning and environment/approach. From my experience, I have found that most traditional assessments tools available do not effectively document, personalize or offer opportunities for authenticity in emergent play-based early childhood education

classrooms. Traditional assessment tools outline criteria for which children should be evaluated, often providing little space for teachers to provide personal insight or for children to conduct themselves naturally while being assessed. Some assessments are better suited to a traditional academic approach to early childhood education while other assessments are better suited to an emergent play-based approach. Approaches to assessment that are integrated into the everyday activities may be more appropriate for an emergent play-based environment.

Reggio Emilia inspired environments commonly use alternative approaches of assessment such as portfolios, parent-teacher conferences to evaluate and discuss growth and development that occur in their students. Portfolios include artifacts of the children's work, photographs documenting experiences at school, dictation of the children's thoughts, documentation of events that occur and personal stories told both from the teacher's perspective as well as the child's. Portfolios authenticate and contextualize each individual child's daily experiences that occur in an emergent play-based early childhood classroom.

Portfolios, however, often do not to follow a standard set of criteria to document child growth and development. The California Preschool Learning Foundations present a domain specific guide to understanding child growth and development that supports early childhood educators. Early childhood education practices have not devoted enough time discovering and developing the form, data and conduct of powerful portfolios (Herbert, 2001).

After creating and operating Coastal Sprouts I became aware of the need to effectively and appropriately prepare young children for school. I did not wish to

use a traditional standard assessment tool as I found the standardized formats to be impersonal while also not complimenting an emergent play-based approach; however I wanted to be sure I addressed the primary domains of children's development. I had already begun to consciously hone these domains into learning opportunities that would allow me to authentically evaluate a student's growth and development in a curricularly emergent, play-based environment. My interest in school readiness and my commitment to a collection of valuable developmentally reflective artifacts, such as portfolios, persuaded me that both can work effectively together. Despite my persuasion, I remained curious if school readiness domains could be effectively mapped onto an authentic formative portfolio assessment in an emergent play-based Reggio Emilia inspired environment.

The Need for School Readiness

A child's participation in preschool has been recognized as playing an important role in preparing them for their future academic success. Before entering kindergarten children typically and usually have domain specific competencies that have created the foundation for their future learning. Acquiring this knowledge in quality early childhood programs is one way to provide support to an ever growing diverse population of learners. Due to this newly placed importance upon kindergarten school readiness many early childhood environments are using various forms of assessment to discuss individual child growth and development. With all of the changes that are taking place within this time period of education it is worthy of our time to make sure that teachers appropriately engage, guide, provide and assess children of this age.

School readiness

Preschool education in America is entering a new era as a result of evidence that underscores its importance. From the time of conception to the first years of kindergarten we know now that children develop at a pace exceeding that of any other time in their lives (Pianta, Cox, & Snow, 2007; Shonkoff & Phillips, 2000). Evidence also shows that preschool children are active learners who are constructing new knowledge to make sense of the world around them (Bowman, Donovan, Burns, 2001). Consequently, increasing importance is being placed on early childhood education as it has been shown to improve academic performance throughout the education continuum (Dwyer, Chait, & McKee, 2000). There is now

more pressure for early childhood educators to lay the proper foundations that result in school readiness.

Pianta, Cox and Snow (2007) commented that, “The K-12 establishment views preschool as school and is in fact banking on the dividends expected from early childhood education to help improve lagging achievement in the era of No Child Left Behind and to meet Adequate Yearly Progress” (p. 6). School readiness, however, is a multi-facetted concept that can mean different things to different people. School readiness in the state of California could be said to address growth and development in the five domains of learning that are included in the California Preschool Learning Foundations V.1, ranging from social-emotional development to cognitive development. A succinct school readiness goal would be to provide a high-quality environment that promotes the acquisition of linguistic, mathematical and other relevant skills and sets the stage for fostering self-regulated and intrinsically motivated learning as key components of the socially defined educational process (Bowman, Donovan, Burns, 2001; Pianta, Cox & Snow, 2007).

Diversity Among Young Children

Diversity in the United States has weaved an increasingly multicultural society. The diversity of families and school populations is likely to be the most pronounced among the younger age groups of children with our early childhood classrooms reflecting our nation’s changing cultural mosaic. The NAEYC (2009) stated in their Standards for Early Childhood Professional Preparation Programs that “this increased diversity is seen in the large numbers of children from culturally and linguistically diverse communities, as well as in the growing numbers of children

with disabilities and other special learning needs who attend early childhood programs" (p. 5). Challenges of culture, language, family background, and special needs all create diversity in a population of learners that benefit from early childhood education. The US Census Bureau (2004) reported that there are approximately 45% of children under the age 5 that are ethnically or linguistically diverse and that this trend is expected to grow. A population of diverse learners in early childhood education has created a situation where many children are being considered at risk when they enter into kindergarten. According to a literacy study conducted in 2008, "risk often coincides with familial and environmental characteristics such as socioeconomic status, parents' (often mother's) educational background, English language proficiency, and racial or ethnic background (Zimmerman et al., 2008). One or more of these characteristics places students at a higher risk for poor academic performance (Perie, Grigg, & Donahue, 2005).

As a result an increased interest has been placed on addressing the achievement gap that exists when children are entering kindergarten with a focus on establishing school readiness prior to their entrance. Early childhood education has been proven to play a monumental role in establishing school readiness and closing achievement gaps for children considered at-risk (Coolahan, Mendes, Fantuzzo, & McDermott, 2000). In 2008 Jack O'Connell signed a bill for Preschool California, Children Now, and the Child Development Administrators Association stating,

> "The single most daunting challenge facing public education in our state today is the achievement gap. Providing high quality preschool is key to closing this gap and ensuring that all children learn at the high levels we

know they can…any effort to close the achievement gap in the state of California must begin with high quality preschool" (p.1).

Access to High-quality, Developmentally Appropriate Environments

Currently, nationwide efforts are aimed at providing access to high-quality early childhood educational environments to all children with special attention to children considered at-risk. Access to high-quality programs promotes positive developmental outcomes both while children are enrolled and as they enter school (Brown, Scott-Little, Amwake, & Wynn, 2007). Brown and Scott-Little (2003) also found that children considered at risk benefit most from quality early childhood services.

Early childhood education supports a critical time of growth and development where the quality of experiences either has a positive or negative impact on children's interest in learning. "High quality early childhood education can promote intellectual, language, physical, social and emotional development, creating school readiness and building a foundation for later academic and social competence" (Brown, Scott-Little, Amwake, & Wynn, 2007, p. 2).

Approaches to early childhood education differ in their practices but agree in the goal of building a strong and multidimensional developmental foundation for all children. For example teachers from *Head Start*, *Montessori* and *Reggio Emilia,* programs implement a curriculum based on professional knowledge of early childhood goals and domain relevant activities. In planning relevant, engaging learning experiences, teachers work to ensure that children's learning experiences

(in both adult-guided and child-guided contexts) are in line with developmentally appropriate practices (NAEYC, 2009).

Making a distinction between adult-guided and child-guided experiences allows us to decipher between more traditional and alternative emergent play-based approaches. While traditional programs rely heavily on adult-guided experiences that are implemented from a predetermined curriculum, alternative approaches such as Reggio Emilia, rely mainly on the appropriate guidance of the children's interest to create a classroom environment that fosters growth and development. Malaguzzi (1998) responded to how the children shape their school experiences by saying, "They can help by offering us ideas, suggestions, problems, questions, clues, and paths to follow; and the more they trust us and see us as a resource, the more they give us help" (p.89). It is important that alternative approaches guide the children's interest in appropriate ways that create an environment that is educationally rich and seen as high quality.

Distinguishing academically-based environments from play-based environments is another way of deciphering between traditional and alternative approaches. Academically-based approaches, which are growing exponentially in number, place an emphasis on building a strong cognitive foundation while play-based approaches place an emphasis on building a strong social-emotional foundation in early learners. The NAEYC position paper (2009) advocating for developmentally appropriate practices stated, "Play is an important vehicle for developing self-regulation as well as for promoting language, cognition, and social competence" (p. 14). However, developmentally appropriate practices which have

been recognized nationally have veered from the traditional approaches that emphasize academics by placing an emphasis on play. Bowman, Donovan & Burns mention critics that argue developmentally appropriate practices lack subject matter substance and they fail to provide the information children need (2001). Reggio Emilians would also agree that play is highly valued for its ability to promote growth and development (Edwards, Gandini, & Forman, 1998).

Throughout early childhood educational history the pendulum has swung from one side to the other as the focus has shifted from development of the whole child through play to cognitive development and intelligence. As it is now, prevailing political winds have placed an emphasis on cognitive development and a disenchanting feeling toward play has taken us a step backward in history. While supporters of the development of the whole child do not devalue the importance of cognitive skills they believe there is a balanced approach that is based upon the best child development research and developmentally appropriate practices (Zigler, Singer & Bishop-Josef, 2004). Zigler, Singer and Bishop-Josef (2004) believed that "decades of empirical research clearly demonstrate the benefits of play for children's cognitive, social, and physical development" (p. 8).

Assessment

Assessment and evaluation are essential components of effective early childhood education programs (NAEYC, 2009). Assessment and evaluation approaches of significance to this study range from informal to formal, standard to authentic, and norm referenced to curriculum referenced. Assessment in early childhood education looks to identify school readiness skills that are typically found

in children prepared for kindergarten and define areas in which a child may need further growth and development. While many early childhood education programs follow a standard published curriculum with an embedded assessment tool, other programs that follow a more emergent curriculum or play-based approach may not adapt a universal approach to assessment and evaluation. Although traditional assessments and evaluation provide necessary information on the quality of early childhood education environments and document a child's school readiness, that goal can be accomplished alternatively (NAEYC, 2009). With the current trend focused on academics and cognition a need has been placed on emergent play-based approaches to provide evidence that school readiness goals can be documented and established within emergent play-based environments. The current project looks to provide this evidence through including mathematic foundations in curriculum planning and authentic formative portfolio assessment of children's mathematic development. This assessment shows how school readiness goals can be documented in emergent play-based environments that are Reggio Emilia-inspired.

Review of Literature

Quality in Early Childhood Education

Nationally an emphasis has been placed on expanding and implementing early childhood education programs. Federal and state governments have invested in early childhood education programs and almost three-fourths of the states now fund such programs that serve over 25% of 4-year olds in this country (Barnett, Hustedt, Robin, & Schulman, 2005).

National attention has not only been placed on providing access to early childhood education programs but also upon the quality of these early childhood education programs to maximize their academic and school readiness outcomes (Pianta, Howes, & Burchinal et al, 2005). Quality in an early childhood education program, not simply whether a child attends an early childhood education program, is the most important predictor of a child's school readiness success.

Designing and measuring quality

Research supports that there is an association between quality and an early childhood education programs success (Pianta, Howes, & Burchinal et al., 2005; Early et al., 2006; Burchinal, Howes, Pianta, Bryant et al., 2008). Evaluating this quality in classrooms became very important, however, how to measure quality is very multi-demensional. Observation of moment-to-moment displays of behaviors, overall classrooms environments, level of teacher education, teacher sensitivity in social interactions with children and academic stimulation are just a few examples of criteria that have been used to measure quality in classrooms.

Due to the importance of quality, NAEYC became very interested in insuring and also evaluating quality in early education programs. Based upon Piagetian and Vygotskian principles of teaching and learning, quality early childhood classrooms should provide developmentally appropriate materials that help children in mastering new concepts. The NAEYC also suggests that learning must be skillfully planned by teachers to occur in the context of lessons, classroom routines, and play interactions (Burchinal, Howes, Pianta, Bryant et al., 2008).

Developmentally Appropriate Practices

Developmentally appropriate practices (DAP) were publicized in a position statement promoting excellence in early childhood education by providing a framework for best practices (NAEYC, 2009). Bowman, Donovan and Burns (2001) would add that DAPs are "probably the best known standards" (p. 300). The standards were published by the National Association for the Education of Young Children and were based upon what we know from theory and literature about how children develop and learn (NAEYC, 2009). The principles that guide DAP have been widely accepted and endorsed and incorporated into teacher education programs through The National Council for the Accreditation of Teacher Education (Bowman, Donovan 7 Burns, 2001).

In early childhood education, DAPs encourage teachers' intentionality in aiming for goals that are both challenging and achievable for children. In order for teachers to align themselves with DAP they must have extensiv knowledge in child growth and development. According to the NAEYC (2009) early childhood educators must consider the following three areas of knowledge:

> [1.] what is known about child development and learning…[2.] what experiences are likely to best promote children's learning and development [3.] what is known about each child as an individual…[together these tell us] how to best adapt and be responsive to that individual variation, [based on] what is known about the social and cultural contexts in which children live…[, and that] experiences in the program or school are meaningful, relevant, and respectful for each child and family. (p. 10-11).

By keeping these three core components close to curriculum design teachers can be intentional in what they do, from planning curriculum to assessment of children.

Children's play as part of DAP

The "Standards for Early Childhood Professional Preparation Programs" position statement released by the NAEYC (2009) supports the role of play by stating "Because spontaneous play is such a powerful window on all aspects of children's development…create opportunities to observe children in playful situations" (p.13). The NAEYC argues that play is not only as pleasurable, but is a way for creating interactions in a reciprocal manner with growth across the developmental domains. Furthermore the role of play is supported by socio-cultural theory, which argues when children are engaged in play; children are functioning close to their optimal development (Vygotsky, 1978).

Emergent curriculum as part of DAP

DAP encourage teachers to use a variety of teaching techniques in order to effectively improve activities that foster growth and development. Emergent curriculum relies on teachers to observe and understand children's interests and questions and create developmentally appropriate curriculum based upon those interests and questions (Chaille, 2008). The NAEYC (2009) states, "effective teachers also organize the classroom environment and plan ways to pursue educational goals for each child as opportunities arise in child-initiated activities and in activities planned and initiated by the teacher" (p. 14). By applying emergent curriculum practices in a classroom, research partnerships between the children and teachers are formed that support a healthy network of relationships in school and promote a collaborative learning environment (Hughes, 2008). The U.S Department of Education in "High Quality Early Childhood Education Programs" (2000) would add that teachers use their expertise to gauge "a child's interests and daily activities to extend vocabulary, introduce numeracy concepts, and reinforce language sounds that are the building blocks of reading" (p. 6).

DAP challenges

Due to the undeniable importance that early childhood education plays in shaping children's futures the NAEYC (2009) highlighted the following three challenges; reducing learning gaps in schools and increasing the overall academic achievement of all children; creating a better educational connection that aligns children's experiences in preschool with children's experiences in elementary

school; and recognizing that high-quality, experienced teachers play an vital role in the decision making processes that promote educational effectiveness.

Assessment and Evaluation in Early Childhood Education

DAP principles are applied to all early childhood educational practices and procedures as the NAEYC strives to meet its goals and conquer its challenges. The NAEYC states in its Early Learning Standards that assessment must be technically, developmentally, and culturally valid as an essential component of effective early childhood education (NAEYC, 2002). As children develop at different rates it is important to respect and acknowledge that individual growth and development will vary for every child. With this early childhood education needs to apply assessment and evaluation techniques that recognize individual variations in learners and allow children to demonstrate their competence in different ways (NAEYC, 2009). The U.S. Department of Education (2000) stated that "schools certainly need to assess the effectiveness of preschool programs in terms of their outcomes for children…because the course of development in the preschool years is uneven and sporadic, assessment results that reflect only a single point in time can easily misrepresent children's learning (p. 21).

Traditional formal assessment in early childhood education

Traditional formal assessment and evaluation techniques are of grave concern (Synder, Wixson, Talapatra & Roach, 2008). The nature and the instruments of these tests are concerning because while they weigh heavily on assessing language and literacy, at the same time they do not address the important early childhood educational goals of social and emotional development (Pianta, Cox

& Snow, 2007). Traditional formal assessment procedures fail to distinguish between a child's current level of performance and his or her ability to learn and acquire new skills and information (Bowman, Donovan & Burns, 2001). Furthermore, these tests fail to recognize the role of motivation, personality, social factors and cultural issues that play an important role in the processes of assessing and evaluation a child (Shonkoff & Phillips, 2000; Pianta, Cox & Snow, 2007). While these test may provide information about a how a child performs in a specific situation compared to that of his peers these tests have limited use to guide decisions about the design, delivery, and monitoring of instruction. In other words Synder, Wixson, Talapatra & Roach (2008) said "they lack instructional or interventional validity" (p. 26).

Authentic formative assessment in emergent play-based environments

According to Malaguzzi (1946) "teachers need only to observe and listen to the children, as they continuously suggest to us what interests them, and what they would like to explore in a deeper way" (p. 90). With emergent curriculum guiding classroom experiences authentic formative assessment and evaluation practices capture the ideas that children introduce as subjects for growth and development and respect the variety in children's learning styles. Authentic formative assessments also allow children to share their growth and learning in ways that express their individuality (Helm et al, 1998). An authentic approach to assessment according to Pianta, Cox and Snow (2007), would not attempt to "create independent scores of competencies but, rather, to apply assessments in naturally occurring contexts in

which the domains of school readiness and achievement would be intertwined" (pp. 209).

Seitz and Bartholomew (2008) opened their research findings with a statement regarding authentic forms of assessment as a place where "children, educators, parents and administrator's are able to see the collection of items that celebrates the child" (pp.63). Authentic formative assessment materials must sample evidence of progressively more complex skill development so that even the smallest increment of change can be detected and celebrated (Neisworth & Bagnato, 2005). Portfolios are a purposeful collection of child's work that can be used for authentic formative assessment and evaluation.

Portfolio creation as part of assessment and evaluation

When thinking about the idea of a portfolio one might imagine a set of items that come together as a collection to represent an individual's work. It may include artwork, photographs, dictation, work samples, documentation, random artifacts and much more. Portfolios may include all of these items; however, it is not only what a portfolio contains but how a portfolio is designed that makes it purposeful. In early childhood education, portfolios that have intentional goals and contain purposeful artifacts help the student, the teacher, and others to understand learning (Seitz & Bartholomew, 2008). For teachers, they provide a way to collect and present a variety of performance data, creating a rich and comprehensive portrayal of each student's accomplishments (Carpenter, Ray & Bloom, 1995). The portfolio has become an alternative approach for teachers to report on a child's individual growth and development in a more authentic way.

Portfolios and their design are very broad in spectrum. Some view portfolios simply as a working folder that can be added to when a child creates something that represents growth and development in an identifiable domain. Others have referred to portfolios as a collection of student work that should show both affective and cognitive growth. One of the most specific definitions was given by Paulson, Paulson and Meyer (1991), however, who said,

> A portfolio is a purposeful collection of student work that exhibits the student's efforts, progress, and achievements in one or more areas. The collection must include student participation in selecting contents, the criteria for selection, the criteria for judging merit, and evidence of student reflection (p.60).

As mentioned above children should be included in the processes of creating their portfolio. Seitz and Bartholomew (2008) stated, "Children and teachers work together to identify strengths, artifacts, and other documentation and to better understand where students need to improve or continue to develop. Students become self-directed when they are supported and scaffolded to produce the portfolio" (p. 64). The complete portfolio becomes a way for students and teachers to both reflect on what domains need work and what goals have been accomplished. Depending on when and how often items were collected, a portfolio can be a component in completing formative and summative assessments. Smith, Brewer & Heffner (2003) identified the portfolio as "a way to demonstrate a specific dimension of learning (e.g., numeracy)…[can be] goal based portfolio [to]…assess pre-established school readiness objectives (e.g., letter recognition)" (p.40).

Of great significance, portfolios can help build a child's self-confidence and self-esteem. Portfolios are a way for teachers to evaluate a child's development

without comparing that child to another child. The individual attention allows the child to experience the process of learning and assessment as enjoyable and fun (Smith, Brewer & Heffner, 2003). Edwards, Gandini & Forman (1998) noted that "portfolios are becoming more popular in American schools and that portfolios are touted as a more authentic form of assessment" (p. 246).

Documentation as part of assessment and evaluation

Documentation is a powerful strategy to effectively make visible the assessment processes in early childhood education programs (Cooney & Buchanan, 2001). Documentation was described by Cooney and Buchanan (2001) "as the practice of representing children's learning through photographic sequences accompanied by explanatory notes, which often include the children's comments and dialogue" (p. 11). Pedagogical documentation may also be viewed as a process of research, and is term used to describe formative assessment leading to program improvement and evaluation of a child's growth and development (Dahlberg, Moss, & Pence 1999). Some have further said that "pedagogical documentation plays a role in seeing and understanding children as individuals rather than normalizing children against standardized measures and categorizing some as "abnormal" (Moss & Dillon, 2000, p. 251).

In her study Margaret MacDonald asked the question, "is pedagogical documentation useful to children and teachers as a method of formative assessment and planning" (p. 234). She reported one teacher stating that children "are making connections that you may not be examining in a standard assessment" (p.238).

Overall MacDonald stated, “in general teachers’ responses were positive to the documentation process” (p. 239).

The process of taking quality pedagogical documentation is a teacher’s true art form. Documentation of children’s work in a wide variety of media also provides critical and compelling public evidence of the intellectual powers of young children, evidence that is not otherwise available (Katz, 1993). In order to provide this, documentation should not only define where children are growing and developing but also show the activities in the school environment are fostering growth and development. Schroeder-Yu’s (2008) research summarized that, “documentation collected through photographs, recorded conversations, and visual art examples can provide an opportunity for educators to make visible the learning that is happening in the classroom for individual children” (p. 129).

Establishing School Readiness Through Authentic Formative Assessment

Recently there is an increased interest in the topic of school readiness as early childhood education practitioners and policymakers are recognizing the importance of establishing specific knowledge, skills and characteristics children should acquire before entering kindergarten (Scott-Little, Kagan & Frelow, 2006). Historically school readiness has been defined by a child’s chronological age rather than by the child’s readiness to learn which varies greatly from child to child with no regard to their chronological age. In order to clarify the concept of school readiness Scott-Little et al. (2006) established the following definition, “a specific set of skills and knowledge that contribute to children’s later success in school” (p.

163). However, even this simple, general definition of "school readiness" does not mean the same to everyone.

Since it is impossible to apply an appropriate universal definition to the term, "school ready," Pianta, Cox and Snow (2007) argues that "readiness exists in the abstract and is a valuable part of the educational landscape" (p. 150). However the School Readiness Act (2005) defined the following areas for children entering kindergarten: language knowledge and skills, pre-reading knowledge and skills, pre-mathematics knowledge and skills, cognitive abilities related to academic achievement, social and emotional development and, in the case of limited English speakers, progress towards English language acquisition (Pianta, Cox & Snow, 2007).

Although this definition was used widely to address the issue of school readiness, when teachers were asked what should be present when children enter kindergarten they placed a huge emphasis on social-emotional development while consistently placing academic skills at or near the bottom of their readiness priorities (Lara-Cinisomo, Fuligni, Ritchie, Howes & Karoly, 2007). In a collaborative university-led study regarding students' growth and development in pre-kindergarten environments the following three areas of growth and development were found necessary for four year old children: academic, language and social skills (Mashburn, Pianta, Hamre, Downer, Barbarian, Bryant, Burchinal, Early & Howes, 2008). Another team of researchers identified five areas of school readiness: physical well-being and motor development, social and emotional development,

approaches toward learning, language and communication development and cognition and general knowledge (Scott-Little, Kagan, Frelow, 2006

While there are many interpretations of school readiness, many identify social-emotional and cognition as domains necessary for establishing a child's school readiness. A child that is considered socially and emotionally school ready would demonstrate social skills, the ability to control emotions or respond appropriately when angry and the ability to form relationships with peers and adults (Bowman, Donovan, & Burns, 2001). Examples of abilities that a school-ready child demonstrates include factual knowledge about a variety of subjects the ability to sort blocks into boxes and the correct identification of letters in the alphabet (Scott-Little et al., 2006; Bowman et al., 2001; Piant et al., 2007

In order to establish school readiness Seitz and Bartholomew (2008) spoke of authentic formative assessment and the evaluation process of a child's portfolio as a procedure of, "collect, select and reflect" (p. 66). Each of these three processes has distinct functions that are equally important and assist teachers in establishing school readiness in their children. In the selection process the teacher has background knowledge about the standards and artifacts that provide evidence of meeting them in addition to the deeper understanding of developmental knowledge. The reflection process is a time to revisit and review past work, to think about strengths and weaknesses, and to set goals for future opportunities. Teachers might use the reflection process to guide curriculum and to assess individual as well as group understanding of concepts (Seitz & Bartholomew, 2008).

A Focus on Mathematics School Readiness

Naturally engrained in emergent play-based environments is social-emotional growth and development as the children learn though guided exploration of their interests, play, and self-expression (Edwards, Gandini & Forman, 1998). Children within emergent play-based environments routinely exercise the social skills that are necessary for establishing social-emotional school readiness. Even though cognitive growth and development is also necessary for establishing school readiness, preschool children are not consistently exposed to the cognitive domain of mathematics (Pianta, Cox & Snow, 2007).

Included within the mathematics portion of the "California Preschool Learning Foundations" (2008) are "behaviors in mathematics learning that are typical of children who will be ready to learn what is expected of them in kindergarten" (p. 143). Children must possess appropriate social-emotional, cognitive and language development as well as show a motivation for learning. Furthermore, mathematics plays an important role in creating a preschool educational environment which builds the foundations for school readiness.

In the California Preschool Learning Foundations are the three major basic building blocks for counting and learning which are, "the sequence of number words, one-to-one correlation, and cardinality (knowing that the last number assigned to the last object counted gives the total number in the set)" (p. 160). A child's ability to count small numbers in preschool has a direct impact on their ability to manipulate larger numbers later on. The preschool years are a critical time for children to build a strong familiarity with numbers and counting. Due to the

amount of importance that mathematics plays in a child's future success the California Preschool Learning Foundations identify the following five main developmental strands for mathematics: number sense, algebra and functions, measurement, geometry, and mathematical reasoning. Included within each of these strands are examples of how preschool age children may show competency for any of the given strands.

Review of Existing Curricula

Current Practices in Early Childhood Education Curriculum and Assessment

Currently in early childhood education there are number of ways that programs are reaching school readiness goals. The philosophies can be viewed as utilizing a traditional approach or an alternative approach. Traditional approaches typically follow a pre-defined curriculum to guide children's experiences and are typically adult lead experiences. Alternative approaches typically build a curriculum around the children's interest and are typically child lead play experiences. Traditional approaches and alternative approaches can also be compared based upon their typical form for assessment. School readiness goals, parental involvement, developmental appropriateness, and assessment will be highlighted as each curriculum is investigated further for this research.

Traditional Approaches in Early Childhood Education

State funding in preschool environment has greatly increased the number of children that are able to attend early childhood education programs. Because of the increased importance placed on development in this age group, school readiness and continuality into public school are the foci for many programs. In order to attain these goals, many programs have been utilizing *The Creative Curriculum for Preschool* (Dodge, D., Colker, L., & Heroman, C., 2002)and *High Scope* curriculum in Early Childhood Education.

The Creative Curriculum for Preschool, Fourth Addition. *The Creative Curriculum for Preschool* was originally written in 1978 with the fourth edition

being completed in 2002 (Dodge, D., Colker, L., & Heroman, C., 2002). The curriculum is based on research and has been revised in order to reflect new knowledge in the area of growth and development amongst preschool age children. This curriculum provides a brief discussion of the fundamentals of child development, the learning environment, what children learn, the teacher's role, and the family's role. It looks further into the basic areas of environment that is included in a preschool classroom (i.e. blocks, dramatic play, toys and games, art, library, discovery, sand and water, music and movement, cooking, computers, outdoors) and discusses how each environment promote sdevelopment, how to create the physical environment, what children are learning while participating in each area, and finally what the teacher's role is in facilitating the activities in that specific area.

School readiness is cited in the introduction of the curriculum as a necessary driver of content standards for this age group. The fourth edition has been enriched to demonstrate how teachers can incorporate content learning into everyday experiences. The goals of this curriculum see social/emotional, physical, cognitive and language development as the framework for creating curriculum that keeps the whole of the child in mind.

With the current focus on readiness, accountability, and high standards, there is always a danger that programs will focus only on academic content and ignore aspects of development that are equally important for achieving long lasting and positive results (Dodge, Colker & Heroman, 2002

As mentioned in the review of literature a high level of importance has been placed on parental involvement. *The Creative Curriculum for Preschool* encourages

teachers and families to work cohesively as it will improve the quality of experiences that children have in preschool. The curriculum outlines how to get to know your families, how to make families feel welcome, how to communicate with families, partnering with families, and how to respond to stress in family situations. The curriculum guides teachers on how to conduct successful parent conferences utilizing student portfolios to support communication. This curriculum suggests meeting with families three times a year. In these meeting an emphasis should be placed on the areas that the teachers know the parents have particular interest in.

Developmentally appropriate practices have guided the framework of this curriculum. In my application of developmentally appropriate practice (DAP), I have sought to highlight the important balance between applying a general knowledge of child development with the particular knowledge a teacher gains by forming a relationship with each child and family (Dodge, Colker & Heroman, 2002).

The Creative Curriculum for Preschool and "The Creative Curriculum Developmental Continuum" assessment system are intended to be used simultaneously to ensure that goals and objectives are being met through curricular activities. This assessment uses a fill in the bubble format to most appropriately describe a particular child's level of development in specific domain areas. The curriculum suggests utilizing portfolios in combination with the assessment as a way to further document student growth and development.

High Scope. *High Scope* preschool philosophy was established out of research that was conducted on best practices in the early 1970's. The main

principle that propels High Scope teaching is the idea that adults and children learn best through hands-on experiences. This philosophy seeks to present opportunities in the classroom where children are actively engaged with people, materials, events and ideas. In order to provide support for High Scope preschool teachers this philosophy includes a complete system of teaching practices, defined curriculum content areas for each topic and age group, assessment tools and a training model.

The curriculum is built around core content areas that include approaches to learning; language, literacy and communication; social and emotional development; physical health, development and well-being; and arts and sciences. Within the core content areas are 58 key developmental indicators that are used to create milestones that guide teachers as they are planning their classroom experiences.

As this philosophy notes, developmentally appropriate practices are aimed at strengthening adult-child interaction, classroom layout and materials, and daily routines. The daily routine is most affected by the first in-class, large group morning meeting that happens each day in a High Scope classroom. At this morning meeting children are asked to make choices about what they will do that day in class. They then carry out their ideas and at the following day's (or a later) meeting they reflect on the activities that they completed throughout the day.

The preschool "Child Observation Record" (COR) is used to evaluate child progress with the practices of the High Scope philosophy. The COR focuses broadly on areas of cognition, social-emotional development and the physical capabilities of preschool age children. These comprehensive and generic tools can be used in any preschool environment that is looking to assess development.

Alternative Approaches in Early Childhood Education

Alternative approaches in early childhood education have been receiving much recognition for providing developmentally appropriate experiences for preschool age children. Within the review of existing alternative curriculum I will highlight the approaches of Montessori and Reggio Emilia.

Montessori. Montessori philosophy was created at the turn of the 20th century when schools were seen as factories and children as blank slates. The Montessori approach is grounded in close and insightful observations of children rather than in adult convenience and misconception (Lillard, 2005). Montessori unlike other approaches uses specific materials, designed for specific purposes, to aid in assessing student growth and development. Lillard states, "Montessori education is organized to the core" (p. 21).

In addition to utilizing tools for a primary purpose, the overarching Montessori curriculum is also tightly structured. Materials within a curriculum area are presented in a hierarchical sequence, and there is a complex web of interrelationships between materials in different areas of the curriculum (Lillard, 2005). Montessori encourages reading and writing through exercises that increase fine motor skills, for example, and these writing exercises introduce children to principles of botany and geometry.

Montessori considers the acquisition of individual character to be as important as cognitive development. The Montessori philosophy and related academic tools were created long before the concept of developmentally appropriate practices became the curricular standard for early childhood education. Although

the Montessori philosophy has been successful in reaching school readiness goals its' practices are typically adult lead activities where open ended play opportunities are not provided.

As Gutek (2004) describes, "Montessori thought strived to move away from abstract philosophical generalizations to the use of the scientific method to discover the patterns of children's development. By doing so, a structured educative environment with a set of instructional processes was created" (p 45).

When entering a Montessori preschool setting, unlike other preschool settings, the children can be found working quietly, concentrating on the series of steps that have been shown to them by their teacher. These steps assist in building the three stages of learning that support Montessori classrooms. The first stage introduces concepts, the second stage allows students to process information and develop understanding, and the third stage tests students to assess their knowledge and understanding.

The Montessori approach does not rely heavily on parental involvement in the classroom. The approach focuses mainly on the importance of parents creating supportive home life environments that are fostering the growth and development that is happening within the curriculum.

Reggio Emilia

For the purpose of this study I will provide an in-depth look at the Reggio Emilia approach to creating a solid foundation of comprehensive understanding among early childhood learners. This philosophy is currently guiding practices in the classroom where my research will take place and has received world wide

recognition. As all alternative approaches offer unique qualities, Reggio Emilia has been commended for taking an innovative and inspirational approach to the practices of early childhood education.

Historically, Reggio Emilia originated in the Italian town of Pistoia, Italy in the early 1950's. It opened as a parents' cooperative that grew exponentially in Italy, and spread to various parts of the world. Reggio Emilia now enjoys an influential international position as an alternative philosophy that guides early childhood principles in a developmentally appropriate way. Barbara Kantraowitz, contributing editor to Newsweek and a German Marshall Fund in education, has argued that "the race for a good education no longer stops at the water's edge. U.S. schools have stumbled. If we're to catch up, there are models to follow-from all around the globe" (Newsweek, 1991). Kantrowitz cites Reggio Emilia a grass-roots project that became an international role model for preschools (Newsweek, 1991)..

Over the past 30 years, many different scholars from different fields have contributed to the ever-evolving practice of the Reggio approach. As Cadwell (2003) noted, "among them are Susan Issacs, Maria Montessori, Lev Vygotsky, Jean Piaget, Erik Erikson, John Dewey, David Hawkins, Humberto Maturana, Francisco Varela, Gregory Bateson and Jerome Bruner" (p. 3). As Reggio Emilia strives to prepare children for future learning and school readiness it places a huge importance on social-emotional growth and development. Activities in Reggio Emilia inspire classrooms to encourage social interactions between children that aid in developing their sense of self amongst their peers.

Reggio Emilia places an emphasis on creating a bridge between home and school where parents are seen as partners in their child's education. The ideas and skills that families bring to the school and, even more important, the exchange of ideas between parents and teachers, favor the development of a new way of educating that helps teachers view the participation of families as an intrinsic element of collegiality and as the integration of different wisdoms (Spaggiari, 1993).

One of the greatest traditional classroom practices that the Reggio Emilia approach challenges is the top-down and uni-directional view of teacher-learner relationship. Reggio instead argues that children and teachers are engaged in a "process of reciprocal learning" (Rinaldi, 2006, p. 57). With this comes the need for teacher and student flexibility and an embrace of the unpredictability that occurs when children are encouraged to guide curriculum within Reggio Emilia schools. The children are free to work and play without the frequent interruptions and transitions so common in most early childhood programs. Edwards, Gandini & Forman (1998) offer their impression that "the majority of our early childhood programs are organized into a rigid timetable, and are often one-shot activities started, packed up, and put away within pre-specified time periods, usually counted in minutes (p. 41)".

One of the most important pieces that is used to create the Reggio approach is the environment/classroom which is considered the third teacher, the first being the child and the second being the teacher. This creates a unique strategy that guides classroom activities as the environment sets the stage for the building of knowledge.

Bergin and Garvey (1999) wrote, they have structured the school in a way that classrooms and community are integrated physically as a part of the learning design.

When examining the goals and nature of distinctively different early childhood education approaches, distinctively different assessment tools were created to meet specific goals included within each approach. A universal format of assessment for Reggio Emilia classrooms has not been created due to the unique approach that Reggio Emilia takes to curriculum design and classroom environment

Math Play

Using authentic formative portfolio assessment to establish school readiness

After reviewing current research, existing curriculum and traditional assessment practices in early childhood education, I created Math Play to make growth and development that occurs in play-based approaches that utilize the child's interest for guiding curriculum more visible through authentic formative portfolio assessment. Math Play is a curriculum that is designed based upon the frameworks provided in the California Preschool Learning Foundations (CDE, 2008) for mathematics which address cognitive growth and development that is necessary for kindergarten school readiness. The curriculum is a set of activities and environments that address mathematics growth and development that can be modified to include a classroom's emergent themes and interests.

Math Play is intended for use within an emergent play-based approach such as Reggio Emilia. A Reggio Emilia inspired classroom of ten preschool aged children between the ages of three and four was the setting for implementation. At the completion of the implementation of Math Play, four children were three and a half years of age while the other six were 4 years of age. Though Math Play was designed to document school readiness within this environment, it is designed in such a way that teacher's may use this curriculum to assist them in guiding children's interests to establish activities and environments that foster growth and development in the mathematics domain. Teachers may also use the template for authentic formative portfolios along with their embedded standardized assessments

as a way to display individual learning that is occurring in each child in their classroom.

In order to make the processes of growth and development more visible in an emergent play-based environment, I created this curriculum with two goals.

Goal One: Engage children in eighteen activities and environments that support growth and development in each of the mathematic sub-strands of the California Preschool Learning Foundations.

On a daily basis, emergent play-based curriculum environments capitalize on the freedom within the curriculum to design quality experiences that help children grow and develop both cognitively as well as socially and emotionally. In emergent play-based environments activities have a natural social-emotional element embedded. Teachers need to appropriately align and guide emergent themes towards cognitive domains that are included in the California Preschool Learning Foundations. Math Play encourages teachers to use The California Preschool Learning Foundations for mathematics to help guide classroom curriculum that strengthens cognitive growth and development.

Goal Two: Authentic formative portfolios will serve as an effective way to communicate information on child growth and development with co-teachers and parents.

Due to national attention on expected outcomes for early childhood education and kindergarten school readiness, Math Play is an approach to creating activities/environments that document growth and development that can be used to establish school readiness. After considering the current trend of using standardized

tools for creating curriculum and assessments, I designed Math Play as a method of formative assessment that is developmentally appropriate for early childhood education. Therefore, Math Play is a developmentally-appropriate assessment tool that provides an alternative to support my belief that it is only a matter of time before assessments are required in early childhood education classrooms.

Math Play addresses the mathematics portion of the California Preschool Learning Foundations by looking at the following five strands of growth and development: Number Sense, Algebra and Functions (Classification and Patterning), Measurement, Geometry, and Mathematical Reasoning. Math Play offers teachers a strategy for creating, implementing, and evaluating emergent play-based activities that meet criteria for establishing school readiness.

Features

Math Play includes an instructive tool that early childhood education teachers can use to familiarize themselves and their assistants with the California Preschool Learning Foundations for mathematics. It reveals how teachers use communication with the children and amongst themselves in planning strategies for incorporating both the emergent theme and the concept within each mathematic sub-strand. Math Play introduces activities for addressing each of the sub-strands included in the California Preschool Learning Foundations for mathematics. In order to help teachers with an authentic formative portfolio design that establishes school readiness, procedures for artifact collection are defined.

California Preschool Learning Foundations. Math Play uses the California Preschool Learning Foundations as the framework for establishing school

readiness. The mathematics foundations have been simplified in Math Play to only include age-appropriate competencies expected for children between three and four years of age. This simplified version of the foundations also includes the definitions of the five main strands and the 18 sub-strands for mathematics. I summarized the foundations in order to make them more useful in daily teacher planning procedures and succinct so teachers would only read age appropriate information. If situated in a teacher-visible location the simplified version of the mathematics foundations can remind teachers of the focus for activities and help to appropriately guide emergent themes during classroom setup, teacher-child communication, and collection of documentation artifacts.

Templates created for classroom documentation

I created multiple templates in order to document growth and development for formative portfolio assessment in the mathematic strands of the California Preschool Learning Foundations. The idea motivating the creation of these templates was to simplify the process of documentation.

Learning story template

A learning story is a teacher's compilation of a child's growth and development that was displayed over an extended amount of time (included in Appendix B). This one page documentation is intended to be included in each child's portfolio as a way of discussing domain specific accomplishments and areas that need further growth and development. Using the California Preschool Learning Foundations as a framework this insert becomes a way of discussing a child's school readiness in mathematics.

I created the document in a way that allows teachers to insert both photographs and text that document growth and development that occurred in their classroom. I used this template as a way of defining what types of documentation should be collected to be included in each child's portfolio. In Appendix B are two completed learning stories that shows how two children's data were used to support the California Preschool Learning Foundations that helped create the framework for the learning story template. Also defined in the Learning Story template is a way for teachers to show where a child is still growing and developing, which are very useful for creating a parent-teacher relationship that is mindful of the child. This part of the learning story places an emphasis on how teachers and parents can help in creating further understanding in specific strands that build mathematic understanding.

Teacher's meeting and daily activities journal template

I also created a Teacher's Meeting and Daily Activities Journal to document how I consciously aligned emergent themes to address the frameworks provided in the California Preschool Learning Foundations. This document reveals how developmentally appropriate activities were created to document mathematic understanding or areas needing further growth and development in an emergent play-based environment. This template helps by proposing leading questions that will help teachers to discuss daily activities that support children's interest that can be appropriately guided to support growth and development in all domains, but more specifically mathematic understanding for the purposes of this research. I have included examples of teacher communications that occurred during implementation

where emergent themes were identified. After the emergent theme was identified teacher's altered pre-defined activities using alternate materials that would better suit the children's interest.

Teacher planning meeting journal. It is important for all teachers and adults in the classroom to agree upon the goals that guide daily activities. In teacher planning meetings the discussion of how to appropriately guide the emergent theme to address the mathematics foundations is documented in the teacher planning meeting journal.

Included in Appendix A are three examples of this journal that were kept to document teacher planning meetings. The teacher planning meeting journal also includes a section for documenting daily activities. Teachers can look at examples from this journal to see how topics discussed in teacher planning meetings were executed in classroom activities.

In this journal, teachers note the portions of the experiences that they feel supported the children's development (i.e. procedures of activity, key vocabulary words, key points of children's interest, teacher props, etc.) of a particular mathematic understanding as well as what they feel confused or took away from the children's development. In addition, teachers note what topics or ideas are not understood by the children so another introduction or investigation can be planned. Through this reflection an emergent theme is more supportive in fostering the children's growth and development in mathematics.

Activities for each sub-strand in the mathematics foundations. Math Play consists of eighteen activities and environments, one activity or environment for

each of the eighteen sub-strands included in the mathematics domain of the California Preschool Learning Foundations. Each of the activities and environments has been described to help teachers re-create the tools that are necessary for implementation in their classroom.

Both emergent and pre-defined activities are included in Math Play. Emergent activities and environments occurred in the classroom during pre-implementation, they were included in Math Play to support the principles and practices of an emergent play-based approach. At the beginning of the year an emergent theme was identified and activities were created to foster the children's growth and development. After identifying math as a key concept in this research, emergent activities were included due to their mathematic nature. They are intended to show how this approach naturally provides opportunities for a child's mathematic growth and development. Pre-defined activities and environments included in Math Play show the conscious alignment of emergent themes with the California Preschool Learning Foundations. Although, they were not truly emergent in their nature, they were modified to fit classroom interests.

Classroom checklist of strand documentation

I created a checklist of what documentation was completed and what documentation was still needed for each of the ten children in my classroom that is included in Appendix A. This checklist is used for each to indicate which specific sub-strands from the mathematics portion of the California Preschool Learning Foundations were needed for each of the children in my classroom. This template

was created to visually remind teachers of what strands they could focus on with the children while developing and creating activities or environments in the classroom.

Emergent activities and environments

Seven of the eighteen activities and environments occurred during pre-implementation. These seven activities show how prior emergent themes naturally support growth and development in the following mathematics sub-strand: Number Sense 1.1, Number Sense 1.2, Algebra and Functions 1.1, Algebra and Functions 2.1, Algebra and Functions 2.2, Geometry 1.1, and Mathematical Reasoning 1.1. (see Appendix A)

For example, rather than pre-defining an activity or environment for Number Sense 1.2, Math Play gives an example of an environment that was created out of the children's interest in grocery stores. With this inclusion, Math Play acknowledges that while an emergent play-based approach does not have a curriculum design for mathematics, children were engaged in an environment that presented an important math concept.

Pre-defined activities and environments

The eleven remaining activities and environments were pre-defined for implementation in this approach. Although these activities and environments are not truly emergent in their nature they can be and were modified to appropriately support a classroom's emergent theme. These eleven activities show how pre-defined activities can be modified to support a classroom's emergent theme while also supporting growth and development in the following mathematics sub-strand: Number Sense 1.3, Number Sense 1.4, Number Sense 1.5, Number Sense 2.1,

Number Sense 2.2, Number Sense 2.3, Number Sense 2.4, Measurement 1.1, Measurement 1.2, Geometry 1.2, Geometry 2.1. (see Appendix A)

For example, Math Play pre-defined activities and environments using the remaining sub-strands of the California Preschool Learning Foundations as a framework for guiding children's interests. Activities and environments were introduced with the intent of establishing understanding or area still growing and developing for each child.

Authentic formative portfolio design. In the classroom teachers and teacher assistants collect photo documentation, dictation of children's communication, documentation of events and happenings and artifacts that provide evidence of understanding in the mathematics strands for use in the children's authentic formative portfolios. When a teacher is interacting one-on-one with a child and understanding is displayed in a particular sub-strand, Math Play encourages teachers or teacher assistants to take either a photo, write down key words that will be used for documentation later or dictate words that the child said.

When multiple teachers are working with a group of children, Math Play encourages the teachers to divide the collecting of the above mentioned items. For example one teacher would be responsible for each photo documentation and written documentation or dictation of the children's thoughts and ideas while the other teacher would be responsible for physically conducting the activity with the children.

Sequence for implementation of Math Play.

Math Play activities and environments, emergent or pre-defined, began in teacher planning meetings that occurred before or after a school day. Teachers discussed and identified the children's interest and ways in which to modify activities and environments to fit these interests. Each activity and environment in Math Play was implemented according to these modifications. During implementation, documentation was collected and each child understanding or area needing further growth and development was established. In the beginning phases of implementation, many children were established as needing further growth and development of mathematic concepts. During this phase Math Play activities and environments were re-introduced in teacher planning meetings to see how they could be further modified or supported to support the children's learning. When a child displayed an understanding of a mathematic concept, the artifact for data collection was added to their authentic formative portfolio. The below figure shows the sequence of events in Math Play that were necessary for appropriate alignment of emergent themes to meet the mathematical frameworks provided by the California Preschool Learning Foundations.

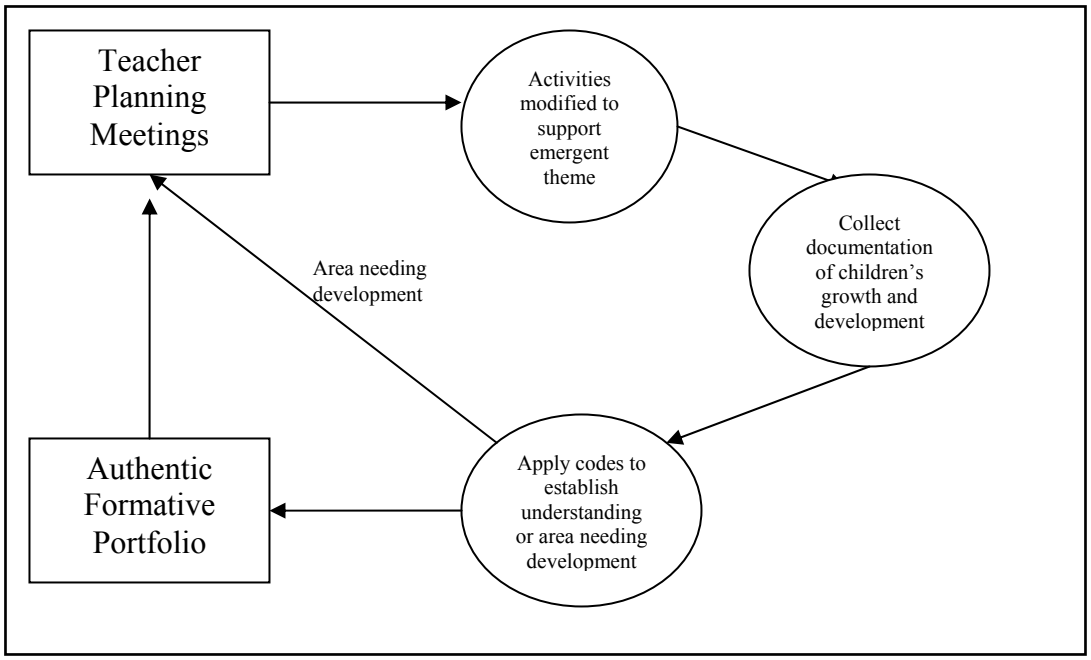


Figure 1 **Math Play sequence of events**

From teacher planning meeting to activity design and implementation Math Play establishes school readiness by evaluating artifacts that are included in the authentic formative portfolios. The portfolios are three ringed binders that are identifiable by the child's name on the side. Although binders are encouraged in Math Play, many teachers have various methods that support formative assessment. If a teacher already has a method in place for displaying student growth and development, it is encouraged that they use a method that best fits their practice. Math Play advises teachers to store portfolios in an accessible area in the classroom to encourage the children to look at their individual portfolio.

Children's portfolios are reviewed by teachers to address mathematic sub-strands that need more attention. The information collected from the activities is placed in the portfolios in chronological order to help teachers in the review process.

If a particular mathematics sub-strand activity produced little understanding in the children a new activity is created. Through this review a child's growth and development can be observed as understanding is displayed when the sub-strand is understood and new knowledge is attained. If after multiple reviews a child still does not show understanding of a particular mathematics sub-strand, the mathematic concept is identified as needing further growth and development along with suggestions for how to further growth and development that will lead to their child's understanding during parent teacher conferences.

Documenting mathematic growth and development.

As the final step teachers use collected artifacts as a way to establish each child's mathematic growth and development. Although this may seem much like the process of completing a standardized assessment tool, it is important to remember that the teachers were reviewing artwork, dictation of children's words, documentation of children's actions and photographs of children's work.

Evaluation for understanding. The children's portfolios are reviewed for understanding in each of the mathematic sub-strands of the California Preschool Learning Foundations. Children's displays of understanding are recognized while areas needing further improvement are re-investigated through additional activities/environments. A child has the opportunity to acquire further knowledge by re-investigating a particular mathematic sub-strand that can be used to document understanding necessary for establishing mathematics school readiness.

School readiness, the California Preschool Learning Foundations, and early childhood education environments share a common thread recognizing that all

domains are necessary for appropriate growth and development. Even though Math Play looks at children's mathematic understanding, all domains are present as a child's play is not domain specific. Teachers who implement Math Play in their classrooms are encouraged to use the California Preschool Learning Foundations as a framework to further document growth and development that occurs in their children outside of the mathematics domain.

Math Play is a curriculum designed for preschool teachers who wish to structure classroom activities that foster growth and development in the developmental domains (i.e. literacy, language, mathematics). Using California Preschool Learning Foundations for math as a framework, age appropriate activities were created with mathematic concepts embedded. While a teacher could follow a curriculum guide to build a mathematics foundation, Math Play attempts to show how teachers in an emergent play-based environment can build a mathematics foundation using the interests of children in their classroom. Math Play also shows how authentic formative portfolios can be used for assessment much like the assessments that are usually completed in a standardized form. Teachers who use this curriculum to inspire their own teaching practices will be able to establish each child's mathematic understanding and areas that need further growth and development which in turn will help in individualizing instruction necessary to meet school readiness goals.

Acknowledging the children's interests in the classroom is the first step in harnessing a child's motivation. Moving from this interest to developmentally

appropriate mathematics activities and environments will make the early childhood classroom come alive as the children build their own mathematics foundation.

Implementation of Math Play

Environment

The environment for this implementation was an emergent play-based preschool that is inspired by the practices and principles of Reggio Emilia. I had ten students that were four years of age at the end of the 2010 school year. I had an assistant teacher every day of the week and have a student helper at least one day of the week. Our classroom operated with a simple routine that includes morning circle after everyone had arrived followed by outside play time that concludes with joining together inside for snack and ending the day with a goodbye circle. The schedule was very flexible so as to fit the principles and practices of an emergent play-based environment. For example, if I wanted to add an additional circle time to investigate or re-investigate a topic I could add one at any point in the day. Additionally, if I wanted to take the children outside for a walk to build on an emergent theme I could do so at any time. This flexibility is very important for emergent play-based environments as a teacher works quickly to build upon the interests of the children not matter what the classroom schedule may be.

Teacher's meeting and daily activities journal

Included in Appendix A of this curriculum are two examples of how the teacher's meeting and daily activities journal supported the proper alignment of emergent themes with the California Preschool Learning Foundations. For example, our Feburary 8th journal reveals how we used the children's interest in our classroom jewels and our mosaic dinosaur to begin building the foundations for

pattern recognition that is included within the mathematics sub-strands. We planned to guide their interests in these two topics into creating an activity that would allow us to document their understanding of patterns.

An example of identifying and introducing an emergent theme

There are transitional times in my classroom when we are moving from one emergent theme to the next emergent theme. Typically there is a final outcome, a project or event, which marks the formal ending of an emergent theme. In our classroom we concluded with a "Teamwork Party" theme with a family gathering at school and then transitioned into a new emergent theme that we are called "Our Great Artist." "Our Great Artist" emergent theme was identified during pre-implementation and spanned over a number of weeks into the implementation of Math Play.

In order to identify a new emergent theme, my assistant teacher and I placed our attention on discovering what curiosities were motivating the children's play. In our classroom we have a box full of jewels and stones, a set of small random shaped tiles and a collection of caps and corks that have captivated the children's interest. The children have been using these various objects in many creative ways. They have been using the objects to fill up containers of various shapes and sizes, are creating chutes and slides for rolling the objects down, forming patterns in the play dough, organizing them into categories and placing them on our light table that illuminates the pieces from below for further investigation. The patterns that the children created in the play dough are reminiscent of a mosaic art piece. Due to the student's curiosity in the objects that we have collected we decided to place an

emphasis on these objects while exploring Betsy Schulz a local mosaic artist that has created pieces on our campus.

Each morning in our classroom begins with a morning circle that offers the teachers an opportunity to introduce ideas for the day's activities. To formally introduce our emergent theme to the children we created an activity that would end with a scavenger hunt searching for a piece of artwork created by Betsy Schulz. On this particular morning the children participated in a play dough story where they collaboratively replicated a smaller version of the dinosaur that Betsy Schulz made on our playground. As the children began forming the dinosaur we asked them how we could use the various objects that we have in our classroom to make our dinosaur more interesting. They immediately wanted to create the dinosaur's eyes, tail, spikes and claws using the stones, tiles, jewels, caps and even the corks. After decorating the dinosaur we asked the children if they had ever seen a dinosaur like this before. We then asked them if they would like to go find a dinosaur much like this one outside. The children were very excited. Many of the children were already discussing their plans to run to the upstairs playground where Betsy Schulz's dinosaur is located. After discovering the dinosaur we shared a photo of Betsy Schulz to acknowledge her as "Our Great Artist."

This is an example of how an emergent theme was identified and introduced in my emergent play-based classroom. Many of the activities and environments included in Math Play, including both pre-implementation and implementation, occurred during "Our Great Artist" theme. Furthermore, many of the activities included in Math Play have been created to include our collection of various objects

in which the children use these objects to investigate and develop a mathematic understanding of patterns, number sense, one to one correspondence, and sorting.

As our "Great Artist" theme spanned over a number of weeks, many of the activities and environments were supported by a variety of other emergent themes. Included in Math Play is a description of how the activity was introduced to the children which addresses the emergent theme that was occurring in the classroom. After viewing the activities and their descriptions, which are included in Appendix B, teachers have the opportunity to see how they can implement these activities in their classroom. Some of the activities are environments for the children to explore for a number of weeks. During the implementation of Math Play new emergent themes transpired due to the children's engagement in the designed environment.

Inclusion of pre-implementation activities/environments

As I began to plan activities and environments for implementation in my classroom, I struggled with how authentic the activities and environments would be if I pre-defined one for each of the eighteen mathematics sub-strands without acknowledging our classrooms emergent themes. I reviewed prior activities and environments that I had created for my classroom and discovered that they supported growth and development in seven of the mathematic sub-strands. Therefore, to appropriately situate my approach in an emergent play-based environment, I included seven activities and environments that were emergent in their nature. Even though these activities and environments occurred during pre-implementation, I had collected enough necessary documentation to establish either a mathematic understanding of a sub-strand or an area needing further growth and

development for each of my ten students. The following Table is a list naming the seven pre-implementation emergent activities giving a brief description of the materials necessary to create the activity and environment. For a more detailed description of the pre-implementation emergent activities please refer to Math Play in Appendix B.

Table 1

Pre-implemention emergent Math Play activities and environments

Mathematic Sub-strand	Name of Activity/Environment	Materials
Number Sense		
1.1	Mosaic Numbers	Number cards 1-10
1.2	Our Grocery Store	Empty food containers, construction paper numbers, cash register with corresponding numbers
Algebra & Functions		
1.1	What a Mess?	Collection of caps, jewels, stones, tiles, buttons, etc.
2.1	What is Going on Here?	Random items of interest to create patterns.
2.2	Buddy Patterns	Strips of easel paper, easel, paint
Geometry		
1.1	What Shape is Your Table?	Easel, paint
Mathematical Reasoning		
1.1	Teamwork Party	Table setting supplies (i.e., fork, knife, spoon, napkin, placemat, cup, plate)

A procedure for each of these seven activities and environments has been included in the following sections to demonstrate how the activities and environments supported mathematics growth and development that built mathematic understanding.

For example, in my classroom I observed children buying and selling items in our dramatic play area, as if they were in a grocery store. I moved from this observation to creating a grocery complete with a cash register that had dollars bills

that correlated to numbers that were placed on empty food containers. The children used grocery baskets and exchanged appropriate dollar bills to purchase the items they had collected. Figure 2 & 3 are photos showing the grocery store environment with children engaged in a discussion of how much particular items cost.

Figure 2&3: Grocery store pre-implementation emergent environment

As I interacted with the children in the environment, I documented the children who were able to recognize the numbers as well as the children who were growing and developing and could use individual encouragement. The inclusion of pre-implementation shows how emergent themes support modifications to classroom activities and environments that naturally foster mathematic growth and development.

Descriptions of emergent activities

A detailed description of the emergent activities and environments that occurred during pre-implementation are provided. These descriptions are organized according to strand and follow the table provided on the previous page.

Number sense 1.1- recite numbers in order 1-10

I used mosaic number cards to create a circle time game. I brought a magnetic board to our circle that was holding each of the 10 mosaic number cards. I asked the children if they would rather work individually with the number cards or if they preferred playing a game. The children shouted, "A game." I explained the game to them as follows: "First you will all shut your eyes and when you open your eyes I will have placed a number of dots in a straight line on the easel from 1-10. Then you will quietly count the dots and see if you can make that number using your fingers. When everyone is ready, with the right number of fingers in front of them I will call on one quiet friend to come up and count the dots and find the number that matches the number of dots on the easel." The children were very excited about the game as shutting your eyes again creates a big surprise for them and is a great way to add order to a game. They all shut their eyes and the game proceeded with each child waiting for their turn to count and find the matching number.

Number Sense 1.2- recognize and name a few written numerals

After placing two shopping baskets in the dramatic house keeping area of my classroom the children began to pretend that they were at the grocery store. In the beginning they pretended to buy the various fruits and vegetables that were already present. I noticed the children discussing the cost of the items as they wished to purchase the items from each other. To add to this play experience I collected and numbered numerous empty food containers with construction paper numbers that corresponded with numbers that I applied to pretend dollar bills. I used

only numbers between one through ten. I also added a cash register to the environment to encourage the children to exchange money that corresponded with the food items.

Algebra and functions 1.1- sort and classify objects into groups

"Our Great Artist" emergent theme had its origins from the children's interest in our classrooms collection of random objects. The children used our various collections for various types of pretend play. As a teacher, I am in support of children using various materials in various settings in the classroom. However, it is important to show children how to care for their collections and how to organize their collections. After numerous days of finding our collection of objects spread throughout the classroom it was time for the children to identify where we as a class would store our collections. The children identified the container and the placement in our classroom for each of our collections. Then we had to separate our mixed up collections so that we could return them to their newly assigned spots. At circle time I placed the mixed up collection in the center of the circle on a black table cloth. As a class we identified all of the types of items that we had in our mixed up collection. Each child was given a container and asked to sort through the mixed up collection and find the items that belonged in their specific container.

Algebra and functions 2.1- recognize a repeating pattern

Rainbows were an emergent theme in our classroom. As a class we discussed how a rainbow has a pattern. The children were very quick to identify the colors and the arrangement of the colors that make up the pattern of a rainbow. After talking about the natural pattern of a rainbow, we discussed how we can create

patterns with almost anything. This idea of patterns in a rainbow also corresponded with our "Great Artist" emergent theme where we identified patterns that we could make in mosaic artwork. Together these two emergent themes supported the children's interest in creating patterns. At a morning circle time I asked the children to complete random patterns that I created with the various collection of objects that we had in our classroom. I used shells, interlocking plastic blocks, and jewels to create challenging patterns that the children could continue and complete. Each child requested an opportunity to finish the unique pattern that was created for them.

Algebra and functions 2.2- create a simple repeating pattern

Patterns became a very popular game to play with friends in the classroom. At a circle time I used the easel to build on the interest of creating patterns for friends. I cut the easel paper in half to create two strips and drew a black line down the middle of the strip to create two halves. I demonstrated how dots can create patterns as artwork. I created a pattern of colorful dots on one half of the strip and challenged my assistant teacher to copy my pattern of dots on the opposite side of the strip. After demonstrating I asked the children if they would like to create patterns for their friends to copy. Many children jumped up wishing to be first while others searched for a friendly partner which showed me that they were very interested in this activity. I used both sides of the easel to speed up the pace of the game. One child would come up to the easel and create a pattern and then would pick a friend to come up to the easel to repeat their pattern. This game continued outside of our circle time game and became an everyday play activity the children enjoyed engaging in.

Geometry 1.1- identify simple shapes such as circle and square

During our "Teamwork Party" emergent theme we investigated the shape of our tables in our classroom and the shape of the tables that the children had at home. I covered each of the tables in our classroom with butcher paper and the children decorated the table cloths. One table cloth was decorated with markers and the other table cloth was decorated with paint. After decorating the table cloths I removed the table clothes and hung them from a shelf in our classroom. After re-entering the classroom from outside time the children noticed the table cloths on the wall and began discussing the shape of the table clothes and their size. We identified that one table was a rectangle and one table was a circle. After this discussion we gathered in a circle and each child used the easel to paint what shape their dining table was at home. Between all of the children most of the shapes were represented.

Mathematical reasoning 1.1- use math to solve everyday problems

In support of our "Teamwork Party" emergent theme we hosted a family party complete with formal table placemats and settings. Over a period of two weeks we identified the different utensils that are essential for setting a proper dinner table. I placed all of the utensils, including plates, forks, knives, spoons and napkins in a basket for the children to set the table with. Individually each child set the table for our snack time using mathematical reasoning to decide how many of each utensil was still needed from the basket. For example, one child looked at the table counting the number of chairs that still had not received a plate, after counting they returned to the basket and pulled out the necessary number of plates. By the

time we reached our “Teamwork Party” the children were using problem solving to complete the necessary steps for a proper dinner table place setting.

Familiarization with the California Preschool Learning Foundations

To begin implementation of pre-defined activities and environments in my classroom it was important to familiarize each of the assistant teachers in my classroom with the California Preschool Learning Foundations. I printed a copy of the mathematics strand from the California Preschool Learning Foundations my assistant teachers to review. I focused our review on a basic understanding of what each of the eighteen sub-strands addressed in content (i.e., number recognition, size, shapes).

After the assistant teachers reviewed the material, I scheduled a meeting to introduce my research topic by giving an overview of my approach to document school readiness in our emergent play-based environment. I discussed how my curriculum differs from the curriculum that we are currently using by pre-defining activities and environments that will align the sub-strands from the mathematics portion of the California Preschool Learning Foundations with our daily activities and environments that support our emergent theme. I then provided examples of activities and environments that had already taken place in our classroom that examined growth and development within the mathematics domain by sharing examples of completed learning stories that were inserted into a child’s portfolio. I used was our table clothe shape investigation as an example of how to identify which children know their shapes and which children need further growth and development in order to paint their shapes on an easel. In addition, I discussed how

each of the learning stories regarding table cloth shapes for our ten children either documented competency or identified an area that needed further growth and development.

Designing pre-defined developmentally-appropriate activities

After identifying and introducing emergent themes, I formulated ideas for pre-defined curriculum activities that would examine growth and development within the mathematics sub-strands of the California Preschool Learning Foundations by identifying materials that would be used in support of each of the eleven pre-defined activity and environments. Table 2 lists the eleven pre-defined activities I created, giving a brief description of the materials necessary to create the activity and environment. The simplicity of the items needed in the material list below shows how everyday items can be transformed into tools that foster growth and development in mathematics.

Table 2

Pre-defined Math Play activities and environments

Mathematic Sub-strand	Name of Activity/Environment	Materials
Number Sense		
1.3	Caroline's Flowers	3 flowers, vase
1.4	Do you have ten?	Black construction paper, plastic cups which contain more than 10 similar object for counting
1.5	Is Everyone Here Today?	Friends
2.1	Fish in a Pond	Construction paper ponds, jewels
2.2	Mosaic Number Meet Their Match	Mosaic number cards, construction paper, collection of objects to use for counting
2.3	Caroline's Flowers and My Flowers	Additional flowers of a different variety
2.4	Mosaic Number Are Confused	Mosaic number cards, construction paper, jewels
Measurement		
1.1	Construction Pulley, Big Guy in a Little House	Rope, pulleys, stones, clay, construction paper, glue, scissors
1.2	3 Little Lost Ducks	Construction paper, paint, play dough
Geometry		
1.2	Miffy's House of Shapes	Felt, felt board, easel, paint
2.1	Hide Inside Little Clam	Clams shells, play dough, clam shell story, construction paper, glue

For a more detailed description of the pre-defined activities please refer to Math Play in Appendix B.

The pre-defined activities and environments that were created for this curriculum are partially emergent as they were introduced to the class using appropriate materials that capitalized on the children's pre-existing interest to support our classroom's emergent theme (using teacher's meeting/daily activities journal to guide pre-defined). Procedures for each of these eleven activities and environments has been included to document how the activities and environments were modified to fit our classroom's emergent theme. Figure 4 shows how pre-defined activities were created prior to the children's arrival in the classroom using objects of interest that supported our emergent curriculum.

Figure 4.
Math Play pre-defined activity set-up

Number sense 1.3- identify, without counting three in a group

When I created this activity I realized that the most important detail would be creating a situation where I could establish either each child's understanding or need for further growth and development. I had originally planned to place three enormous stones on the writing center table and discuss how many stones there were with the children as they engaged in writing table activities. However, one morning a child came to school with flowers for our classroom. I removed three of

the gerbera daisies from the bunch and placed them in a vase at the writing center. Over the course of a couple of days I was able to engage with each child and ask, "How many flowers did Caroline bring for us?"

Number sense 1.4- count up to five objects with one-to-one correspondence

Before circle time I placed more than 10 similar objects (i.e., plastic fish, corks, stones, shells, etc.) into 10 plastic cups, one plastic cup for each child. As a group we discussed how many years old we were. We went around the circle and everyone said their age and pulled out as many objects as they were old. When it came time for me to share my age I stated that I was 34 years old. The children at this point realized that we were about to count a lot of objects. I began pulling objects out of a child's plastic cup next to me as we counted. We reached 25 and the plastic was empty so I had to borrow a few more objects from another friend. The children enjoyed counting as a group and a rhythm was created that helped move us from one number to the next. I gave each child a half sheet of black paper for them to place their objects on. As a class we discussed how we are all getting older and that one day they will be 10. I followed this story by asking each child to place 10 and only 10 items on their piece of paper.

Number sense 1.5- use number name of last number to answer "How many?"

It became a great daily tradition in our classroom to recognize which children were present and which children were absent. At circle time one child would go around the circle and count the number of children in the circle

recognizing that we should have ten children if everyone was present. If for example, the child counted nine the child would investigate the friends that were present to determine who was missing. After conducting this activity for a month, I wanted to move away from this tradition at circle time as I felt the children immediately recognized who was missing and that focus time at our circle could be better spent on other activities. The children however, enjoyed the counting of their friends, so we added a daily tradition of counting our friends before we entered the classroom from our outside play. It became such a popular activity that we had to create a list of who would be our daily counter. By the end of the year, every child lined up to be counted by the "counter of the day" before going inside. This became a developmentally-appropriate way to document each child's understanding of how to answer the question, "How many friends are here today?"

Number sense 2.1- compare visually two groups and communicate "more" or "same"

During "Our Great Artist" emergent theme we used our jewels as pretend objects in many different types of play. One morning the children added the jewels to the manipulative table that was set up for clay play. The children were pretending that the jewels were the ducks that they had seen in one of our classroom books that lived in a pond. I used the children's interest to formulate an activity that would address the idea of "more," "less" or the "same." I cut out two ponds, one orange and one yellow with construction paper and placed them on the floor. I asked the first child to close his/her eyes as I added pretend ducks (jewels) to each of the two ponds. When the children were encouraged to open their eyes I asked them "Which

pond has more ducks? Why?" The children used the color of the ponds as a way of identifying which pond had more ducks. As I started to play this game with one child another child would come over and ask to play. I created more orange and yellow ponds and the children continued to play the game with one another. The idea of closing your eyes and opening your eyes awaiting a surprise from your friends was very motivating and engaging for the children.

Number sense 2.2- adding or taking away one or more objects will increase or decrease the number of objects in the group

"Our Great Artist" emergent theme supported many of Math Play's predefined activities. The children were interested in our collection of treasure like materials ranging from glass jewels to wine corks. Building upon the children's interest in these materials, I created mosaic number cards for each of numbers through 1-10 out of stones that appeared to look like mosaic pieces themselves. I placed the number cards in our collection of stones to introduce them to the children through their play. The children began playing with the cards by identifying numbers they recognized. I then arranged the mosaic number cards on a black table cloth with construction paper lines connected to each card. When the children entered the classroom they were drawn to idea of playing a number game with the engaging display that had been created. I modeled to the children how I could place the appropriate number of jewels on each of the lines according to the number. This activity was modified from using stones to using glass pieces that were determined as both having a greater interest in our classroom and more aesthetically-intriguing for play. The children placed stones on each of the lines, some counting out as they

laid the jewels down, some counting after they had completely filled the lines. This activity also presented situations where children completed early addition and subtraction functions. For example, one child engaged in the activity after a number of jewels had been previously placed on a line by their peer. The child counted the number of the jewels that were already present and used addition to figure how many more jewels were necessary to make the mosaic number presented. Furthermore, some children exchanged the mosaic number cards for numbers that were smaller than the previous mosaic card. In this instance the children used their knowledge of subtraction to take away as many jewels necessary to create the mosaic number that had been exchanged.

Number sense 2.3- understand that putting two groups of objects together will make a bigger group

As in Number Sense 1.3, this activity needed to be documented in such a way where peer support would not affect whether or not the child had an understanding of the math concept or whether the child was still growing and developing the math concept. I had pre-defined this activity using the various collections that we had in the classroom already, however when it came time to implement I used Caroline's flowers. In our classroom we had some additional sunflowers that I had purchased to inspire children's drawings as well as support a children's book that we were reading. I arranged the sunflowers and the gerbera daisies in small vases and placed on our writing center table along with an empty vase that was larger in size. One by one the children engaged in activities at the writing center and I was able to say to them, "If we put all our flowers together in

this vase will we have more flowers or less flowers?" This activity inspired the children to arrange the flowers for me, 9 out of 10 children enjoyed arranging the flowers individually into the larger vase.

Number sense 2.4- solve simple addition and subtraction problems non-verbally with small number of objects

As mentioned, Number Sense 2.2 encouraged the children to engage in simple addition and subtraction. I originally had pre-defined an alternative activity however I felt that the children would benefit from another opportunity to investigate addition and subtraction in the same environment that I created for Number Sense 2.2. I arranged the mosaic number cards and placed either too few jewels or too many jewels with each number. Individually I asked the children to find a number that they loved and asked them to count the jewels that were on the construction paper line. When the children recognized that there were too many or too few they either removed a jewel, added a jewel or displayed that they were still growing and developing in this area. For example, some children removed all of the jewels to begin with a empty line while others proceeded to add jewels well beyond the mosaic number presented.

Measurement 1.1- demonstrate awareness that object can be compared by length, weight using words such as *bigger, longer, heavier or taller*

I created and implemented two activities or environments to support mathematics growth and development in this sub-strand. The first activity was implemented during circle time to see what the children had learned about shorter and longer. For a period of time the children had been playing with ribbon and

investigating length by cutting ribbon. The children were using the words “longer” and “shorter” in the processes of their play. Several children were cutting strips of ribbon that were as tall as their own bodies and comparing them to the length of their own bodies by holding the strips above their heads. To build on this interest of individual heights, I created a circle time activity that included a clay story about three men who were three different heights, one was very tall and one was very short. Each of these three men lived in houses that were build just right for them: one house was very tall, one very small and the other in between. I then gave each child a long strip of white construction paper and a pair of scissors and ask them to cut the strip into three houses, one short, tall and medium and glue them on their piece of paper. I then gave each child a short, medium and tall piece of construction paper that represented a man that lived in each of the houses. I them asked the children to glue each man in their correct-sized house.

To address mathematics growth and understanding regarding the concept of density I created an environment in the classroom where children investigated weight. I connected two ends of a rope to buckets that were hung in the classroom to a pulley system in our dramatic play area. I first introduced the pulley system using stones as the material in which we could weigh. As the children lost interest in weighing stones I introduced cotton balls and then colored water. As the children played in the environment they identified key vocabulary that described what was happening to the buckets as they added more material. I asked the children throughout the course of many weeks “What is happening with that bucket when you add the stones, cotton balls, or water?”

Measurement 1.2- order three objects by size

To support a classroom emergent theme an activity was created that included a play dough story about three little lost ducks. Frequently at circle time I will tell a story that is supported by creating shapes and representing objects from the story out of play dough. To support mathematics understanding about size as well as support an emergent theme about ducks, I created a story about a small, medium and large duck. I loosely formed the small, medium and large duck and their corresponding sized ponds. The children helped create the story by identifying what the ducks should do for their day. They wanted the ducks to go on an adventure into the city to enjoy ice cream. After the ducks enjoyed ice cream it was time for them to return to their ponds. However, they were lost and confused. The children helped me using the words "small," "medium" and "large" to help the ducks return to their corresponding sized pond. After finishing the story, each child was given three construction paper ponds, one of each small, medium and large. The children used paint and paper on the easel to order the three ponds by size starting with the largest pond. Some children placed the smallest pond on first only to realize that the large pond would completely cover the small pond. These children would remove the small pond and then place the largest as they did not wish to cover any of the ponds.

Geometry 1.2- use shapes to represent elements within a picture

As a class we went on a walk around our neighborhood looking for all the shapes that we could find. I took a photograph of each child's favorite shape as they identified which one was their favorite. When we returned to school I printed the photos in small sizes and created construction paper cut-outs that corresponded with

the shapes that we had discovered. I place the photographs and the shape cut-outs on a felt board and the children began playing a game where they placed each photograph with the appropriate cut-out. After recognizing that the children enjoyed playing and placing items onto the felt board I created the pieces of a story about a cat out of cut-out felt shapes. At circle time we talked about the cat we named "Miffy", his house, the trees, the clouds and the other shapes that made up our story. After two circle time activities with the story the children had connected with the shapes in the story. At the following circle time each child painted a picture at the easel representing their favorite part of Miffy's story.

Geometry 2.1- identify positions of objects and people in space, such as in/on/under, up/down and inside/outside

In our outside play area a teacher had brought snails to school for the children to investigate. The children in my classroom were very interested in them and were very curious about what happens if their shells were cracked or if their shells became too small. As a class we discussed how interesting snails were because they lived in a shell. As the discussion continued one child pointed out that we have clam shells in our shell collection. The following day in class I read a book to the children about a beaver who finds a pearl in a clam shell. We talked about how clams, snails and turtles can hide inside their shells when they are frightened and come outside of their shells when they are not. Through an art project the children told the story of a pearl that a beaver had found. Each child was given a piece of construction paper that resembled a shell and two circle pieces that represented the pearl. Using the book for further investigation I asked the children,

"Where is the pearl in this page of the book?" The children answered, "On the inside." I then asked each child to glue one pearl on the inside of the clam shell. Again using the book I asked the children, "Where is the pearl on this page of the book?" The children answered, "On the outside." I then asked each child to glue one pearl outside of the shell.

Math Play activities and environments were implemented in my classroom to elicit children's understanding of mathematic concepts outlined in the California Preschool Learning Foundations. The mathematic concepts were scaffolded using emergent themes for support. These activities and environments were available for the children's investigation and re-investigation for various amounts of time according to the perceived level of interest and understanding.

The teachers who helped in the implementation of this curriculum gathered artifacts that displayed each child's understanding or area needing further growth and development for evaluation. The following chapter will provide further information about individual growth and development as well as mathematic growth and development for each of the mathematic sub-strands.

Evaluation and Assessment of Math Play

Development in mathematics from a emergent play-based approach was appropriately guided by the use of the California Preschool Learning Foundations. Seven of the activities occurred during pre-implementation and were truly emergent, while the remaining eleven mathematic concepts were introduced in developmentally appropriate activities that did not take away from classroom emergent themes. Children were presented with multiple opportunities to investigate the mathematic concept that was embedded within each activity. This research did not constrict our classrooms emergent play-based approach due to the teachers careful structuring of activities and environments to support both the emergent theme and the eighteen mathematic sub-strands. For example, teachers who have a passion for this approach do not typically structure their daily activities and environments around predetermined frameworks for early childhood growth and development. So, Math Play was sensitive to this approach by using the children's interest in emergent themes as a platform for not only child investigation but also for mathematic concept exposure that supports cognitive growth and development.

Methodology

The curriculum Math Play was evaluated to show if growth and development in mathematics as outlined in the California Preschool Learning Foundations was documented in an emergent play-based early childhood education environment. Math Play was also evaluated to show if the California Preschool

Learning Foundations could be effectively aligned with an emergent play-based curriculum.

Date reduction: Establishing understanding

The California Preschool Learning Foundations (CDE, 2008) were used to create a-priori codes for children's understanding in each of the eighteen sub-strands within the mathematics domain. Understanding was pre-defined for each mathematic sub-strand activity and environment according to the mathematic concept. Children's understanding was displayed in the various forms of data that was collected (i.e. art pieces, photo documentation, documentation and dictation) and discussed further in this chapter. Included in each of the eighteen sub-strands are examples of how a child may display understanding in a particular mathematic sub-strand. In Appendix A, is a chart that shows each mathematic sub-strand and the examples that are provided in the California Preschool Learning Foundations that were used to guide the coding process for establishing whether a child demonstrates understanding or an area needing further growth and development. After participation in each of the eighteen activities or environments the artifacts were reviewed for each child and a code of demonstrates understanding or needs further growth and development was given and recorded. Artifacts were collected after the children were given appropriate time to engage in the activities or environments that had mathematic concepts embedded. In total one artifact was collected for each of the ten children in each of the eighteen activities, for a total 180 artifacts. These artifacts are discussed below. Appendix A includes a chart that shows the coding

scheme that was applied to each of the 180 artifacts along with the type of artifact that was collected for each of the 18 activities.

A code of demonstrates understanding was given when the artifact collected from the child for each activity supported the description and examples provided for that sub-strand in the California Preschool Learning Foundations. A code of needs further growth and development was given when the artifact collected from the child for each activity did not support the description and examples provided for that sub-strand in the California Preschool Learning Foundations. Each artifact was coded during discussions between the teacher and assistant teacher that occurred at the end of the school day.

Data collection methods

During the implementation of the eighteen activities in Math Play various forms of data were collected. For each of the 11 activities conducted during official implementation the data type was pre-designated before implementation for proper collection. For example, if the activity involved the children using the easel the data type was pre-defined as an art piece to be added to each child's authentic formative portfolio. If for example the activity was an environment in the classroom that the children experienced for a number of days, the data type was pre-defined as written documentation or dictation of children's actions or words to be added to their authentic formative portfolios. The following are the various types of artifacts that were collected: art pieces, photographs, dictation or documentation of children's actions and words.

Art pieces. The Math Play curriculum included five activities where a child's art piece was collected and coded as either demonstrates understanding or needs further growth and development. These art activities were implemented to address mathematic concepts that supported emergent themes. Two pieces of art were collected and coded for the Geometry sub-strand 2.1 that address the mathematic concept of identifying positions of objects and people in space, such as in/on/under, up/down, and inside/outside (CDE, 2008) (see Figures 5 and 6). For this particular activity the children's emergent theme showed an interest in a book that discusses sea creatures that live in shells and produce pearls. For this activity the children were first asked to place the yellow pearl on the inside of the shell just as it was in the beginning of the book and then to place the pink pearl on the outside of the shell just as it was in the end of the book.

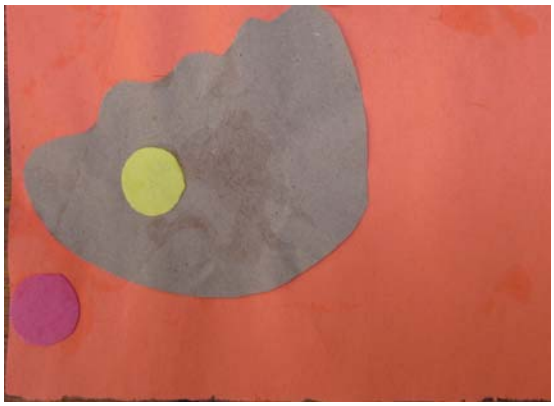


Figure 5. *Demonstrates Understanding art piece: Yellow pearl is placed inside, with pink pearl placed outside.*

Figure 6. *Needs further growth and development art piece: Yellow and pink pearls are both placed inside.*

As Figure 5 shows, the child appropriately placed the yellow pearl inside the shell and the other pink pearl outside the shell while the art piece in Figure 6 shows a child that placed both of the pearls inside the shell. These two pieces of art were coded by teachers and then added to the child's authentic formative portfolio.

Photo documentation

Photo documentation was used to capture displays of understanding in the mathematics domain of the California Preschool Learning Foundations. While the children participated in each activity, photographs were taken by the teacher or by the instructional aides to document children's experiences. In some cases photographs were taken of the children's artwork to simplify the process of establishing and documenting the child's understanding in a sub-strand of the California Preschool Learning Foundations.

Each of the eighteen activities were created and implemented in a way that made it possible to document and establish mathematic understanding in a particular sub-strand for an individual child. The following two photographs (Figure 7 & 8) are examples of how mathematics understanding was coded for two children in one

mathematic sub-strand. The first (Figure 7) was coded as demonstrates understanding, while the second (Figure 8) was coded as needs further growth and development for the mathematic sub-strand Number Sense 1.4. This particular sub-strand defines the concept of counting objects and using one-to one correspondence. For this activity each child was asked to count out ten objects and place them on their personal black sheet of paper. The children used one-to-one correspondence to be sure that they had only placed ten objects on their paper. Together as a class we investigated each child's set of objects recognizing which child had too many or not enough. My assistant teacher took photographs of each child's work to document their understanding of counting and one-to-one correspondence as presented in Figures 7 and 8.

Figure 7. *Demonstrates understanding photo documentation*

Figure 8. *Needs Growth and Development photo documentation*

In Figure 7 the child displays understanding of how to count ten objects by re-counting each fish placed on his sheet of paper in front of peers using one-to-one correspondence. In Figure 8 the child displays that this is an area where they are still growing and developing by placing 15 objects and not having the ability to use one-to-one correspondence to re-evaluate while counting in front of peers.

Documentation and dictation

Documentation and dictation was used in order to establish and document understanding in seven of the activities or environments included in Math Play. Documentation includes teacher notes of what was witnessed and heard while watching the children engage in Math Play activities and environments. Dictation includes the teacher written notes that document word for word what a child said while engaging in Math Play activities and environments. Either myself or an assistant teacher documented or dictated children's actions or words that displayed understanding or an area needing further growth and development. Hand-written notes were transcribed into a text format using Microsoft Word and organized by

sub-strand to be used for evaluation of mathematic conceptual understanding. Figures 9 and 10 are examples of documentation or dictation of a child's mathematic understanding that was coded with either demonstrates understanding or needs further growth and development in the mathematic sub-strand Number Sense 2.2. This particular sub-strand defines the concept of addition and subtraction as a process of adding to or taking away one or more objects from a group that will either increase or decrease the number of objects in that group. The children were asked questions while involved in a number card game that involved them identifying a number and then counting and placing objects on that number to create a match.

Ali (4 yrs): Counts out 10 jewels: puts 9 jewels on the number 8 card, counts the jewels again and takes one away to make 8

Figure 9. *Demonstrates understanding documentation and dictation*

Bria (3.5 yrs): When asked, "What number is this?" Breccan responds and then laughs, "It's an A…no an A is a letter." He counts the numbers 1-6 looking at the 6 card. He replies, "It's the number six." He starts by taking a handful of jewels out of the container and places all of them on the line. He starts to count the jewels on the line and gets to the number six leaving many more uncounted jewels on the line and says, "Six jewels…see."

Figure 10. *Needs further growth and development documentation and dictation*

In the documentation provided above, Ali displays her understanding of the mathematic concept of adding to or taking away of one or more objects that will either increase or decrease the number of objects in a group when she counts the jewels and realizes she has too many and takes on away. Brian displays that he is still growing and developing in this area by first incorrectly identifying the numbers as letters and proceeds to place jewels on the line and counts to the number six leaving numerous jewels uncounted.

Authentic formative portfolio assessment

The authentic formative portfolio is a combination of all of the pieces of Math Play that documents how mathematic growth and development was accomplished in an emergent play-based environment. From the teachers identification of an emergent theme to the modification of a Math Play activity or environment to coding for understanding all the way to the creation of the individual authentic formative portfolio teacher and teacher's assistants worked together to structure mathematic learning that did not stifle the children's interests.

Authentic formative portfolios were created as a global assessment of mathematic growth and development for each child in my classroom that participated in the activities and environments that were implemented during Math Play curriculum. Portfolios were compiled and organized using the above-mentioned artifacts that were collected during each activity. Every item in the portfolio was examined for demonstrates understanding or needs further growth and development according to the codes that were created from the sub-strands of the mathematics domain of the California Preschool Learning Foundations.

Creating each child's authentic formative portfolio. Each child's authentic formative portfolio included a collection of the above mentioned artifacts. These artifacts were augmented with photographs and text as a way to discuss mathematic growth and development that was occurring in the child's emergent play-based environment with their parents during parent-teacher conferences. The photographs included were demonstrations of how their child engaged in activities or environments that fostered mathematic growth and development.

Also included in each child's authentic formative portfolio was an individual learning story which included two photographs of the child engaged in mathematic activities and environments accompanied by text written by the teacher that addressed the areas of understanding that directly corresponded to the sub-strands of the California Preschool Learning Foundations. I highlighted areas where each child displayed understanding, supporting some areas with quotations or documentation of events that occurred in the classroom. Additionally, each child's learning story text included areas where the child was still growing and developing. I provided ways in which the parent could support further learning at home as well as how our classroom was planning to support the child's growth and development while at school. Included in Appendix B are examples of two authentic formative portfolio learning stories that I created for two of the children in my classroom.

Figure 11 is a photograph of a Math Play environment that provided children opportunities for growth and development in the sub-strand Measurement 1.1 which provides a framework of comparison using density. During implementation teachers engaged in this pulley environment with the children while documented children's

actions and dictating words that were coded as demonstrates understanding or needs further growth and development. However, as seen in this picture this environment is an alternative way of addressing this particular mathematic concept. This environment provided both social and emotional opportunities as well as cognitive opportunities. While visitors and families to an emergent play-based environment may see a pulley in the classroom, teachers see an engaging child experience that builds a mathematic foundation necessary for school readiness. The use of authentic formative portfolios is important for teachers who practice in this approach as a way to educate and inform visitors and families of how cognitive learning goals are being accomplished.

Figure 11. *Authentic formative portfolio photograph example*

Analysis and findings

The artifacts that were collected during Math Play implementation were analyzed to address the following two goals: Goal One: Engage children in eighteen activities and environments that support growth and development in each of the mathematic sub-strands of the California Preschool Learning Foundations. Goal Two: Authentic formative portfolios will serve as an effective way to communicate

information on child growth and development with co-teachers and parents. The findings associated with each goal are described, presenting supporting evidence for each. In addition to these two goals, an additional finding emerged as teachers continued to observe the children and their use of mathematic vocabulary and engagement in mathematic activities and environments after the completion of the Math Play curriculum. This finding is also presented below.

Goal One: Children's growth and development will be documented in eighteen activities and environments that support each of the mathematic sub-strands of the California Preschool Learning Foundations.

Finding One: Children engaged in and demonstrated a range of mathematic growth and development that corresponds with the eighteen sub-strands of the California Preschool Learning Foundations.

Each child in my classroom engaged in eighteen activities that supported their growth and development in each of the mathematic sub-strands of the California Preschool Learning Foundations. Developmentally appropriate activities for each of the eighteen sub-strands were created and implemented supporting classroom emergent themes. If a child missed an activity or environment due to an absence or declining participation, the activity was reintroduced and data was collected for that child at an alternative time. For example, in Number Sense 2.3 a particular child was not interested in the writing center where data was being collected regarding the children's knowledge of combining groups of objects. In order to collect the necessary data for this child an alternate activity was

implemented in a transition time from outside to inside play with the identical set of teacher tools.

The Mathematics portion of the California Preschool Learning Foundations covers five main developmental strands; Number Sense, Algebra and Functions, Measurement, Geometry and Mathematical Reasoning. Figure 12 and 13 show how many of the ten children were coded as demonstrates understanding or needs further growth and development in each of the eighteen sub-strands within the five mathematic strands of the California Preschool Learning Foundations.

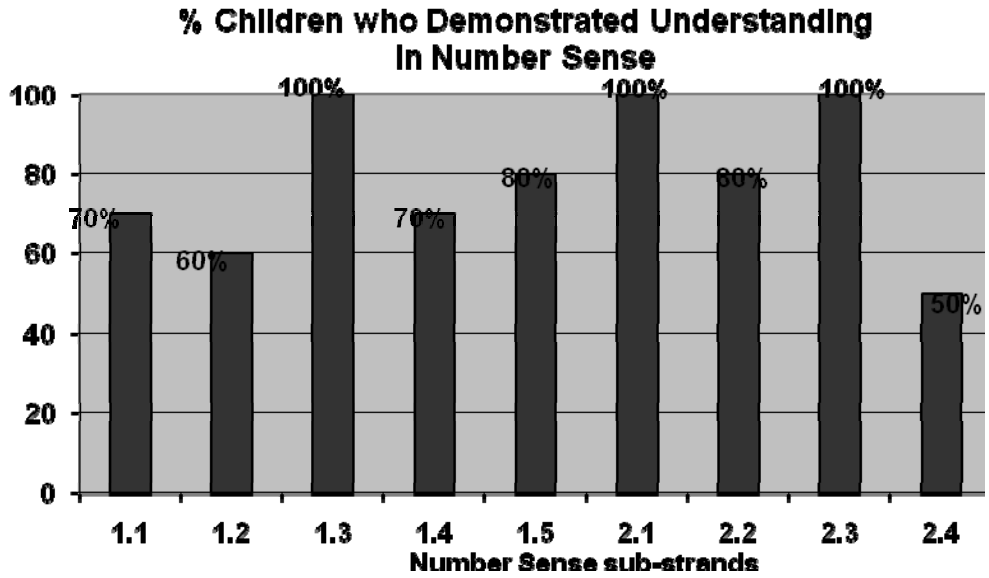


Figure 12. *Percent of children (n=10) who demonstrated understanding for each mathematic strand in Number Sense*

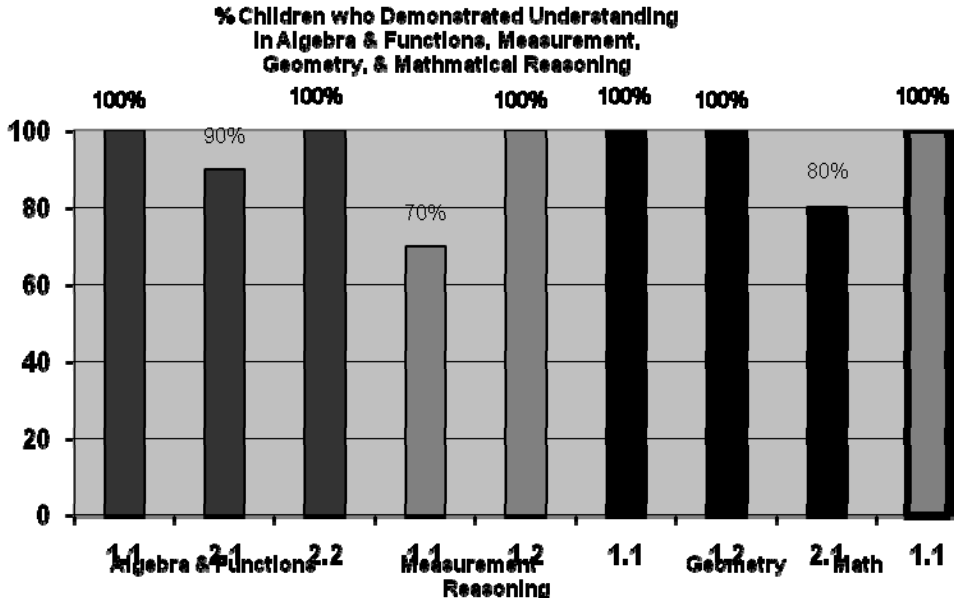


Figure 13. *Percent of children (n=10) who demonstrated understanding for each mathematic strand in Algebra & Functions, Measurement, Geometry, & Mathematical Reasoning*

These findings demonstrate that the children had a range of growth and development in mathematics.

Number sense. This was the strand where the children demonstrated the largest amount of variability in their degree of understanding or need for further growth and development. In only three of the nine sub-strands 100% of the children were coded as demonstrates understanding. Each of the other six sub-strands included one to five children who were coded as needs further growth and development.

In Number Sense 2.1 & 1.3 & 2.3 the children demonstrated the least amount of variability as every child was coded as demonstrates understanding of the mathematic concept of visually comparing two groups that are obviously equal or non-equal and communicate, "more" or "same." (CDE, 2008) Figure 14 is the dictation of one child's words that are representative of the classrooms level of understanding. The children not only demonstrated their understanding of only the specified concept but also used other mathematic skills such as one-to-one correspondence to support their answers.

Livvi (4 yrs): Livvi points to the largest pile of pretend fish and says, "That pond of fish is the biggest." I ask her, "Why?" She begins by counting the largest pile 1-6 and follows by counting the smaller pile 1-5. She then replies, "That one is 5, that's why."

Figure 14. *Representative of 100% demonstrates understanding in Number Sense 2.1*

Figure 15 is representative of the variability that exists among the children in my classroom that have an understanding of Number Sense 2.4 that addresses the mathematic concept of solving simple addition and subtraction problems with a very

small number of objects. (CDE, 2008) Out of the ten children, only 50% were coded as demonstrates understanding. Figure 15 includes an example of a child that demonstrated a clear understanding of the mathematic concept while Figure 16 includes an example of a child that demonstrated the needs further growth and development.

Ali (4 yrs): Ali counts out 10 jewels: puts 9 jewels on the number 8 card, counts the jewels again and takes one away to make 8 jewels match the 8 card.

Figure 15. *Representative of 50% demonstrates understanding in Number Sense 2.4*

Cindy (3.5 yrs): When asked, "Do you see any numbers?" Cindy responds, "Yeah, I see a 7 and a 5." She counts out 6 jewels placing them on the number 7 card and says, "6…there is 6." I ask, "Is that seven?" She picks up a handful and places them all on top of the number 7 card. I state "I think that may be too many." She replies, "There, now there are seven."

Figure 16. *Representative of 50 % needs further growth and development in Number Sense 2.4*

The artifacts collected during each of the eighteen activities and environments for this research were also organized by child to establish areas where children were coded as demonstrates understanding or needs further growth and development.

Table 4 shows the percentage of activities where each child was coded as either demonstrates understanding or needs further growth and development. For example, Brian displayed understanding in eight of the eighteen mathematic

activities or environments while Livvi displayed understanding in all of the eighteen mathematic activities or environments.

Table 3

Sum of the children's demonstration of understanding or needing further growth and development across sub-strands

Child's Name	*Demonstrate Understanding*	*Needing further growth and development*
Brian 3.5yrs	44% (n=8)	56% (n=10)
Cindy 3.5yrs	56% (n=10)	44% (n=8)
Kyle 3.5yrs	61% (n=11)	39% (n=7)
Ryan 3.5yrs	72% (n=13)	28% (n=5)
Carol 4yrs	89% (n=16)	11% (n=2)
Ali 4yrs	100% (n=18)	0% (n=0)
Ella 4yrs	100% (n=18)	0% (n=0)
Grace 4yrs	100% (n=18)	0% (n=0)
John 4yrs	100% (n=18)	0% (n=0)
Livvi 4yrs	100% (n=18)	0% (n=0)

The above table includes child specific information of mathematic growth and development. Brian and Cindy, while also being the youngest 4 year olds in the classroom only demonstrated understanding in approximately half of the mathematic activities and environments. Although documenting their growth and development in the eighteen mathematic sub-strands of the California Preschool Learning Foundations was accomplished, this collection of artifacts is not the only way to document their growth and development. It is important to keep in mind that during early childhood, children are growing and developing at a rate faster than any other time of their lives (Bowman, Donovan, & Burns, 2003). Due to this rapid rate of growth children may shift their focus from social and emotional development and show little interest in cognitive concepts. Through teacher discussions of

observations we agreed that Brian and Cindy were at a developmental stage where they were more interested in talking to and interacting with their peers which improves their social and emotional skills. Brian and Cindy showed little interest in cognitive developmental activities at this time, which does not say that they will never show interest in these activities however their personal development is focused on social emotional growth. In Eager to Learn, Bowman, Donovan and Burns stated, "While development occurs in a similar fashion for all children, developmental differences are the inevitable result of individual genetic and experimental variations and differing cultural and social contexts" (p. 59). Brian and Cindy are developing much like their peers however, it may be their age, their interests, or their culture that had an effect on their understanding of the mathematic concepts.

Discussion of findings

In early childhood emergent play-based environments, teachers typically use the interests of the children to guide curriculum. Using Math Play is a way to show how teachers can not only use children's interests to guide curriculum but can also use articulate frameworks for creating developmentally appropriate mathematic activities and environments. In Math Play the California Preschool Learning Foundations were effectively used in aligning emergent themes with mathematic concepts that play an important role in building the necessary foundations for future learning.

It is important for children to build a strong foundation across domains before entering in to kindergarten. As emergent play-based environments typically

focus on social and emotional development it would be to the best interest of the emergent play-based approach to also meet cognitive school readiness goals. Considering the lack standardized curriculum where an assessment is embedded, emergent play-based approaches can be supported through the use of frameworks such as the California Preschool Learning Foundations. It is my opinion, after implementing Math Play, that teachers with a passion for this approach will find these frameworks inviting as they do not have to stifle the importance of emergent themes.

I would argue that many emergent play-based teachers who do not apply frameworks such as the California Preschool Learning Foundations naturally create and support mathematic learning through activities and environments that emerge from the children's interest. However, after implementing Math Play it was clear to me that with consciousness of both the emergent theme and California Preschool Learning Foundations frameworks activities and environments contained more conceptual depth and breadth that furthered mathematic growth and development. This alignment is also important for an approach that does not included specific tools for addressing mathematic concepts. Parents that have chosen an emergent play-based approach should also be confident that their child is receiving the necessary interactions that will support their transition into the formal school setting. By using Math Play, teachers are more equipped to provide parents with information that will make the learning that is occurring in the classroom more visible. It will not only support the learning of the child in the classroom but support the validity of the approach itself.

Goal Two: Authentic formative portfolios will serve as an effective way to communicate information on child growth and development with co-teachers and parents.

Finding Two: Authentic formative portfolios provided an effective way to discuss individual child mathematic growth and development with assistant teachers and parents.

The authentic formative portfolios were effective for the teacher, teacher's assistants, and for parents to better understand individual children's growth and development of mathematic concepts. Effectiveness was demonstrated through assistant teacher comments on using Math Play portfolios for parent teacher conferences and parent comments on authentic formative portfolios.

Teacher findings

For teachers, the portfolios helped in understanding individual growth and development to aid in curriculum development as well as providing a guideline for what artifacts to discuss in the final parent-teacher conference that communicate specific information about individual child growth and development. With the conscious alignment of the California Preschool Learning Foundations and emergent curriculum, the children's portfolio artifacts contained depth that spoke to each child's mathematic growth and development. Portfolios specifically helped teachers and teacher assistances as they provided a framework for not only artifact collection but also a structure for parent teacher conference discussions detailing mathematic growth and development that is appropriate for this age group. Figure 17 & 18 are two comments made by teacher assistants as to how they felt about the

portfolio guided parent-teacher conferences of mathematic growth and development.

> "Creating mathematic activities for the children with learning goals in mind helped us to be more aware of individual needs in our classroom. We could help them learn and if the learning did not happen we talked about these areas with the parents. The parents, I think liked this information [from the portfolios], however parents like to focus on the child's strengths in conferences but some of them probably went right home to work on numbers or whatever."

Figure 17. *Assistant teacher comment on using authentic formative portfolios for parent teacher conferences*

> "You would introduce the activity and I could see how this related to math. The children enjoyed the activities and it [the portfolio] was nice to share how our classroom was not just "playing all the time" with the parents. I think parents chose this school because of the reputation but with your project we were able to draw out who needed what and then used this information in our parent-teacher conferences…Our portfolios were more organized this year then years previous too."

Figure 18. *Assistant teacher comment on using authentic formative portfolios for parent teacher conferences*

The above quotes support the effectiveness of portfolios for teachers. Teacher's assistants found the portfolios to be an effective communication tool for discussing classroom mathematic goals that are developmentally appropriate and areas where individual children needed further growth and development. Teacher's

assistants also commented on the effectiveness of sharing cognitive development that occurred in an emergent play-based environment that emphasizes play and social and emotional development.

Parent findings

For parents the authentic formative portfolios provided insight and opened up communication with their children about what they were learning. Children and parents re-visited the portfolios numerous times engaging in conversations about specific activities and environments. Parents were not only learning more about their own child's growth and development but were also learning how an emergent play-based environment fosters cognitive growth and development.

As mentioned previously, mathematic learning stories in Appendix B were created by teachers using data that was collected during the implementation of Math Play. Individual learning stories were inserted into each child's portfolio and were discussed with parents during parent-teacher conferences. During parent-teacher conferences, teachers covered growth and development that occurred across the domains, however an emphasis was placed on discussing mathematic growth and development due to the implementation of Math Play in the classroom. Either I or my assistant teacher's presented the learning story to the parents that shared how activities and environments were created to foster mathematic learning. Using the photographs provided in learning story helped the teacher and teacher's assistants to make the learning that occurred more visible by shedding light on the mathematic sub-strand that was being addressed.

To answer the question of whether the portfolios were an effective way of supporting communication the parents were asked for their general feedback about their child's portfolio. Figure 19 & 20 present information about how the parents enjoyed seeing specific learning processes at work and how they used the portfolios to support growth and development at home. The comment in Figure 18 also addresses the preconceived notion that emergent play-based approaches emphasize social and emotional development. This comment sheds light on the fact that many parents in this school view social and emotional growth as the priority however they also want to know that their children are developing cognitively.

"I enjoyed Livvi's portfolio and I can't wait to eventually pass this on to her when she is older. From the beginning of the portfolio to the end it is apparent how much she changed throughout the year. I also enjoyed seeing how creative learning was in the classroom. Making learning fun should be what this time period is all about. Livvi has also loved to look at her own portfolio over the summer. She talks about, "Remember when I drew myself like that?" I wish my two other boys had an organized portfolio from their preschool days."

Figure 19. *Parent comment on authentic formative portfolio*

"Ryan's portfolio is great. We have looked over it many times throughout the summer. He enjoys it the most. It is amazing how much they change over the course of one year. You guys did a really nice job showing us how they were developing socially with their friends while also sharing with us what was happening in the classroom educationally. We are still trying to work on those letters and numbers when we have the time…he will get there."

Figure 20. *Parent comment on authentic formative portfolio*

Another interesting finding that came from the collection of parent comments was how children enjoyed looking at their personal growth and development in their portfolios. Six of the nine parents mentioned that their children were reviewing their portfolios over the summer and continued to share experiences that they had in the classroom. Parents were learning more about the education that was taking place as their children discussed artifacts that were included in their portfolios. After taking the portfolios home parents reported that children repeatedly re-visited their portfolios and furthered their parents understanding of what activities they engaged in while at school. In this way it is likely that authentic formative portfolios will continue to support parent and child communication. Portfolios provided a platform for parents to ask questions about school while reminding children of specific events that occurred during their time at school. Authentic formative portfolios bridged children's home environment with their school environment.

Discussion of parent and teacher findings

Child specific findings on mathematic conceptual understanding or areas needing further growth and development were addressed through authentic formative portfolios. Early childhood educators find it developmentally appropriate to focus on a child's strengths, and the mathematic learning story that was included in each child's authentic formative portfolio is no different. The mathematic learning story documents how each child's growth and development was supported in an emergent play-based environment that fostered understanding of mathematic concepts. Also included in these learning stories were the areas where a child was continuing to grow and develop. After establishing areas where a child was still needing development, teachers and parents can assist in creating activities that will support development to an understanding of the mathematic concept being investigated. Included in Appendix B are two examples of completed mathematic learning stories along with a blank template that teachers can use to create new learning stories for their children.

During Math Play, teachers interacted and addressed individual needs of the children. With the frameworks in place the teacher and teacher's assistances were able to see where attention was needed to further learning of a mathematic concept. The teacher and teacher's assistants were able to individualize the curriculum as they collected artifacts to include in the portfolio recognizing child specific areas that needed further growth and development. In teacher meetings, the teacher and teacher's assistants discussed how the curriculum could best be modified to address particular mathematic concepts that presented the most difficulty. This was a way

for the teachers to prepare for the discussion of individual child growth and development with parents.

It was after the creation of the authentic formative portfolio that the teachers had the opportunity to discuss each individual child's growth and development with the families in parent-teacher conferences. Teacher assistants felt more prepared to discuss individual children's accomplishments and needs due to the structure of the portfolios that provided domain specific information about growth and development. With the California Preschool Learning Foundations as a framework, teacher's assistants felt confident about discussing mathematic growth and development using artifacts that displayed the child's level of conceptual understanding.

Authentic formative portfolios provided a developmentally appropriate way of including individual child assessments that discuss growth and development into an emergent play based curriculum. While standardized formats leave little room for sharing authentic experiences and child artifacts, authentic formative portfolios provide a format where both individualism and experiences are shared to effectively demonstrate both social emotional and cognitive individual child growth and development. To support an emergent play-based approach where the classroom environment is child created and teacher supported and consequently veers far from a standardized curriculum, alternative formats of assessment are more appropriate.

Surprising additional findings

The children involved in this research continued to grow and develop by engaging in activities that further developed their mathematic foundation after Math Play implementation. Many of the children involved in this research that were coded as needs further growth and development in the activities or environments continued to display a desire to grow and develop after implementation. Through the use of mathematic vocabulary children involved in this research continued to grow and develop after implementation as they aspired to make sense of the mathematic concepts that surround them in their everyday play activities.

After implementation of Math Play the teacher and teachers assistants kept a tally, up to ten each day, of when a child used mathematic vocabulary or engaged in a mathematic activity while in the classroom. For example, on one occasion a teacher was listening to Cindy describe her dog. Cindy mentioned the name of her dog and then stated, "He is a medium sized dog, you know kinda like that medium sized part of our mosaic fountain, you know the one in the middle, not the top, not the small but the middle one…remember." This is just one example of how mathematic vocabulary was used after implementation to help a child make sense of the world around them.

A co-teacher also documented Carol and Ella discussing the use of circle templates that were provided at the painting easel. Three different sized circle templates ranging from small, medium to large were cut out of cardboard and then hung from the side of the easel for the children's use. The teacher documented the children negotiating who would use which of the templates. Before beginning their

paintings Carol explained, “I am going to use the biggest circle first so you can use the medium one if you want to.” This is another example of how mathematic vocabulary was used after implementation to help a child make sense of the world around them. The communication between Carol and Ella was assisted by the proper use of mathematic vocabulary to negotiate which circle templates were going to be used. In an emergent play-based environment that typically focuses on social emotional development, providing vocabulary to improve communication is an accomplishment.

Figures 21 and 22 are photographs that were taken after the completion of Math Play implementation. Figure 21 shows a child engaging in a self initiated sorting activity that addresses Algebra & Functions 1.1 sub-strand. In Figure 21 the child is sharing an accomplishment of sorting jewels that occurred while she was

Figure 21. *Child engaged in sorting activity after implementation*

In Figure 21, the child is utilizing her free time in the classroom to engage in an emergent pretend play that demonstrates her competence in sorting. The child was very focused on sorting the jewels and displayed her excitement in her accomplishment of successfully sorting the jewels. It was particularly to witness a child initiating an activity that supports their mathematic growth and development

in an emergent play-based environment. This is one way that we can demonstrate to parents that even through play children are learning valuable mathematic concepts.

Figure 22 shows a child developing her ability to create shapes to represent parts of a picture that addresses Geometry 1.1 sub-strand. In figure 22 a child is using the shape of a square to represent the pot in the potted plant artwork that she is creating.

It is also the goal of an emergent play-based environment to provide open ended art opportunities where children use their current knowledge to engage in an experience that will support their further growth and development. In Figure 22, the child is using their mathematic knowledge of shape representation to create a square with glue in which a construction paper square can be placed. From this experience a teacher could further support their competence of this mathematic concept by providing glue and other construction paper shapes.

Figure 22. *Child engaged in shape representation after implementation*

Summary

After the evaluation of Math Play, I reflected on how my teaching in an emergent play-based environment has been enhanced by using the frameworks of the California Preschool Learning Foundations. This evaluation has proven to me

that it is possible to create a developmentally appropriate early childhood environment by combining children's interest with domain specific structure necessary for school readiness.

Conclusion

Implementation of Math Play in an emergent play-based environment had many implications. For teachers in an emergent play-based environment Math Play provided insight on how a framework such as the California Preschool Learning Foundations can be effectively used to support growth and development. Furthermore, these frameworks can be used concurrently with an emergent curriculum without disrupting the overall approach. For parents, Math Play provided evidence through the use of authentic formative portfolios that an emergent play-based approach does foster cognitive growth and development. Math Play also supported teacher and parent communication regarding individual child growth and development. For children in an emergent play-based environment, Math Play helped to appropriately guide an emergent curriculum to effectively and appropriately foster mathematic growth and development which is valuable to their future educational success.

Personal teaching practice implications

While my learning theory for early childhood education focuses on social and emotional development through play it has been improved by including cognitive development of a mathematic foundation. My passion for the Reggio Emilia approach that structures early childhood educational experiences around emergent play-based curriculum has been embellished and now includes a structure that will make my practice in the classroom more appropriate to meeting early childhood educational goals.

Implications on approach

The California Preschool Learning Foundations provide a supportive framework for building my theory of learning that creates a developmentally appropriate early childhood classroom. Although this document provided a framework, it in no way establishes definite boundaries for growth and development of children. It provides a view of growth and development that recognizes the many ways in which children in this age group display their learning.

Math Play investigates how mathematic foundations can be built in an emergent play-based environment using the California Preschool Learning Foundations as a framework for creating developmentally appropriate activities and environments. After implementing Math Play in my classroom I am looking forward to using these frameworks to build strong foundations across domains that will better prepare the children in my classroom for future learning. Through this experience my teaching practices have been positively affected by combining a well articulated framework with my passion for an emergent play-based approach.

Teacher's interactions in children's play are imperative to the success of appropriately guiding an emergent curriculum to support cognitive growth and development. Math Play helped to guide teacher interactions with children through the conscious use of the California Preschool Learning Foundations that resulted in cognitive development while involved in play activities.

Teachers in emergent play-based environments do not frequently use a framework such as the California Preschool Learning Foundations to guide classroom interests. Before Math Play, I would have argued that this guidance might

overshadow the authenticity of children's play and pushed out the individualization of classroom experiences. However, after implementing Math Play I am confident that a teacher can effectively use both a structure for creating classroom environments while also celebrating and manipulating children's interests to foster learning that creates the necessary foundations for future learning.

I am looking forward to my next investigation into my theory of learning that supports literacy in an early childhood emergent play-based classroom. I will use the California Preschool Learning Foundations to guide classroom interests that build a child's foundation for literacy that will scaffold their future learning experiences. I want to elaborate on this approach by adding the formality of the California Preschool Learning Foundations to appropriately address cognitive growth and development and therefore broaden the approach making it a more viable choice for families as they seek an early childhood education environment for their child.

Developmentally appropriate time-line for mathematics understanding

Addressing mathematic concepts in a pre-defined implementation period limits the amount of growth and development that can be documented and established while children continue to use vocabulary and investigation to further their understanding of mathematic concepts outside of pre-defined implementation period.

Authentic formative portfolios for assessment

Authentic formative portfolios can be organized to document growth and development in all domains. This organization, using the California Preschool Learning Foundations as a guide for domain specific information, is a great way for emergent play-based environments to ensure that developmentally appropriate activities are created to foster necessary future educational skills.

By sharing the conscious alignment with the California Preschool Learning Foundations emergent play-based environments can address school readiness that would otherwise be documented through formal assessment practices in traditional early childhood education approaches

There is an art to teaching. This art includes the way in which a teacher feels that they can best meet the needs of the private learning theories of the students in their classroom. This art also includes the teacher's passion for an approach in which they have found to be a method of celebrating the learning process. My art for teaching in an early childhood classroom has blossomed with the use of The California Preschool Foundations as I have become more confident that I am appropriately preparing children for future learning while also maintaining an environment that places an emphasis on play and social and emotional development.

Appendix A

Math Play Supporting Documents

Revised Version of the California Preschool Learning Foundations

Succinct version of the California Preschool Learning Foundations that was used to create codes for demonstrates understanding or needs further growth and development in each of the eighteen mathematics sub-strands. Also, artifact type collected for each of the eighteen activities implemented in Math Play curriculum.

Sub-strand and Artifact type collected	***Examples of how understanding might be observed in ECE***
Number Sense	
1.1 Recite numbers in order to ten with increasing accuracy. **Type: Dictation**	• Recites one to ten incompletely or with errors while playing. • Recites one to ten while walking. • Recites one to ten while singing.
1.2 Begin to recognize and name a few written numerals. **Type: Documentation**	• Communicates, "That's a one," while playing with magnetic numerals. • Indicates or points to the numerals on a cube and names, "three, two, five." • Identifies the numeral 3 on the page of the Five Little Speckled Frogs while sitting with a teacher.
1.3 Identify, without counting, the number of objects in a collection of up to three objects (i.e., subitize). **Type: Dictation**	• Perceives directly the number of objects in a small group without needing to count them. • Indicates or points to a pile of blocks and communicates, "Three of them." • Attends to the child next to her at snack time and communicates, "Clovey has two." • Looks briefly at a picture with three cats and immediately communicates the quantity by saying "three" or showing three fingers.
1.4 Count up to five objects, using one-to-one correspondence with increasing accuracy. **Type: Photo documentation**	• After building a block tower, counts the number of blocks by pointing to the first block and communicating "one" then pointing to the next block and communicating "two." The child counts up to five blocks. • Indicates or points to each toy in a line while communicating, "One, two, three, four, five."
1.5 Use the number name of the last object counted to answer the question, "How many…?"	• Counts the number of sticks in her hand, communicating, "one, two, three, four, five." The teacher asks, "How many sticks do you have?" and the child communicates "five." • When asked, "How many cars do you

Type: Documentation	have?" counts, "one, two, three, four" and communicates, "four." • Counts the beads in her necklace, communicating, "one, two, three, four, five, six." A friends asks, "How many beads do you have?" and the child replies, "six."
2.1 Compare visually two groups of objects that are obviously equal or nonequal and communicate, "more" or "same." **Type: Dictation**	• Examines two groups of counting bears, one with two bears and the other with six bears, and indicates or points to the groups with six bears when asked which group has more. • Communicates, "I want more-she's got more stamps than me" during a small group activity. • Communicates, "We have the same," when referring to apple slices during snack time.
2.2 Understand that adding to (or taking away) one or more objects from a group will increase (or decrease) the number of objects in the group. **Type: Dictation and documentation**	• Has three beads, takes another, and communicates, "Now I have more beads." • When the teacher adds more cats on the flannel board, indicates that there are now more cats. • While playing bakery, communicates that after selling some bagels there are now fewer bagel in the bakery shop. • Gives away two dolls and communicates that new she has fewer.
2.3 Understand that putting two groups of objects together will make a bigger group. **Type: Dictation**	• Combines his blocks with a pile of his friend's blocks and communicates, "Now we have more." • Puts together crayons from two separate boxes to have more. • Puts together the red bears and the yellow bears to have a bigger group of bears.
2.4 Solve simple addition and subtraction problems verbally/nonverbally with a very small number of objects. **Type: Dictation and documentation**	• Recognizes that one ball together with another one makes a total of two balls. The child may create a matching collection or say or indicate "two." • Adds one car to a train with two cars and indicates the total number of cars in train by showing three fingers. • Recognizes that only two bananas are left after giving away one of three bananas to a friend. • Takes away one flower from a group of four flowers on the flannel board, while acting out a story, and communicates that only three flowers are left.

Algebra and Functions	
1.1 Sort and classify objects by one attribute into two or more groups, with increasing accuracy. **Type: Photo documentation**	• Selects some red cars for himself and some green cars for his friend, leaving the rest of the cars unsorted. • Chooses the blue plates from a variety of plates to set the table in the kitchen play area. • Sorts through laundry in the basket and takes out all the socks. • Places all the squares tiles in one bucket and all the round tiles in another bucket. • Attempts to arrange blocks by size and communicates, "I put all the big blocks here and all the small ones there."
2.1 Begin to identify or recognize a simple repeating pattern. **Type: Photo documentation**	• Recognizes a simple repeating pattern made with interlocking cubes, such as yellow, green, yellow green. • Sings, moves, or claps through part of a pattern song. • Anticipates a repeating pattern in a storybook, with support.
2.2 Attempt to create repeating pattern or participate in making one. **Type: Art piece**	• Puts together connecting blocks in alternating colors t form a repeating pattern, with guidance. • Demonstrates a pattern of claps, signs, or movements, with guidance. • Lines up pretzel sticks and cheese slices to make patterns at snack time.
Measurement	
1.1 Children begin to compare and order objects. **Type: Art piece, documentation and, dictation**	• Communicates, "I'm big like my daddy." • Communicates, "This one's heavier" when choosing from a variety of beanbags in a basket. • Communicates, "He has more than me." • Communicates, "Mine is longer then yours" when placing trains side by side to check which is longer. • Build a tower beside another child, attempting to make her tower taller.
1.2 Order three objects by size. **Type: Art piece**	• Sets bowls by size in dramatic play area, the biggest bowl for daddy bear, the medium bowl for mommy bear, and the smallest bowl for baby bear. • Lines up three animal figures by size. • Attempts to arrange nesting cups or ring stackers in correct order by size.

Geometry	
1.1 Identify simple two-dimensional shapes such as a circle and square. **Type: Art piece**	• When playing a matching game, communicates, "This is a circle." • While playing shape bingo, indicates or points to the correct shape. • Indicates a shape block and communicates, "This is a square." • Sorts shape manipulatives of varying sizes into different shape groups.
1.2 Use of individual shapes to represent different elements of a picture or design. **Type: Art piece**	• Uses a circle for a sun and a square for a house in a picture. • Puts together a foam shape puzzle in which each shape is outlined. • Creates a design by putting shape tiles together.
2.1 Identify positions of objects and people in space, such as in/on/under, up/down, and inside/outside. **Type: Art Piece**	• Goes under the table when the teacher in communicates, "Pick up the cup. It's under the table." • Communicates to another child in the playhouse, "Put the pan on the stove." • Requests that another child put the balls inside the box. • Looks up when the teacher says, "If you look up you'll see your coat."
Mathematical Reasoning	
1.1 Begin to apply simple mathematical strategies to solve problems in their environment. **Type: Documentation and photo documentation**	• Reconfigures blocks to build a balanced, tall tower by placing the rectangular blocks at the bottom and triangular blocks at the top. • Asks for one more paintbrush so he can pt one brush in each paint cup while helping to set up an easel for painting. • Gives a friend two flowers and keeps two for himself, so they both have the dame number of flowers. • Compares the length of her shoe to her friend's shoe by placing then side by side to check who has a longer shoe. • Classifies objects according to whether they can roll or not. • Pours sand from a big bucket to a smaller bucket and realizes that not all the sand can fit. The child looks for a bigger bucket.

Sample Journals
Date: February 8, 2010
Teachers Meeting Journal

In our class we have a box of jewels that the children are very interested in. The box contains glass circles, small tiles in various shapes, ceramic shapes, plastic prisms, misc. sea shells and organic shaped glass droplets. The children have always had an interest in incorporating these items into their play. We have decided to build upon their interests and explore art that can be created with such pieces like the ones included in this box.
In our outside playground area we have a mosaic art piece by a local artist Betsy Schulz. It is a dinosaur that we want to use to inspire the children to do mosaic artwork.
We also have been talking about patterns as the children have been creating patterns in the play dough with these pieces from the box along with caps of different colors and eating utensils.

Daily Activity Journal

In our circle time we asked the children, who is an artist? We received many answers, all of the answers included that each of them were artists. Many went on to describe how artists do their work. Some artists are painters, some artists do drawings and some artists even make clocks.
I then told the children I was going to create a piece of art work out of play dough that would be made to look like something in the classroom. I had them guess as I created. I made the art easel out of play dough to show them how art can be representative of things that we see. I then told them I was going to make another piece of art work out of play dough that could be found outside. I started to represent the mosaic dinosaur outside and told them that we were going to go on a scavenger hunt for this artwork. We went outside and the children raced to the dinosaur.
I prepared square pieces of play dough that we pressed onto the dinosaur to create impressions of the shapes that were used in the mosaic. The children then added the jewels from the classroom box to complete their impressions. The children made a collaborative piece that they described as a flower. They added a play dough leaf and used sand to fill in some of the white portions of play dough.

Sample Journals
Date: February 10, 2010
Teachers Meeting Journal

We are going to start working with grout. We as the teachers need to familiarize ourselves with the processes of mixing, cleaning, procedure, outcomes, etc. To do this we are going to start by mixing the grout for the children to be sure of what consistency we need.
We placed the play dough on the manipulatives table in long plastic pipes that have been cut in half lengthwise. We created patterns in the play dough with caps and corks leaving room for them to finish the pattern.
We are going to encourage patterns on the easel and patterns in the play dough.

Daily Activity Journal

At circle time we used the plastic pipes to further discuss patterns. We talked about how mosaic artists like Besty Schulz use patterns to create pictures. I created a pattern in the play dough with the same caps and corks that were out earlier in the morning. The children helped to create the patterns and continue the patterns as a group. I then asked the children in pairs to create patterns on the easel with paint. The first child painted a pattern out of dots and the second child copied the pattern that the first child had created. We took pictures of them with their completed patterns. After this activity we announced that we were going to be making patterns later in the day with a material that was called grout.
After mixing the grout, I placed it in the plastic pipes. The children then added jewels to the grout to create patterns. This work was done collaboratively as it was introduction into our work with grout. Due to the fact that there were so many children working on one piece the patterns were lost. However, the children were trying to create patterns and were still seeing their patterns as they created amongst the other pieces already in place in the grout.
We are going to dry the pieces and use these pieces to further discuss the idea of patterns and the lack there of.

	Ali	Brian	Cindy	Carol	Ella	Grace	John	Kyle	Livvi	Ryan
Number Sense										
Recite #'s in order to 10	U	G	G	U	U	U	U	G	U	U
Recognize and name a few written numerals	U	G	G	U	U	U	U	G	U	G
Identify, without counting 3 in a group	U	U	U	U	U	U	U	U	U	U
Count up to 5 objects with 1 to 1 corr.	U	U	G	U	U	U	U	G	U	G
Use # name of last to answer "How many?"	U	G	U	U	U	U	U	G	U	U
Compare visually two groups, more or less	U	U	U	U	U	U	U	U	U	U
Adding one object to group will increase #	U	G	G	U	U	U	U	U	U	U
Two groups together make a bigger group	U	U	U	U	U	U	U	U	U	U
Simple addition and subtraction verbally	U	G	G	G	U	U	U	G	U	G
Algebra/Funct.										
Sort and classify objects into groups	U	U	U	U	U	U	U	U	U	U
Recognize a repeating pattern	U	G	U	U	U	U	U	U	U	U
Create a simple repeating pattern	U	G	G	G	U	U	U	G	U	G
Measurement										
Compare using bigger, longer, heavier, taller	U	G	G	U	U	U	U	U	U	G
Order 3 objects by size	U	U	U	U	U	U	U	U	U	U
Geometry										
Identify simple shapes such as circle and square	U	U	U	U	U	U	U	U	U	U
Use shapes to represent elements of a picture	U	G	G	U	U	U	U	G	U	U
Identify positions of objects (in, on, under, up)	U	G	U	U	U	U	U	U	U	U
Math. Reason.	U	U	U	U	U	U	U	U	U	U

Appendix B

Math Play

"The ability to play is central to our capacity to take risks, to experiment, to think critically, to act rather than react, to differentiate ourselves from our environment, and to make life meaningful."

Dear Early Childhood Educator,

As an early childhood educator it has been my wish to create developmentally appropriate experiences that offer exciting opportunities for growth and development. I have worked in my practice to formulate ways in which school readiness goals can be achieved through play in emergent play-based curriculum environments. I implemented this curriculum in a Reggio Emila inspired classroom.

Recognizing the natural socio-emotional gift that is inherent in an emergent play-based environment, such as Reggio Emilia, Math Play turns its' attention to cognitive growth and development.

As a teacher in an emergent play-based environment you may have already recognized the uniqueness of the approach. Math Play is a method of curriculum design, implementation and documentation that makes the learning experiences of emergent play-based approaches more visible

Age appropriate growth and development is clearly defined in the California Preschool Learning Foundations. These foundations include the following four domains of growth and development, Social-Emotional Development, Language and Literacy, English Language Development (for English learners), and Mathematics. Math Play, as you may have already guessed supports growth and development in the mathematics domain of the foundations. Within the mathematics domain are the following five strands: Number Sense, Algebra and Functions, Measurement, Geometry, and Mathematical Reasoning that are further identified by eighteen sub-strands.

The California Preschool Learning Foundations mathematics sub-strands were used to establish a structure for curriculum design and authentic formative portfolio creation that addresses school readiness criteria. Math Play is just one example of how the foundations can be consciously woven into activities that support your emergent theme. I encourage you and your classroom to apply your creative inspirations to each of the activities included in Math Play.

I believe authentic formative portfolios celebrate the individuality of the growth and development that is occurring in each of the children in our classrooms. By establishing a union between the California Preschool Learning Foundations and emergent play-based approaches school readiness assessment for future children could be accomplished in alternative ways. It is my hope that this procedure for establishing school readiness will replace standardized assessment practices.

Hope you enjoy.

Kendra DeGroot

Math Play

Creating experiences in an emergent play-based environment that foster growth and development in mathematics.

Number Sense

(At around 48 months of age)

1.1	Recite numbers in order to ten with increasing accuracy.

Description of activity/environment:

Using the photos below introduce the children to each of the numbers between 1 and 10. There are many ways in which this can be done. You may ask each of the children in your class to pick out their favorite number, you can turn the photos upside down and reveal each number one at a time or you can randomly pick the numbers out of a engaging container that you have in your classroom. After identifying each of the 10 number photos you can start counting as a class by pointing to the number 1 photo and saying the numbers together ending with the number 10 photo. In order to establish if each individual child knows how to count to 10, ask them one by one to count the number photos that have been placed in the middle of the circle. To build on this experience you can place sand in a shallow container and help the children recreate the numbers with stones as seen in the photos.

Items used to create activity/environment:

Procedure for engaging children in activity/environment:

To engage the children in the number photos you can ask the children to help you cut out the photos, laminate the photos or place them in space in your classroom where they are sure to be seen. After the number photos have been identified, have the children who assisted you or noticed the photos place them in a spot that is convenient for use at circle time. After circle time activities, leave the number photos with the sand box and stones for free play and exploration. Number photos can also be used to encourage children to write numbers in sand that is blanketing a light table.

Vocabulary/Keywords	Numbers 1-10

Number Sense

(At around 48 months of age)

1.2	Begin to recognize and name a few written numerals.

Description of activity/environment:

Turn the dramatic play area of your classroom into a grocery store for your children to explore. To create an environment that encourages number recognition, add number tags to both a collection of empty food containers and pretend dollar bills. The number tags on the items should be similar in size, color and penmanship.

Items used to create activity/environment:



Procedure for engaging children in activity/environment:

Allow the children to first explore the new dramatic play grocery store without an emphasis on the numbers. As the children start to mention the numbers help them to establish the connection between the numbers on the objects to the numbers on the pretend dollar bills. Pick up a pretend dollar bill and share the number that is on the tag with the children. Ask the children if you can buy anything at their store with the pretend dollar bill that you are holding in your hand. Hold the pretend dollar bill in a way that it is visible for the children to make comparisons as they search for an item for you two buy. Pack your items in a grocery and exchange your pretend money with the children. When few children are engaged encourage them to buy grocery items from their friends. Distribute pretend dollar bills to potential customers and offer advice on how to be helpful if you work at a grocery store. By placing random objects in the various empty food containers you can re-engage the children in the grocery store dramatic play environment.

Vocabulary/Keywords	Numbers 1-10, number, buy, same

Number Sense

(At around 48 months of age)

1.3 Identify, without counting, the number of objects in a collection of up to three objects (i.e., subitize).

Description of activity/environment:

Place a vase of flowers at the writing center in your classroom. Provide the children with markers, colored pencils, and crayons that fit the color scheme of the flowers. In the vase place only three flowers. As the children are engaging in writing center activities ask them, "How many flowers they see in the vase?" This activity can be modified using any object that is of interest to the children. For example, if a child comes to school wishing to share box cars, caterpillars, or necklaces, arrange three of any of these items on a well defined tray and do as described above. This activity may also lead the children to represent the three items in their drawings at the writing center.

Items used to create activity/environment:

Procedure for engaging children in activity/environment:

By using the children's objects of interest you will engage them in a mathematic activity. You can point out who supplied the objects and where the objects came from. It is helpful if you are engaged in drawing at the writing center. This will take away the pressure that some children may feel as you ask them a mathematic question.

Vocabulary/Keywords	Number 1-3, group, using fingers

Number Sense

(At around 48 months of age)

1.4 Count up to five objects, using one-to-one correspondence (one object for each number word) with increasing accuracy.

Description of activity/environment:

Before a circle time gathering arrange a number of cups that corresponds to the number of children that you have in your classroom. Begin a circle time discussion centered on how old everyone is. As early childhood teachers know children love to talk about how many years old they are. Ask each child to pull out the same number of objects as they are years old. The children will begin to discuss their age while pulling out the objects. You then ask them to think about how old you are. Start to pull all of the objects out of your plastic cup one by one only to realize that you do not have enough. Borrow objects from the children's cup until you have reached your age. Follow this activity by telling a story about how the children will be ten one day. Ask the children to pull out ten objects to represent their age when they will be ten.

Items used to create activity/environment:

Procedure for engaging children in activity/environment:

One way of ensuring the items are of interests is to use items that have been taken out during free choice play (i.e. trains, jewels, animals, etc.). Place at least ten of the various objects in the cups. At circle time distribute the cups to the children and ask them to count out 10 of the items and place them on the floor in front of them.

Vocabulary/Keywords	numbers 1-10, each one, use finger to count, point to each

Number Sense

(At around 48 months of age)

1.5 Use the number name of the last object counted to answer the question, How many…?"

Description of activity/environment:

Create a classroom procedure of counting the number of friends that are at school. This is an excellent way to make the most of transition times, such as going from outside play to inside play. The children line up and one friend is responsible for counting every friend. This may take a number of times before the child uses one-to-one correspondence to complete the counting. At the completion of the counting ask the child, "How many friends do you have at school today?" If necessary repeat the counting emphasizing the last number counted to help them answer the previous question.

Items used to create activity/environment:

Procedure for engaging children in activity/environment:

This becomes a very popular activity for children. It is helpful to create a chart of the children's names to be sure that every child receives their turn and when their turn can be expected.

Vocabulary/Keywords	"How many…", count, each one, "last number"

Number Sense

(At around 48 months of age)

2.1	Compare visually (with or without counting) two groups of objects that are obviously equal or non-equal and communicate, "more" or "same."

Description of activity/environment:

Use the children's interest to formulate an activity that would address the idea of "more," "less" or the "same." Cut out two different colored pieces of papers to represent the place where animals or objects may live or be stored. In this example the children were making ducks out of clay during free time so I created two ponds. Ask a child to close his or her eyes and place a random number of objects in each one of the colored pieces of paper that are clearly not the same. When the children open their eyes ask, "Which pond has more ducks and why?" The children will use the colored pieces of paper to identify which group has more or less.

Items used to create activity/environment:

Procedure for engaging children in activity/environment:

During free choice time in your classroom pay close attention to what the children are playing with. If the children are playing with animals, cars, or stones use these objects for comparison. For example it they are playing with stones, create a beach scene and ask them to compare the stones on the beach. Think about where the objects would be in their natural setting and create a scenario that would build upon the children's interests.

Vocabulary/Keywords	group, more, less, same, how many

Number Sense

(At around 48 months of age)

2.2	Understand that adding to (or taking away) one or more objects from a groups will increase (or decrease) the number of objects in the group.

Description of activity/environment:

Arrange mosaic number cards on a black table cloth with construction paper lines connected to each card. The children will be drawn to the arrangement as they will recognize that they are able to play a game. Model to the children how you can place the appropriate number of jewels on each of the lines according to the corresponding mosaic number card. The children will place jewles on each of the lines, some counting as they go along, some counting after they had completely filled the line. Ask the children to share what number they are working with as they count the jewels they have placed. Ask them if they have "too many" or "not enough." They will either add or take away jewels depending on this answer. This activity also presented situations where children completed early addition and subtraction functions.

Items used to create activity/environment:

Procedure for engaging children in activity/environment:

Have the arrangement described above ready for the children when they enter the classroom. Arranging this game on a black table cloth really helps in making the objects easily seen. Ask the children if they would like to help you play a game, or if they would like to help you fix the numbers and make them right. Children can also mix up the numbers and jewels and play this game with their friends.

Vocabulary/Keywords	More, less, add, take away, fewer

Number Sense

(At around 48 months of age)

2.3 Understand that putting two groups of objects together will make a bigger group.

Description of activity/environment:

Using flowers that you have in your classroom, place three vases at the writing center table. Place one type of flower in the first vase, place another type of flower in the second vase, and leave the third vase empty. As the children engage in activities at the writing center table ask them, "If we put all our flowers together in this vase will we have more flowers or less flowers?" Allow the children to arrange the flowers one by one into the third vase. You can encourage them to count the flowers as they are separated and then encourage them to count the flowers again as they are placed together.

Items used to create activity/environment:

Procedure for engaging children in activity/environment:

Ask the children if they would like to decorate your classroom with flowers. Arrange a number of vases around the classroom and allow the children to place the flowers one by one into the vases. The children will become interested in the flowers and you can use the flowers to explore this mathematic concept either the same day or the following day.

Vocabulary/Keywords	bigger group, together, more, separate, smaller group

Number Sense

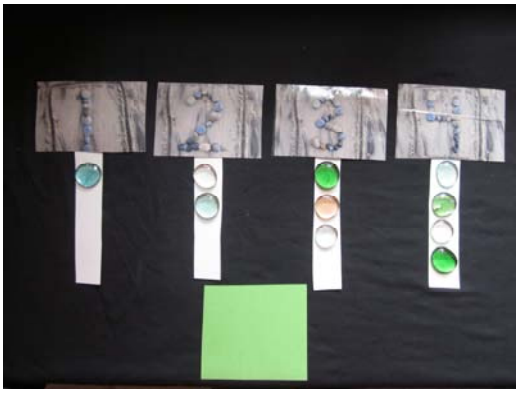
(At around 48 months of age)

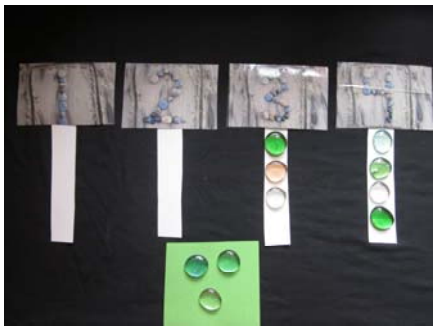
2.4 Solve simple addition and subtraction problems nonverbally (and often verbally) with a very small number of objects (sums up to 4 or 5).

Description of activity/environment:

Number Sense 2.2 encouraged the children to engage in simple addition and subtraction. I arranged the mosaic number cards and placed either too few jewels or too many jewels with each number. Individually, I asked the children to find a number that they loved and asked them to count the jewels that were on the construction paper line. When the children recognized that there were too many or too few they removed a jewel, added a jewel or displayed that they were still growing and developing in this area.
As shown below you can also place the appropriate number of jewels with each card and allow the children to pick to numbers to place in the green square. After the children have placed the jewels in the green square allow them to count the numbers they have added together.

Items used to create activity/environment:





Procedure for engaging children in activity/environment:

Asking children to help you fix a problem is a great way to engage children in this activity. Let them know that these numbers are all mixed up and need help. Say to your children, “Hey this number is the number two…not the number four. How can we make this right?”

Vocabulary/Keywords	more, less, take away, add, plus, minus

Algebra and Functions
(Classification and Patterning)

(at around 48 months of age)

1.1 Sort and classify objects by one attribute into two or more groups with increasing accuracy.

Description of activity/environment:

Collect various colors of plastic lids and various shaped tile pieces to use for a circle time sorting activity (lids and tiles are just two examples of collections that may be used for this activity). If using another type of collection, use distinct collections that can be sorted according to different attributes (i.e., color, shape, type). Place the collection of plastic lids and tile pieces in a pile in the middle of the circle (sorting one collection at a time). Encourage the children to share their ideas about the shape, size, color and use of the lids and tiles. As the children identify the colors and shapes place a corresponding colored piece of construction paper in the circle or create a designated container for each tile shape. After placing the children in teams of two, assign the teams a specific color of construction paper or a container including a specific shape. Ask the children to create groups of objects according to their color and shape.

Items used to create activity/environment:

Procedure for engaging children in activity/environment:

Keeping collections of various objects in your classroom is very engaging for children. After introducing new collections you will find them purposefully placed throughout your room. Before sorting at circle time place collections out with a manipulative material, include in an art project, or ask children to bring in objects from home to form collections for use in your classroom.

Vocabulary/Keywords	sort, type, separate, not the same, glass, cork, tile, cap

Algebra and Functions
(Classification and Patterning)

(at around 48 months of age)

2.1 Begin to identify or recognize a simple repeating pattern.

Description of activity/environment:

At a morning circle time ask the children to complete random patterns that you create with the various collection of objects that you have in your classroom. Using shells, interlocking plastic blocks, and jewels create challenging patterns that the children can continue and complete. Place the random objects in lines using your description of the objects to identify the pattern. For example, make a pattern that is, "shell, jewel, block, shell, jewel, block, shell, jewel, block." By saying the objects the children will not only be able to see the pattern but also hear the pattern. Ask them, "Which object goes next?" Create the beginning of a pattern for each child and provide them with the materials necessary to extend the pattern. If a child is struggling with the pattern allow a friend to provide assistance and then try again. Each child should be given an opportunity to finish the unique pattern that was created for them.

Items used to create activity/environment:

Procedure for engaging children in activity/environment:

Rainbows were an emergent theme in our classroom. As a class we discussed how a rainbow has a pattern. The children were very quick to identify the colors and the arrangement of the colors that make up the pattern of a rainbow. After talking about the natural pattern of a rainbow, we discussed how we can create patterns with almost anything.

Vocabulary/Keywords	pattern, next, before, after, again, first, middle, end

Algebra and Functions
(Classification and Patterning)

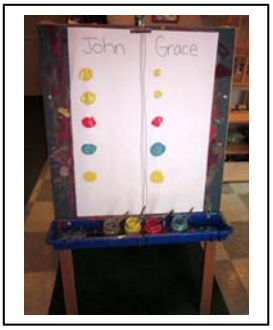
(At around 48 months of age)

2.2 Attempt to create a simple repeating pattern or participate in making one.

Description of activity/environment:

Patterns became a very popular game to play with friends in the classroom. At a circle time use the easel to build on the interest in patterns for children to create patterns for their friends. Divide the easel paper in half by drawing a black line down the middle of the paper to create two halves. Demonstrate how dots can be used create patterns in artwork. Create a pattern of colorful dots on one half of the paper and challenge another adult in the classroom to complete your pattern. After demonstrating this procedure, ask the children "Would you like to create patterns for your friends to copy?" Use both sides of the easel to speed up the pace of this activity. One child at a time comes to the easel and creates a pattern, then picks a friend to come up to the easel to repeat their pattern. This game continued outside of our circle time game and became an everyday play activity the children enjoyed.

Items used to create activity/environment:



Procedure for engaging children in activity/environment:

Ask the children to create random patterns on their own during free time at the easel. These patterns can be verbal as the child switches paint brushes to use various colors, such as "yellow, yellow, green, yellow, yellow, green." Patterns can also be visible, such as creating lines, dots, shapes or smudges that are intended to be in a pattern. Rainbows are a great way to get children to think about patterns.

Emergent Curriculum	pattern, next, before, after, again, first, middle, end

Measurement

(At around 48 months of age)

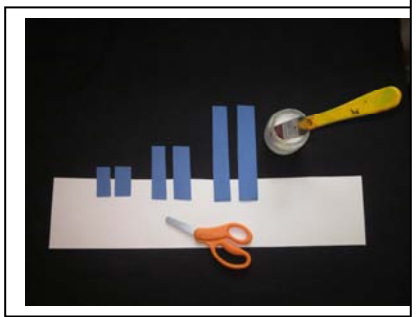
1.1	Demonstrate awareness that objects can be compared by length, weight, or capacity, by noting gross differences, using words such as bigger, longer, heavier, or taller, or by placing objects side by side to compare length.

Description of activity/environment:

To address the multiple concepts that are mentioned in this strand you may chose to create a couple of different activities or environments. To explore the concept of density, install a pulley system in your classroom complete with buckets as shown below. Provide the children with various materials to weigh, such as stones, cotton balls, water, and wood. As the children add materials to one bucket they will notice how it falls to the ground and as they additional materials to the other bucket it rises.

To explore the concept of taller, longer and bigger create a play dough story of three different sized men that live in three different sized houses. Provide the children with three different sized colored strips of paper that represent the three different sized men. Give the children a strip of white paper and have them cut the strip into three different sized pieces to represent the man's house. Have them glue the appropriate sized man into the appropriate sized house.

Items used to create activity/environment:



Procedure for engaging children in activity/environment:

Children are very interested in how tall they are compared to other children. You could start the investigation of taller by tracing each child on large sheets of butcher paper and use the tracing for comparison. To encourage children to think about density place random objects in containers and ask them to describe which one is heaviest. For example, in one container place a heavy stone and in another container place a bunch of feathers, ask the children to guess what is inside.

Vocabulary/keywords	taller, smaller, tall, short, heaviest, lightest, heavy, light

Measurement

(At around 48 months of age)

1.2	Order three objects by size.

Before circle time cut four different sizes of circles ranging in size from a very large circle to a very small circle. Make each of the four sizes of circles different colors so they are easily identifiable. Prepare an easel to be included in your circle time activities with one color of paint (so children are not distracted by the color choices) and easel paper. The paint is going to be used as glue to hold each of the circles on the easel paper so a large paint brush should be provided. Ask the children to talk about how the circles are different. Identify small, medium and large circles. Show the children how by placing a smaller circle first and then applying a large circle you hide the smaller circle. Then ask the children to stick the circles on the paper starting with the largest circle and moving to the smaller circles. Allow each child an opportunity to complete their work in front of their classmates.

Items used to create activity/environment:

Procedure for engaging children in activity/environment:

To engage the children in a topic about small, medium and large a play dough story can be created. This play dough story included 3 different sized ponds and 3 different sized ducks that were lost after their trip to the ice cream shop. The children identify each of the ponds and ducks using a multitude of words that describe small, medium and large. Have the children help you to place each of the ducks in their appropriate pond. Now that they are experts at small, medium and large ask if they can identify each of the sizes of circles.

Vocabulary/keywords	small, medium, large, huge, gigantic, tiny, middle, enormous, little

Geometry

(At around 48 months of age)

1.1	Identify simple two-dimensional shapes, such as a circle and square.

Description of activity/environment:

Before the school day begins cover two different shaped tables in your classroom with butcher paper. On one table place markers and colored pencils for drawing and on the opposite table provide jars of paint with paintbrushes. Ask the children to help decorate the tablecloths. Remove the decorated tablecloths and hang them in a prominent area in your classroom. Discuss the shapes of the tablecloths and how they relate to the shapes of the actual tables. Offer what shape of table you have at home and ask the children to share what shape of table they have at home. On an easel that you have set near your circle invite each child to paint the shape of their table and explain the shape of their table to their friends.

Items used to create activity/environment:

Procedure for engaging children in activity/environment:

There are many ways to engage your children in this art activity. Use any media that the children are particularly interested in to decorate the tablecloths. One child, as seen in the photo above, rolled the wheels of a toy car through paint to create patterns on the tablecloths. If you would like to extend this activity, place the butcher paper tablecloths on the underneath side of the tables to provide an opportunity for the children to draw upside down with markers (markers are encouraged as they do not require as much pressure as crayons and pencils).

Vocabulary/Keywords	shapes, sizes, tables, other things you see that have shape

Geometry

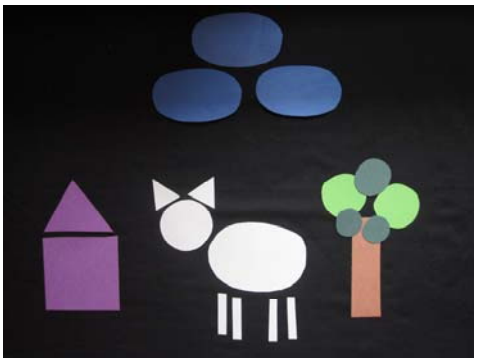
(At around 48 months of age)

1.2	Use individual shapes to represent different elements of a picture or design.

Description of activity/environment:

After realizing that the world is full of shapes the children started to identify shapes everywhere. We talked about the shapes that make up our own bodies. For example, our head is a circle. Follow the recognition of shapes with a story about either a cat or a dog. Create a story about the animal as you go along while also cutting out pieces of felt that represent important parts of the story (i.e. house, tree, cat, dog, clouds) It is helpful if you have the children help you name the main character of the story. Tell the same story each time you use the felt pieces. After a couple of introductions to the story and the pieces that create the story the children will engage in this activity in their free time. When you feel they have a good understanding of the story and the shapes have each child pick out one part of the felt story to represent at the easel.

Items used to create activity/environment:



Procedure for engaging children in activity/environment:

As a class go on a walk around your neighborhood looking for all the shapes that you could find hidden in the landscape of houses, building, etc. Take a photograph of each child's favorite shape as they identify the shape they have found. Printed the photos in small sizes and created construction paper cut-outs that corresponded with the shapes that the children have discovered. Place the photographs and the shape cut-outs on a felt board where children can playing a game by placing each of the shapes in the appropriate cut-out.

Vocabulary/Keywords	triangle, diamond, square, circle, oval, rectangle, heart

Geometry

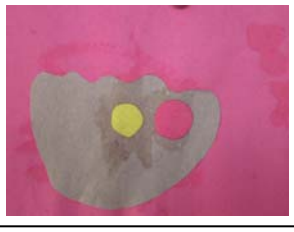
(at around 48 months of age)

2.1 Identify positions of objects and people in space, such as in/on/under, up/down, and inside/outside.

Description of activity/environment:

Talked with your children about how clams, snails and turtles can hide inside their shells when they are frightened and come outside of their shells when they comfortable. Use a story that entails pictures of a shell animal inside the shell and outside the shell. Provide each child with a piece of construction paper that resembles the animals shell and two circle pieces that represent the animal or a pearl in this example. Using the book for further investigation asked the children, "Where is the animal/pearl on this page of the book?" The children will answer, "On the inside." Then ask each child to glue one animal/pearl on the inside of the shell. Using the book again ask the children, "Where is the animal/pearl on this page of the book?" The children will answer, "On the outside." Ask each child to glue the remaining animal/pearl outside of the shell.

Items used to create activity/environment:



Procedure for engaging children in activity/environment:

A children's book about an animal that lives in a shell is an excellent way to engage children in thinking about inside and outside. In this particular classroom they were interested in a book about oysters that contain pearls. On the manipulative table play dough was used to represent the pearls that were located inside the oyster shell. Snails are another easy to find and engaging shell animal.

Vocabulary/Keywords	inside, outside, under, over, in, out

Mathematical Reasoning

(At around 48 months of age)

1.2	Begin to apply simple mathematical strategies to solve problems in their environment.

Description of activity/environment:

Plan a circle time to discuss the items that are included in a table place setting. Before gathering as a group, prepare a basket with the following items: forks, spoons, knives, plates, drinking glasses and napkins. By instigating conversation about the children's dinner tables they will identify the items in the basket. Name and count each item as they are mentioned and place in the middle of the circle. Use a piece of paper or create individual place mats to show the children how a proper table is set. Identify the number of items needed and have the children practice setting their own placemat representing each item with play dough. Ask the children to share their creations with their classmates. Chose two children at a time to pick the appropriate number and type of items needed to complete their setting at the snack table. Allow the children to place their own setting.

Items used to create activity/environment:

Procedure for engaging children in activity/environment:

Children can artistically create their own placemats in order to become engaged in the idea of table place settings. Provide the children with different media (i.e., paint, markers, sand, glue, fabric, colored pencils, scissors and construction paper) so they may create their personal place mat art piece. Ask the children to assist you in laminating each of the place mats. Formulate additional art activities using the utensils or napkins as media. Allow the children to explore the shape of the utensils with paint, add utensils to manipulative materials, place utensils on light table, trace utensils in writing center, etc.

Vocabulary/Keywords	How can we figure this out by counting? One each.

This photograph should show the child demonstrating mathematical conceptual understanding. This is an opportunity to address what is developmentally appropriate as it pertains to cognitive growth in the mathematics domain. This photograph will also show how this child is growing and developing the necessary skills for future academic success in math.

The text in this box should share personal experiences that the child had in the classroom. The text should relate to at least one of the photographs on this page. Including quotes from the child are a great way to show how cognitive growth in mathematics is not only accomplished but supported in an emergent play-based environment.

"Enjoys using his/her understanding of" note any of the following mathematic concepts that the child has demonstrated an understanding of… recognizes numbers, can count to…, uses one-to-one correspondence, sorts objects according to attributes, creates patterns, discovering densities of materials, comparing object according to length/height/weight, recognizes shapes, uses shapes to represent parts different elements of a picture, uses math to solve everyday problems

CHILD'S NAME

This photograph should demonstrate how the child used investigation, discovery or play activities/environments to grow and develop mathematic understanding. This photograph is an opportunity to display how emergent play-based environments create opportunities that build the necessary foundations for future mathematic success. This will show how we as teachers in this environment create activities that have math concepts embedded.

In this text highlight areas where the child is still growing and developing. This text should help parents gain insight on concepts that their child is struggling with. This box may also include teacher/parent strategies for creating classroom/home activities that will help to build mathematic understanding of the specific concept.

Ali has enjoyed learning about…

- Patterns. “Rainbows have a pattern.”
- Density. “This one is so full. It is so heavy. This one is empty. It is nothing.”
- Shapes. She is using her skills to create shapes to represent objects in her pictures.
- Numbers. Loves to help her friends identify numbers in the everyday play activities.

Ali

Ali enjoys…

- Creating shapes
- Using numbers in her play
- Counting
- Discovering how objects can be compared
- Sorting objects
- Playing games using math reasoning
- Recognizing and repeating patterns
-

Learning to perform simple addition and subtraction is an area where Ali is motivated to grow and develop. She enjoys the processes of acquiring new information.

Ryan has enjoyed learning about…

- Patterns. “I like to make Brian’s pattern”
- Density. “That one is really really heavy, it makes such a loud noise.”
- Shapes. He is using his skills to create shapes to represent objects in her pictures.
- Numbers. Likes to explore his numbers while playing in our grocery store.

Ryan enjoys…

- Creating shapes
- Using numbers in his play
- Counting
- Discovering how objects can be compared
- Sorting objects
- Playing games using math reasoning
- Recognizing and repeating patterns
- Weighing objects

Ryan

Ryan is growing and developing his abilities to recognize numbers, perform simple addition and subtraction problems, positions of objects in space (i.e. inside, under), and using one-to-one correspondence.

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