Designing Literacy Rich Classroom Environments for Young Children:

A Study of Teachers' Design Processes and Tools.

by

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ABSTRACT

The development of literacy abilities in young children has been a major concern for authorities and teachers in the USA for the last two decades. Significant effort has been devoted to ensure that preschool settings allow and motivate children to engage in literacy activities before entering kindergarten.

Research has found that a rich classroom environment in preschool settings enables teachers to encourage literacy interest in children at a young age. While a large amount of research has concentrated in testing the effect of prescriptive modifications in the classroom environment, few have focused on studying the design process and tools that teachers follow to design their classrooms.

Public policy and research studies in the United States, mention the design of the classroom environment among teacher's responsibilities, but they do not include practical or methodological guides for them to use. The purpose of this research was to study the design process and tools that teachers use to design literacy rich classrooms in preschool settings.

A case study was conducted at the ASU Mary Lou Fulton Teachers College Preschool at Arizona State University. This setting provides a unique opportunity for an exploratory study of this nature because it is a private child development laboratory with a flexible curriculum. Participant observation sessions and in depth semi-structured interviews were conducted to explore the design process used and experienced by the teachers.

Findings revealed an iterative and cyclic design process that is repeated over time adjusting to the influence of numerous factors. Results also suggest that teacher's knowledge and beliefs highly influence the organization of their classrooms. Considering these factors as a standpoint allows for further exploration to determine a design process suitable for teachers when designing their learning environments. The use of a structured yet flexible design process, can be a potential tool for educators to design their classrooms, collaborate, document and transmit their knowledge.

Although the findings correspond to a specific site studied, the implications are wide reaching as problems and opportunities expressed by the staff are common to other educational settings with similar characteristics.

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TABLE OF CONTENTS

CHAPTER Page

CHAPTER Page

CHAPTER Page

CHAPTER Page

CHAPTER Page

LIST OF TABLES

Table Page

LIST OF FIGURES

Figure Page

LIST OF PHOTOGRAPHS

Photograph Page

CHAPTER 1
INTRODUCTION

Background to the Research

The ability to learn a language is inherent to human beings. Pinker (2007), describes it as an instinct that develops spontaneously in children without the need of formal instruction. The environment where a person grows, influences the development of his or her language with the use of this basic instinct. But in order to communicate and learn, we all need literacy. Learning to read and write opens access to knowledge and enables communication and collaboration. Literacy is not only a skill but also a powerful tool for social interaction (The United Nations Educational, Scientific and Cultural Organization UNESCO).

Brain development and language learning are particularly active during the first five years of a child's life. In today's world, children spend a significant amount of hours a day in daycare or preschool facilities. This means that the classroom space and the materials it contains will constitute children's reality for a long period of time influencing their learning. As researchers in the field agree, the design of the classroom as a rich environment requires forethought (Vukelich, Christie & Enz, 2011), and design knowledge (Roskos & Neuman, 2011). This area of study is particularly relevant considering that the preschool years are fundamental in preparing children for future learning. (Roskos & Christie, 2011).

Literacy initiatives in the USA

Finding ways to promote literacy interactions for preschoolers has been a major concern in the U.S.A for the last two decades. Authorities have been focused in ensuring that children receive enough stimulation and direct contact with print before entering kindergarten (0 to 5 years old). The need for implementing these actions is supported by the results form the latest NAEP report (National Assessment of Educational Progress) that found that "one third of America's fourth graders read at levels so low that they cannot complete their schoolwork successfully" (Lee, Grigg & Donahue, 2007).

In 2000, the National Early literacy Panel (NELP) was formed with the mission of examining what could be done to prepare young children for success in reading. Two years after that, in 2002, The No Child Left Behind Act passed. It focused on 5 relevant components for reading instruction (phonemic awareness, phonics, vocabulary, fluency and comprehension). It emphasized the need of effective instructional material to support teachers in their effort of implementing the essential components of literacy instruction (Taylor, 2004).

In 2002, the Good Start Grow Smart initiative was developed to improve the early childhood programs in the U.S. One of its goals was to assist teachers by providing them information on preparing the children to read and succeed in school. It had three mayor areas of intervention; strengthening Head Start program with resources, working with the states to improve early childhood education and providing information to teachers, caregivers and parents. Part of the Good Start Grow Smart initiative was the Early Reading First program. The program's purpose was to prepare young children to enter kindergarten with the necessary language, cognitive, and early reading skills to prevent reading difficulties and ensure school success.

In 2008, the NELP published a report presenting the findings of a large study in which current research on literacy instruction was reviewed. They discovered six variables that predict power for later literacy. These are; alphabet knowledge (AK), phonological awareness (PA), phonological memory, rapid automatic naming (RAN) of letters or digits, RAN of objects or colors and writing or writing name. The report concluded that the learning achieved during the first five years of a child's life is "likely to be sustained throughout the primary-school years and is an important basis for successful early performance in school" (Report of the National Early Literacy Panel, 2008).

In 2010, the International Reading Association's Standards for Reading Professionals was developed to describe what candidates to the reading profession should know and be able to do in their professional settings. One important aspect mentioned is that teachers should be able to "create a literate environment that fosters reading and writing" (Standard 5, pg.40). Although the relevance of creating literacy rich environments is emphasized, there is no recommendation or procedure suggested for the teachers to achieve that requirement.

One of the key elements in the studies and initiatives mentioned above, is the quality of the classroom environment were the children spend most of their day. On 2002, ELLCO (Early Language and Literacy Classroom Observation) was developed as a tool to assist teachers in evaluating their classroom settings (http://www.brookespublishing.com). This instrument has been widely used since then, but it mainly measures the results of the designed classroom without concentrating in the design process involved in its creation.

Teachers deal with pressures coming from authorities, parents and assessment measurements (Reyes, 2010). They are responsible for teaching their students and designing their classrooms. Even if they work efficiently, they need support in order to be able to organize their actions, take advantage of their knowledge and optimize their time.

Research problem and questions

Purpose of the research.

The purpose of this research is to study the design process that teachers use to design rich classrooms in preschool settings. The study explores collaboration opportunities between design and education focusing in the methods and tools that teachers use or could use in their design process.

Research questions.

There is a primary research question that leads the study:

What is the process that preschool teacher's follow to design rich classroom environments?

Further primary research questions are related to understand and describe the teacher's experience designing their classroom:

How does the process determine the design of the space?

What are the tools that the teacher uses to design his or her classroom?

Secondary questions are related to the effect of the process in the designed classroom and how it affects or models literacy behaviors in the children.

How do the election and disposition of the materials influence children's behaviors?

How does the classroom environment model the interactions between children?

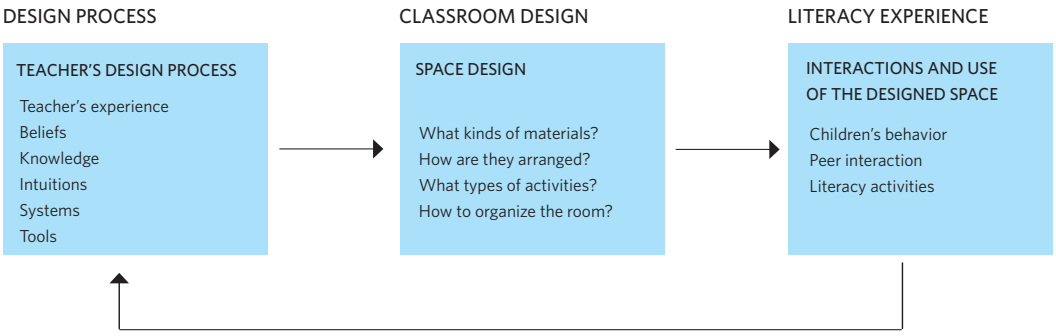


Figure1. Conceptual Framework.

I conclude that teachers follow an intuitive cyclical process guided by their experience, beliefs and knowledge. The development of a structured and specific process for classroom design could help teachers collaborate, document and transmit their experiences. I propose future research areas centered in 21st Century requirements for learning environments and in the potentialities of collaboration between design and education.

Specific Research Context

There are several kinds of preschool and childcare centers across the U.S.A. This research is focused in the classroom design process in a child development laboratory school at Arizona State University. This particular setting serves a multi-cultural population and provides part and full-day early childhood programming. Forming part of a university setting allows the children to experience a wide variety of interactions with members of the different schools. They are also involved in several research studies throughout the school year. Learning through play and exploration are considered powerful tools for children's development and constitute the leading concept of their curriculum.

Justification for the Research

The evaluation of classroom's environment quality in terms of literacy richness has been the topic of a considerable amount of studies. ELLCO has been the preferred tool to analyze the classrooms and determine their quality (Wayne, DiCarlo, Burts & Benedict, 2007; Guo, Justice & Kaderavek, 2012). Although this method has allowed researchers to evaluate whether classrooms contain enough literacy materials, it does not examine the process that the teacher used to design the learning space.

According to the International Reading Association's Standards for Reading Professionals, teachers are expected to "create a literate environment that fosters reading and writing" (Standard 5, p.40). This requirement is difficult for teachers to accomplish mainly because as Roskos and Neuman (2001) express: "knowledge on design for creating literate environments in classrooms (old and new) is lacking".

Preschool teachers need processes and tools to help them in the hard work of designing their classrooms. Many follow their intuition and experience without documenting their design systems or knowledge for future teachers or colleagues.

This research explores the relationship between design and education in the creation of literacy classroom environments. Based in the belief that design processes can be extremely useful for teachers, it is an exploration for further collaboration among disciplines. Designers may as well be benefited by the findings of this research when facing the challenge of designing preschool classrooms that foster literacy.

Methodology

Research strategy.

A case study approach is used in this research. The research site is The Mary Lou Fulton College of Education Preschool. This Preschool is a private developmental laboratory facility located at the Farmer building at ASU Tempe Campus.

Research methods.

The research design is flexible and uses two main ethnographic methods of data collection: participant observation and semi-structured interviews. Observation sessions were conducted in two different situations. Two teacher meetings and a series of six sessions of daily activities (2 in each classroom) were observed. Interviews were conducted with the administrator and the three teachers working at the three different rooms that the preschool offers for its students.

Parallel to this, literature was reviewed as a way to understand and familiarize myself with the context and topics of the research and to acknowledge the different variables that participate in the design process.

The data analysis considered elements of grounded theory. Thematic Coding Analysis (Robson, 2011) and the recommended set of analytic moves suggested by Miles and Huberman (1994), structured the analysis. Interviews were also analyzed using meaning interpretation (Kvale & Svend, 2008).

Conclusions form the findings serve as a generative standpoint for the formulation or adaptation of a design process specifically applicable in the design of educational settings. The information obtained can be used to determine relevant variables to consider when designing a literacy classroom environment and to understand the complexity of the design problem. It can also open space for future research connecting Design and Education.

Definitions

Literacy: The term “literacy” is used widely depending on the context and has several different meanings. UNESCO describes literacy as the “ability to identify, understand, interpret, create, communicate, compute and use printed and written materials associated with varying contexts”. It can also mean the ability to create meaning through different media (visual literacy), knowledge of concepts (cultural literacy), and the ability to manage technologies

(computer literacy) (Vukelich, C., Christie, J., & Enz, B, 2011). For the purpose of this thesis the term “literacy” refers to reading and writing as a way of communicating through print. Verbal interactions will be described as “oral language”.

> Child developmental laboratories as described by Mc Bride et al. (2012):
> Child development laboratories are defined as campus-based units that provide part-day or full-day early programming for young children while at the same time addressing one or more of the missions associated with an academic program, including research, teacher training or outreach dissemination. (pg. 155)

Design Method: Design has evolved over time from an activity centered in the production of “things” to a larger discipline involved in the development of complex configurations. Design methods are understood in this context as tools to manage, collaborate, register and replicate certain actions and activities guided by a purpose (Jones, 1980). Jones explains that design methods are intended for the design of “all things together” or “the total situation”. By this definition he considers that a method or process allows designers to intervene in the function of things, “the ‘systems’ into which they are organized” or “the environments in which they operate”.

Scope and Limitations

There are numerous aspects to consider in the design of a preschool classroom. The data collection is based in finding relevant information related to the literate aspects of the classroom design. The design process is the main topic of inquiry. The orientation of the interviews and observations is guided to obtaining valuable data on that aspect. Physical characteristics of the classroom and materials are reviewed as a way to understand and deepen the information on the design process. The research does not analyze or recommend specific educational materials over others but it does touch upon the close relation between learning objectives and types of materials used. The research is not intended to develop a design guide for teachers or to offer design suggestions for implementation although some findings could be used by future studies for those purposes.

This research is limited by the uniqueness of studying only one preschool setting. As a common aspect of case studies, “findings are generalizable to theoretical propositions and not to populations or universes.” (Yin,2003 p.10)

All participants work at the Mary Lou Fulton College of Education Preschool and live in the Phoenix Metropolitan area. I was the only observer and interviewer in the research, which suggests a limited view and interpretation of the data.

Conclusions to the Introduction

The introduction presented the research context, purpose and questions. It introduced the methodology and the main procedures of the research design. The following sections will provide a revision of the literature, a detailed description of the methods used to collect and analyze data, findings and conclusions.

CHAPTER 2
LITERATURE REVIEW

The literature review is divided in four sections: Child Development Laboratory Schools, Preschool Design Knowledge, Cognition and Development and Design Methods and Tools.

Child Development Laboratory Schools

Entries in this category build a general understanding on the specific characteristics of laboratory schools as centers of research and service for preschool age children in University Campuses. The selected articles agree on the relevance of these settings as generators of research and knowledge and describe the opportunities and challenges that they face as multi-purposed facilities. The role of teachers in these particular childcare centers is a common topic discussed. Their participation in research activities is recommended as a way to disseminate knowledge.

Cutler, K., Bersani, C., Hutchins, P., Browne, M., Lash, M., Kroeger, J., Brokmeier, S., Venhuizer, L., & Black, F. (2012). Laboratory schools as places of inquiry: A collaboration journey for two laboratory schools. [Electronic version]. *Early Education and Development & Development, 23*(2), 242-258. Retrieved February 5, 2013, from http://dx.doi.org/10.1080/10409289.2012.647609

This article describes the experience of a process of CI (collaboration inquiry) developed between the schools at Kent State University in Ohio and at South Dakota State University in South Dakota. Both institutions share the use of the Reggio Emilia (municipal schools of Reggio, Italy) approach to research, which considers the teacher as a researcher and includes children in research activities. The collaboration experience helped both schools focus on their own research agendas and strengthen each school's values and philosophies.

File, N. (2002). Identifying and addressing challenges to research in university laboratory preschools. [Electronic version]. *Early Education & Development, 23*(2), 143-152. Retrieved June 13, 2012, from http://dx.doi.org/10.1080/10409289.2012.619136

In this article, the author examines the historic evolution of laboratory schools as centers of research. She suggests researchers to examine new areas of inquiry and to incorporate diverse research methods in their studies. Considering the context as a topic for future research is presented as an opportunity and a challenge to move away from the traditional focus on child development.

Kantrowitz, B. & Wingert, P. (1991, December 2). The 10 best schools in the world. [Electronic version]. *Newsweek*, Retrieved February 11, 2013, from http://www.thedailybeast.com/newsweek/1991/12/01/the-best-schools-in-the-world.html

Newsweek's article on the 10 best schools of the world was the result of a dozen of interviews with American and foreign experts in international education. In the story, the authors describe the origins of American education, and compare it to other realities worldwide. In the Early Childhood category, the Diana School of Reggio Emilia is recognized as a space of innovation. The particular approach and history of Reggio Emilia schools is explained.

McBride, B. A., & Hicks, T. (1999). Teacher training and research: does it make a difference in lab school program quality? [Electronic version]. *Journal of Early Childhood Teacher Education, 20*(1), 19-27. Retrieved February 7, 2012, from http://dx.doi.org/10.1080/0163638990200105

This article studied 15 laboratory schools to explore the opinions and perceptions that staff and parents have of the three-part mission that characterize them. These particular sites offer personnel training in child development, research on early education and child development and are leaders in their communities. Findings show that the need to satisfy multiple clientele situations is complex and generates tension, impacting the quality of the programs.

McBride, B. A., Groves, M., Barbour, N., Horm, D., Stremmel, A., Lash, M., Bersani,C., Ratekin.C., Moran,J., Elicker,J., & Touissaint, S. (2012). Child development laboratory schools as generators of knowledge in early education: new models and approaches. [Electronic version]. *Early Education & Development,23*(2), 153-164. Retrieved October 25, 2012, from http://dx.doi.org/10.1080/10409289.2012.651068

This article discusses the role of child development laboratory schools in the 21st century. The authors challenge lab schools of the future to become places were knowledge is not only accumulated but also disseminated. For this purpose they recommend the use of ADS (applied developmental science).

Scales, B., Perry, J., Tracy, R., & Jones, H. E. (2012). Creating a classroom of inquiry at the university of california at berkeley: The harold e. jones child study center [Electronic version]. *Early Education and Development, 23*(2), 165-180. Retrieved June13, 2012, from http://dx.doi.org/10.1080/10409289.2012.651198

This article describes the process of developing a method for examining the experience of research by teachers in The Harold E. Jones Child Study Center at the University of California in Berkeley. The interpretive approach method uses observation of children's play as the main

tool to understand the learning process. Insider's views (children and teachers) are used to design "social ecologies" that foster learning based on children's behaviors and preferences.

Rinaldi, C. (2006). *In dialogue with reggio emilia. listening, researching and learning*. Abingdon, Oxon: Routledge.

Carlina Rinaldi is the president of Reggio Children and professor of pedagogy at the University of Modena and Reggio Emilia. In this book, she presents a series of articles written in collaboration with distinguished authors in the field of education. The main topic discussed is the potential of documentation as a tool for developing curriculums based on children's interests. Documenting in Rinaldi's view, allows teachers to create educational projects that respect "children's existential and cognitive paths and processes". (pg.126)

History, mission and challenges of laboratory schools.

Child Development Laboratory Schools were created in the United States during the early 1920s. While some developed in large universities others were created in small private institutions of higher education. Their main mission was to offer activities engaged in research, training and services (Mc Bride, et al., 2012).

Although laboratory schools share common characteristics, each one has its own structure and function depending on the context in which it operates. Differences in the population they serve, location, and mission (among others) makes each particular site unique. Each school also faces its own budget challenges to sustain their activities. Many have extended their hours of operation offering full-day child care service to meet their requirements, but the extension of service for children doesn't leave much time to concentrate in research or training activities. The need to satisfy multiple clientele (children, parents, university students, faculty instructors and researchers) creates complexity and tension for the schools' staff impacting on the quality of their service (Mc Bride & Hicks, 1999).

The fact that laboratory schools offer an opportunity for training personnel in early childhood education is also a challenge for their service quality. As students are earning assistantships while studying, there is a permanent change in the school personnel and the need to observe teachers in action for research is difficult to accomplish (Mc Bride & Hicks, 1999).

Laboratory schools' opportunities and potential as research sites.

Historically laboratory schools have served a population of faculty and graduate students interested in studying children, but not necessarily in understanding the context were the development takes place (File, 2012). The study of the environment has increased in the last

years but it is still generally approached using quantitative measurement tools. An example of this situation is the generalized use of the ELLCO tool to evaluate the literacy richness of preschool classrooms. Books are counted to estimate how many there are for each child to use, but the content of the books or the interactions between peers in the environment is not considered. File (2012) suggests that qualitative inquiry is needed to study the environments were children spend time that is critical in their development.

Teachers can have a relevant role in research at laboratory schools. In interviews conducted by File (2012) they reported themselves as facilitator or sources of information for studies done by external researchers. The involvement of teachers in research is a potential that laboratory schools can use to move forward form being a useful site for others and becoming generators and disseminators of their own knowledge.

An example of teachers as researchers is the development of a method of inquiry at The Harold E. Jones Child Study Center in the University of California in Berkeley. Teachers created a method called “the interpretive approach”, as a result of their experience observing the interactions between the children that took place in the classroom. This type of approach helped teachers focus on the process of play as a way to understand how learning occurs. The model developed is called “spheres of inquiry” and it offers a process for teachers to use their observations for future planning or evaluation (Scales, Perry, Tracy & Jones, 2012). Teacher research in laboratory schools is an opportunity to provide localized knowledge from an insider’s perspective (Mc Bride, et al., 2012).

Another case of teachers as researchers was a collaborative experience developed by the laboratory schools at Kent State University in Ohio and South Dakota State University in South Dakota. They used a collaborative inquiry (CI) approach to generate knowledge based on their particular experiences at each school. The result of their interaction process was published in 2012 (Culter, et al., 2012), and is an available source for other laboratory schools interested in collaboration experiences. Both school shared a common mission highly influenced by the ideas and processes of The Reggio Emilia Schools in Italy.

In 1991, Newsweek Magazine published an article describing the 10 best schools in the world. The Reggio Emilia schools were considered the best among early education programs by early childhood educators all over the world for its commitment to innovation (Kantrowitz & Wingert, 1991).

Reggio Emilia Schools in Italy.

The Reggio Emilia schools started after World War II. A teacher named Loris Malaguzzi founded them based on the belief that children are all different. Each child's special characteristics are nurtured by offering a wide variety of learning opportunities.
Loris Malaguzzi believed that the teacher "cannot work without a sense of meaning" (Rinaldi, 2006, pg.56), and that they should be involved in the creation of the curriculum for each particular group of children. He understood the teacher as a permanent researcher that documents processes as they happen.

Documentation as a method is one of the main tools that teachers use in Reggio Emilia Schools, to reflect, discuss, share and plan by themselves and with others. Carlina Rinaldi, President of Reggio Children (Rinaldi, 2006), describes documenting as a method that helps interpret children's processes and understand the meaning attributed to them. Howard Gardner (creator of the multiple intelligences theory), in an interview with Rinaldi, explains that recognizing documentation as a tool for assessment and evaluation gives a strong 'antibody' to the anonymous assessment tools proliferating in the educational field. Gardner considers that the process of observing, documenting and interpreting children's spontaneous activities and behaviors help teachers realize their potential to learn how to teach (Rinaldi, 2006, pg.68).

Laboratory schools face multiple challenges due to the many different activities that they offer their communities. At the same time, these sites are potential centers for knowledge production and dissemination. Teachers working in laboratory schools experience particular situations as direct witnesses of valuable learning experiences that are not always documented. Research done at this type of schools could consider including teacher's views and knowledge as part of their topics. Teachers as well, working on their own or collaboratively between different centers, can add relevant knowledge to the study of learning environments.

Preschool Design Knowledge

This category contains literature related to preschool design knowledge. Articles and books in this section provide a standpoint to understand the characteristics and particular needs of these settings according to experts in the field. It is divided in three sub-categories: Classroom Environment Design, Literacy Rich Classroom Environments and Literacy Enriched Play Environments.

Classroom environment design.

Ceppi, G., & Zini, M. (1998). *Children, spaces, relations: Metaproject for an environment for young children*. Milan, Italy: Domus Academy Research Center.

This book is the result of a collaborative research study on designing spaces for young children between Reggio Children and the Domus Academy Research Center. It is divided in three main sections. First, a critical analysis of the approach at Municipal Reggio Emilia Schools in Italy is presented, to identify desirable characteristics of a space for young children. The second part is a reflection on design tools that help define the space and the "soft qualities" of early education centers. Finally, a series of essays defining the theoretical basis of the research discuss design and pedagogical issues.

Curtis, D., & Carter, M. (2003). *Designs for living and learning: Transforming early childhood environments*. St. Paul, MN: Redleaf.

In this book the authors make a statement about the way institutionalization and homogenization are shaping early childhood programs. They suggest a design method based on a process of asking questions that refer to physical, emotional and developmental aspects of children's lives. Based on the belief that children learn when they are welcomed by a space they can trust, the book describes a variety of characteristics that help create a home-like environment were children and adults can learn together. A large number of real examples help visualize the concepts clearly and creatively.

Fu, V. R. (2003). Learning and teaching in preschool. Retrieved June 14, 2012, from http://www.pbs.org/teachers/earlychildhood/articles/learning.html

This article summarizes the essential knowledge that children need to acquire in their preschool years. The author describes the preschool learning environment, as a space were knowledge emerges from the interactions among individuals and with the context. Early literacy, mathematics and science, are considered the two main areas of knowledge needed for children to understand and make sense of the world they live in.

Mau, B., VS Furniture, & OWP/P Architects. (2010). *The third teacher 79 ways you can use design to transform teaching & learning*. New York: Abrams.

This book was created by a team of architects and designers concerned about the impact of the school environment in learning. It was intended as a space for discussion on initiatives to improve the educational system in relation to the creation of high quality learning spaces for children. It presents 79 practical design ideas and a series of interviews, case studies, statistics and stories from experts in a wide range of fields.

Olds, A. (2000). *Child Care Design Guide*. New York: McGraw-Hill.

The late Anita Olds was part of the faculty of the Elliot-Pearson Department of Child Study from 1969 to 1999. She also founded and directed The Child Care Institute, an annual training program for designers and educators co-sponsored by Tufts University and The Harvard Graduate School of Design. After 30 years of personal projects in her own firm, she developed this complete guide for the design of high quality Child Care Centers. The guide is divided in four main parts: the child's environment, the design process, ingredients of good design and functional spaces. All of the sections contain detailed descriptions and useful information to consider when designing spaces for young children.

U.S. General Service Administrations, (2003). *Child Care Center Design Guide*. [Electronic version] Retrieved February 12, 2013, from Public buildings service website: http://www.gsa.gov/portal/content/103653

This guide was developed to present criteria for planning and designing child care centers in spaces owned by the GSA. The guide promotes a child-oriented design approach for new centers or for the renovation of existing ones. It includes considerations on child development, environmental safety and functionality among others. A large number of references cited in this guide refer to publications from the late Anita Olds.

Desirable characteristics of the classroom environment.

The influence of the environment in children's learning and development has been a topic of discussion and research for the last two decades. The late Loris Malagauzzi (Reggio Emilia founder and director) defined the environment as "the third teacher". He sustained that children learn through interactions, first with their parents and teachers, second with their peers and finally with the environments around them (Mau, VS Furniture & OWP/P Architects, 2010). According to the GSA Design Guide, children can spend up to 12,500 hours in a child care facility if they are enrolled while being infants and continue to be until entering school. Spending such long hours in a classroom will impact children's development and learning specially in the first years of their life. Classrooms are social places in which children and teachers learn together when they have opportunities to make decisions, test ideas and connect what is known to the unknown (Fu, 2003).

Design considerations for the creation of rich classrooms are critical to ensure children's sense of safety and belonging, which are essential requisites for learning to occur. Abraham Maslow, one of the founders of humanistic psychology, developed the Hierarchy of Needs (Mau, VS Furniture & OWP/P Architects, 2010), were he stated that children learn only when they feel

safe and secure. According to Maslow, those needs should be addressed first before considering any design aspect of a child's environment.

Anita Olds (Olds, 2000) suggests that the classroom has four main environmental needs:

Movement: being able to move and explore.

Comfort: a balanced control of the atmosphere's sensorial stimulation.

Competence: a variety of qualities that allow the children to act on their own.

Control: creating a space that offers privacy, predictability and orientation.

The basic environmental needs of the classroom in Old's view, help create a "spirit of place", a spirited design is the one that satisfies children's souls before any other requirement. Awareness on the aspects that nourish children should inform the design process and guide the decisions on the characteristics of learning environments.

Following a similar design concept, The Reggio Emilia Approach is based in discovering children's interests to guide their learning experience. In their educational system the environment is hybrid and the space is given shape and identity by the relations created within it (Ceppi & Zini, 1998). In the creation of their classrooms they focus in offering a space that is welcoming, rich in diverse stimuli and that connects to the outside reality. Space is considered alive and in constant modification according to the needs of its users (teachers, parents and children). The classroom is also built in the belief that it should create empathy and reciprocity, respecting individual and group needs. It should narrate the richness happening inside by documenting children's processes. By combining many different elements in the classroom there is a sense of "rich normality" that allows a great variety of activities and learning experiences to take place.

> The context defined and determined by the relationships and interactions with others and thus also with the environment –spaces, furnishings, color, lights and sounds-determines the possibilities and quantities of the learning processes that each individual chooses to produce within that context and thanks to that context (Ceppi & Zini, 1998, pg. 17).

Curtis & Carter (2003), express that early childhood programs are becoming each time more institutionalized due to standardized requirements and models. The authors consider there is a need to develop creative thinking when designing classroom environments that invite children to learn. Among the relevant elements to consider when designing a classroom they mention the need to create flexible spaces with open-ended materials, including natural materials that engage the senses and allowing wonder and curiosity to promote intellectual engagement. Creating a home-like environment allows children to develop a sense of belonging and feel confident in

their space. Using open-ended materials offer a more diverse use to satisfy the eager to acquire knowledge and skills that pre-designed materials can't provide.

Managing the multiple needs that a classroom environment should satisfy can be overwhelming for teachers and staff, specially when they have limited time and resources to design their classrooms. How can they optimize their knowledge, experience and time when facing the design of their classrooms? What process can they follow and what are the available tools that could help them organize their work? Do they know about design processes and how can they be used in their specific case?

Classroom design approaches.

This section contains three different and complimentary design approaches to create classroom environments that foster children's learning experience. Even when each system follows its own characteristics and orientation, they share common features in response to the specific challenges and opportunities of creating learning spaces.

The interpretive approach.

As previously discussed in the description of laboratory schools, the teachers at The Harold E.Jones Child Study Center at the University of California in Berkeley, developed a method for examining teacher research in this particular laboratory school. Their unit of analysis was interaction and the tool used was observations on children's interactions with their peers and the environment. The cyclic method they propose can be used to design the curriculum and the classroom environment where it takes place.

The classroom is conceptualized as a "social ecology" that communicates children's expectations on the characteristics of the space they need to learn. The approach allows to determine important aspects of the ecology such as the types of materials needed, actions that the children enjoy doing with them and the interactions that happen with the materials in the classroom space. The model is called: spheres of inquiry, and allows teachers to use their observations as valuable information for planning and evaluation of their curriculum and classroom design. Observations are used to enrich standardized formats that only measure skills without considering qualitative aspects of the situation being studied.

The model considers five main stages to follow described bellow:

Preparing the environment: Set up areas for group play and learning. Teachers use their own knowledge to set the classroom as a space where children can do the activities they enjoy with the materials available.

Observe and verify: Systematic observation of children's interactions. Observing is used to understand children's motivations while playing and be able to respond in ways that foster children's thinking.

Interpreting and reflecting: Reflections from teachers and children are interpreted.

Facilitating and observing again: Adjust space and activities according to the interpretations.

Evaluating: Teachers evaluate behaviors learning (their own and the children's) by analyzing their data and children's work. Ecologies are refined and the spheres of inquiry start again.

The process is summarized in table 1.

Preparing the Environment	Observe and Verify	Interpreting and Reflecting	Facilitating and Observing again	Evaluating, Reporting and Refining
Set up areas for group play and learning.	Systematic observation of interactions and behaviors to learn about children's expectations. Meaning emerges.	Teachers use play observation, children's narratives, portfolios of work, and children's reflections on their own work to document growth and change.	Teachers set up the ecologies as: "places were something happens".	Teachers evaluate their behavior and children's learning by analyzing the observational data and children's work.

Table 1: Phases of the Spheres of Inquiry process at The Harold E.Jones Child Study Center at the University of California in Berkeley (Scales, Perry & Jones, 2012).

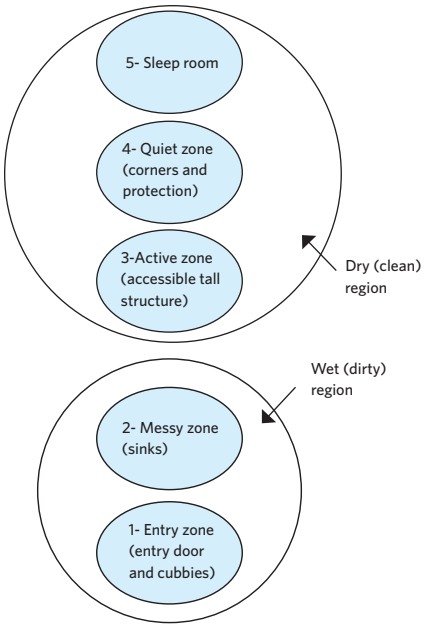
Child Care Design Guide: Anita Olds, 2000.

In this guide the author explains that the design process is enriched by collaboration between the different participants. Having the time to listen to different perspectives and discuss concerns allows people to think about how they are currently doing things and how would they like to do them in the future (Olds, 2000). The author considers that at least one of the members of the design team should represent the child's needs. Child care staff and members' knowledge should inform the rest of the team of their "dreams" to open their expectations because they are more used to "adapting to difficult circumstances" than creating innovative solutions for their environment.

Designers and architects are invited by the author to be attentive to the knowledge of the people that actually spend their days in the classroom. Understanding the needs and concerns of the users should lead the design decisions over aesthetic characteristics that may not necessarily contribute to the learning experience.

Among the different tools to approach the design of the classroom, the author mentions the use of three dimensional study models and behavioral mapping. Models or real scale mock-ups allow ideas to be tested and visualized without having to spend too much resources or time in their productions. Behavioral mapping is suggested to understand how the space is being used and what are the potential implications of introducing a new element in the classroom. The actual situation should be observed first to be able to project, compare and evaluate future interventions' impact.

The design process according to Olds starts by identifying the fixed features in the classroom, which set the constraints and opportunities of the space. A second step is recognizing that certain activities work well in exposed places while others need a protected area to function. Separating the room in two main regions; wet and dry, define the two main categories of activities. Within those two regions there are four types of activities that normally take place, entry, messy, active and quiet. Figure 2 shows the regions and categories proposed by Olds and list the twelve main steps to follow when laying out a group room.



Twelve steps in laying out a Group Room

1 Identify the room's functional requirement
2 Draw the room's fixed features
3 Identify the protected regions
4 Identify the Exposed Regions and Main Transit
5 Locate the Wet and Dry regions
6 Locate the entry zone
7 Locate the messy zone
8 Locate sinks/bathrooms in the messy zone
9 Locate the quiet zone
10 Locate the Active zone
11 Find a location for a tall structure
12 mark the boundary between Wet and Dry

Figure 2. Twelve steps in laying out a group room (Olds, 2000).
Figure reproduced form the Child Care Design Guide by Anita Olds.

After the general distribution of the classroom's main areas, group-room activity areas can be localized in the spaces that contain the adequate characteristics for them to work well. Group-room activities help to optimize the use of the space by regulating behaviors and

promoting independence. Each area should consider storage and display of materials and should be distinguishable from contiguous spaces.

Olds creates a design system that is based on the activities to be done and the specific attributes that the space needs to provide for them to be successful. The design does not emerge from aesthetical preferences of the designers or from arbitrary preconceived ideas of the teachers. With this system the team can understand the classroom as a place were different activities happen simultaneously and were a diverse group of people coexist for long periods of time.

The classroom environment is a complex situation that requires planning, testing, observing and learning in the process. It is also a “living environment” in the sense that the interactions happening will be different depending on the specific group using the space each time. The Reggio Emilia approach to the design of the classroom space, shares similar variables with Old’s system and enumerates a set of design tools to consider when designing a preschool classroom environment.

The Reggio Emilia design tools.

The seven design tools used by the Reggio Emilia schools in Italy are summarized in the findings of the study on classroom environment design developed in collaboration with the Domus Academy. They are listed and described below:

Relational Forms

Autonomous learning and communication are the objectives of the classroom design. The classroom should be recognized by its own unique characteristics, considering each part of the space as equally relevant in the total design. The space should be constantly modified and re-designed as a result of the experimentations of teachers and children. The space should display the learning process visually in the form of drawings, objects, posters, children’s work, images, videotapes and sculptures.

Light

Light is used as a living material for children to play and learn. Natural and artificial light is recognized and manipulated in a variety of forms by using shadows, projectors, screens, mirrors and computers.

Color

The use of color is understood as an added feature of the environment. The color of the surfaces of furniture or walls is neutral and acts like a canvas were a variety of color situations are displayed. Color, is added to the surfaces by people, objects, materials and children’s work. Balance is obtained only when the space is inhabited.

Materials

Materials in the classroom offer a variety of tactile experiences. Children are able to access materials freely and autonomously because they are displayed at their height and reach.

Smell

Smell influences the learning experience and is a vital element in the design of the space. It can be designed and should be taken into account.

Sound

Sound is considered as a material in the classroom space. It can be manipulated and designed to allow interactions and to offer a variety of situations.

Microclimate

Temperature, ventilation, floors texture, visibility and light cycles are elements to be considered in the design of the classroom.

As a result of decades of experience in observing, testing and designing learning spaces, the Reggio Emilia schools are created with the child's experience in mind. The classroom tells a story and documents children's memories and experiences by offering the possibility to interact with a respectful and meaningful environment. Adults are facilitators and partners in the learning of the children and act according to their needs and interests. Being attentive to children's behaviors guides the design process, as Vea Vecchi explains:

> When given the opportunity, children do not necessarily use the spaces strictly according to the preconceived purposes of the adults who equip them: in other words, children do not jump only in the movement area, they do not "play house" exclusively in the home corner, and so on. Children are nomads of the imagination and great manipulators of space: they love to construct, move and invent situations". (Ceppi & Zini, 1998, pg. 131)

The literature compilated in this section creates a standpoint to understand the multiple situations and considerations that take place in these specific settings. The following section explores the particular requirements of literacy rich classrooms. What are the main aspects to consider in the creation of a classroom that fosters emergent literacy development? Are there specific conditions that facilitate literacy behaviors? What actions should a teacher follow to design a literacy rich environment? What role does the teacher and the environment play in literacy development?

Literacy rich classroom environments.

Guo, Y., L.M. Justice, J.N. Kaderavek, and A. McGinty. The literacy environment of preschool classrooms: Contributions to children's emergent literacy growth. [Electronic version]. *Journal of Research in Reading. 35.3* (2012): 308-327. Retrieved February 20, 2013, from http://dx.doi.org/10.1111/j.1467-9817.2010.01467.x

This study examined the relation between features of the physical and the psychological literacy environment. The authors found that these two aspects of the environment are interdependent and that balance between them offers the most optimal context for literacy learning. The study also found that the organization of the physical material is more influential than just its presence in the classroom.

Guo, Y., Piasta, S.B, Justice, L.M, & Kaderavek, J.N. (2010). Relations among preschool teacher's self-efficacy, classroom quality, and children's language gains. [Electronic version]. *Teaching and Teacher Education, 26*, 1094-1103.

In this article, the authors describe classroom quality as a "multi-dimensional construct" that includes emotional and instructional support. The study explores the relation between teachers' self-efficacy and literacy learning in preschool children. The study concludes that preschool education quality can be improved by offering a high quality teacher education curriculum.

Piasta, S. B., Justice, L. M., Kadervavek, J. N., & McGinty, A. S. (2012). Increasing young children's contact with print during shared reading: Longitudinal effects on literacy achievement. *Child Development, 83*(3), 810-820.

This article presents the findings of a three-year research project to determine the influence of verbal and non-verbal interventions in shared reading sessions in 85 preschool classrooms. Teachers were trained to make explicit references to the presence of text in a set of selected books. Findings suggest that adults can promote children's short and long-term print knowledge by using these verbal and non-verbal references to print. The authors explain that implementing this instructional approach only requires an adjustment of teachers' typical book reading practices without the need of considerable training or material investments.

Morrow, L. M. (1982). Relationships between literature programs, library corner designs, and children's use of literature. *The Journal of Educational Research*, 75(6), 339-344.

The purpose of this research was to study the physical characteristics of library corners and literature activities used by teachers in early childhood classrooms. The results indicated that many early childhood classrooms did not have well-designed library corners and that teachers didn't plan regular literature activities for the children. When literature activities were scheduled, the number of children who chose to use literature during free-play period increased.

Roskos & Neuman, S. B. (2011). The classroom environment first last and always [Electronic version]. *The Reading Teacher, 65*(2), 110-114.

In this article the authors express that teachers need design knowledge if they are expected to create literate environments. Some principles proposed are aligning the design of the physical space with instructional goals, creating flexible spaces that can be modified for different purposes and providing sufficient materials organized well. The classroom should also include the development of new social skills like problem solving and meaningful interaction with media tools.

Vukelich, C., Christie, J., & Enz, B. (2011). *Helping young children learn language and literacy birth through kindergarten*. (Third ed.) Boston: Pearson Education Inc.

This book offers instructional strategies for teaching language to children from birth to kindergarten. It covers two perspectives in children's early literacy learning, emergent literacy and scientifically based reading research, and explains how aspects of both strategies can be combined in a blended instruction curriculum. The physical organization of a literacy rich classroom environment is described as well as the qualities and role of an effective teacher in these settings. The authors also offer a complete guide of instructional activities for each of the aspects of language and literacy learning and a series of assessment tools to measure and record children's knowledge.

Wayne, A., DiCarlo, C. F., Burts, D. C., & Benedict, J. (2007). Increasing literacy behaviors of preschool children through environmental modification and teacher mediation [Electronic version]. *Journal of Research in Childhood Education*, 22(1), 5-16.

The purpose of this study was to determine the frequency in which individual preschool children engaged in literacy activities during their free choice activity time in the classroom. Findings are consistent with previous research in revealing that the incorporation of literacy props in the dramatic play area, together with teacher mediation, increases literacy behaviors in children. The study also demonstrated that the inclusion of these materials in other areas of the classroom promote literacy behaviors as well.

Dimensions of the literacy rich classroom environment.

The literacy rich classroom environment is a complex configuration where several situations coexist simultaneously. On one hand the physical characteristics of the space and the disposition of the different elements define its limits, circulations and availability of materials for the students. On the other hand, the literacy opportunities and activities that the teachers promotes in the space, and their personal knowledge and capacities, play and important role in giving meaning to the arrangement of the physical features.

The physical literacy environment refers to the structure and organization of the classroom and the design, arrangement and display of the literacy materials in the space. The psychological literacy environment refers to the way in which teachers plan their activities and interact with the children to support their literacy development (Guo, Justice, Kaderaveck & McGinty, 2012). Research has found that these two dimensions of the classroom environment are interdependent and that the balance between both provides a rich learning context. Physical characteristics, as the availability of writing materials and books in the classroom by themselves are not enough to engage students in literacy behaviors. Teachers' can intentionally stimulate children's explorations through the organization of activities and materials in the classroom.

The curriculum plays a relevant role in the design of a literacy rich classroom. Two very different approaches have been constantly debating in preschool language and literacy instruction: Emergent Literacy and Scientifically Based Reading Research (Vukelich, Christie & Enz, 2011). Emergent literacy proponents believe that if children are provided with a rich environment, experiences and social interactions, formal instruction is not needed to learn how to read and write. SBRR on the other hand, states that children need targeted instruction in order to learn literacy skills. This approach is based in considering that all children learn at a different speed and that not all students can learn by the emergent literacy system. Vukelich, Christie & Enz, propose a blended instruction approach that incorporates aspects of emergent literacy and SBRR. Blended instruction considers that the print-rich environment is the setting where a combination of developmentally appropriate activities and specific literacy instruction allow children to learn literacy concepts and skills.

Classroom organization and layout.

The environment is a key element in modeling behaviors and offering opportunities for literacy instruction, working for or against teachers (Roskos & Neuman, 2011). Print rich environments according to Vukelic, Christie & Enz, are organized physical spaces that offer a variety of literacy materials for exploration and manipulation. They contain meaningful print to guide children's learning and offer reading and writing materials in nearly all the activities. The authors suggest dividing the classroom space into literacy enriched "centers", locating similar or related centers close to each other. Each center should contain labeled materials to engage children in the activities. The literacy materials should constitute the "fabric" of each center. Relevant centers in the classroom are the classroom library, play centers and writing center. Children's writings should be displayed in the room and the use of environmental and functional print should guide the actions and behaviors in the classroom.

According to Neuman & Roskos (1990), the design of the space should be planned according to the instructional goals to create active literacy engagement. Some principles to consider when designing a print-rich classroom environment are: creating a flexible spaces that can be modified to adjust to different purposes and organizing materials to be reachable physically and conceptually by the students. This means that the materials can communicate their use and invite students to do certain activities. The walls are considered an active element of the environment allowing communication, display and signage to be present visually. Finally, the authors mention the importance of controlling some environmental factors such as the exposure to natural light and the control of sound and temperature in the classroom.

The Role of the teacher in promoting and mediating literacy behaviors.

The teacher has a fundamental role as the mediator between the environment and the students. The design of the space reflects teachers' beliefs, preferences, knowledge and experience, as well as their instructional orientation and personal abilities.

In a three-year research study in 2012, Piasta, Justice, Kaderavek & Mc Ginty, explored the impact of increasing preschoolers attention to print during shared reading sessions by incorporating teacher's direct references to print in the books. Teachers made simple verbal and non-verbal adjustments in their typical book reading sessions to emphasize concepts about print such as letter's shapes, the presence of text in the page and the spelling of some words. Results showed that these references made by the teachers, enriched children's contact with print and suggest causal links between this practice and later literacy achievement (Piasta, Justice, Kaderavek & Mc Ginty, 2012). The study is relevant in showing how an instructional approach incorporated by the teacher (that does not implicate a time consuming training or a high cost investment), can impact directly on children's literacy learning.

The relation between teacher's self-efficacy and the quality of literacy instruction was explored in a study conducted by Guo,Piasta, Justice and Kaderavek in 2010. Self-efficacy in the study was defined as the teacher's belief in her own capabilities to promote desirable changes in students' behavior and achievement. Findings revealed that emotional and instructional support were related to vocabulary gains in the students and that preschool education quality can be improved by teacher education curriculums.

The role of the teacher as the designer of the classroom consists in promoting high quality instruction while organizing the physical space. Research has found that the presence of the material is not so influential in children's literacy behaviors as their organization in the classroom (Guo, Justice, Kaderaveck & McGinty, 2012). For example, the organization of the

materials may influence children's motivation in exploring them and learning about literacy. The authors hypothesize that the physical disposition of the space aligned with a high-quality instruction provided by the teacher invites children to use the resources and as a result improve their literacy abilities.

Among the different curriculum approaches adopted by teachers in preschool settings, play has been a mayor area of research as an influential activity in learning literacy. The design of a classroom that promotes free-play activities by providing literacy props has been found to positively affect the interest that children show in including literacy behaviors while they play. The last sub-section includes entries related to play and its powerful link with literacy learning in young children.

Literacy enriched play environments.

Morrow, L. M., & Rand, M. K. (1991). Promoting literacy during play by designing early childhood classroom environments [Electronic version]. *The Reading Teacher, 44*(6), 396-402.

The purpose of this article was to explore the influence of classroom modification in encouraging play and promoting literacy activities in young children. A study of behavioral observations was conducted including one hundred and seventy youngsters. Literacy materials were introduced in different areas of the children's classrooms, with and without adult guidance. Findings demonstrated that preschool children engage in more voluntary literacy behaviors during free-play periods when materials are present in their playing areas and teachers guide their use.

Neuman, S. B., & Roskos, K. (1990). Play, print and purpose: enriching play environments for literacy development [Electronic version]. *The Reading Teacher, 44*(3), 214-221.

The study examined how a planned design of a print environment may influence children's literacy activities during play. 37 children in two racially mixed childhood settings participated in the research. Classroom design was modified according to previous research findings (Neuman & Roskos, 1989) on five functional domains. Play activities were observed prior and after the classroom modification. Results showed behavioral changes in children's play activities after the introduction of literacy material. Findings suggest that a planned design of the physical play environment offers a rich context to discover and explore reading and writing.

Reyes, C. L. (2010). A teacher's case for learning center extensions in kindergarten. *Young Children,65*(5), 94-98.

This article was written by a teacher who expresses her frustration in being forced to demonstrate visible results of reading and writing in kindergarten students. Her teacher graduate school courses taught her that hands-on activities are more effective in supporting the learning

of young children, but assessments and policies are not necessarily in line with her knowledge. She introduced hands-on activities in her classroom and noticed positive behavioral changes that allowed her students to explore new challenges and live new learning experiences.

Roskos, K.A., & Christie, J.F. (2011). The play-literacy nexus and the importance of evidence-based techniques in the classroom. *American Journal of Play, 4*(2), 204-224.

This article reviews the literature and research on the role of play in young children's literacy development and early-literacy learning. It defines the concept of play to clarify the activities and behaviors that characterizes these actions in preschool age children and the implications they have in learning literacy. It also summarizes the major findings in a set of principles to consider when designing literacy-enriched play environments.

Roskos, K. A., & Christie, J. F. (2011). Mindbrain and play-literacy connections. *Journal of Early Chidhood Literacy, 11*(1), 73-94.

In this article the authors describe the actual situation of research in the study of the literacy-play connection. The digital reality that children experience in the 21st century is presented as a new condition to consider and explore in the design of preschool environments and in the understanding of what it means to be literate. The authors propose moving forward by using a new conceptual framework based on connectionist and dynamic system theories to answer the question: Does play make a difference in early literacy development?

Play and literacy.

Play is a wide concept that can be interpreted in many different ways. Burghardt (2011) defines play in a set of five criteria that must be present to recognize this behavior. Some aspects considered by Burghardt are the presence of a spontaneous behavior that is pleasurable and intentional, not fully functional and repeated in a similar but not rigid way. Play offers an ideal context for literacy abilities to develop and for children to experience continuous opportunities to practice them (Morrow, 1991). Literacy objects allow young children to imitate and pretend literacy behavior from adults and older children while playing.

Research on the connection between literacy and play has found that sociodramatic play is the most closely linked to emergent literacy. This type of play involves symbolic representation, imaginative use of language, role-taking, social interaction, and sustained play activity (Roskos & Christie, 2011).

Play environments that promote literacy.

According to Roskos and Christie (2011), the relation between literacy and play is defined as a nexus, a "space where play, language and emerging literacy behaviors converge and interact". The relation between the play environment and the literacy behaviors of children was the focus of research in the 90's and one of its mayor findings is that literacy rich environments promote literacy behaviors (Roskos & Christie, 2011).

Morrow and Rand (1991) explored how changes in the environment encouraged play and influenced children's activities and behaviors while playing. Literacy materials were introduced in different classroom areas, with and without adult guidance. Results showed that children's engagement in literacy activities during free-play periods increased when literacy objects were introduced in the classroom and when teachers guided their use. The researchers found some practical elements of the classroom organization to have an influence in children's interests, such as labeling containers with materials to facilitate its use and storage and changing materials periodically to keep children's interest.

Following a similar method, Neuman and Roskos (1990), examined how a specially designed print environment could influence children's literacy activities while playing. The classroom was divided into defined play centers and all materials in each center were labeled with a printed name or a symbolic form. Generic and thematic literacy objects were introduced considering three dimensions appropriateness (safety and recognition), authenticity (natural to children) and utility (familiar function). Findings revealed that literacy in play became more purposeful, situated, connected, interactive and role defined. The study showed that play can become a powerful context for the discovery of reading and writing if the playing space is thoughtfully designed to promote children's interest and use of literacy materials. It also emphasized the role of play as an opportunity for children to learn from each other.

Roskos and Christie (2011), propose three principles for the design of literacy-enriched play environments.

Infrastructure principle: the planned organization and disposition of the materials in the space were storage and maintenance is intentional.

Authenticity principle: literacy materials are accessible and related to everyday activities.

Complexity principle: variety of complex materials with multiple modes (tactile, auditory, visual) and uses.

21st century context for play in preschool environments.

Preschool education has been changing in the U.S over the last two decades. The emphasis on direct instruction of literacy skills in preschool (as a way to be prepared for kindergarten) has grown debilitating the play experience. As time is used for literacy instruction, it is taken away from play activities (Roskos and Christie, 2011).

At the same time the permanent presence of technology in children's everyday life is introducing new and different ways of relating to the act of reading and writing. Roskos and Christie (2011), explain that these new setting introduces questions about the design attributes of literacy play settings and about the role of traditional play activities as we know them.

Roskos and Christie (2011), emphasize that an important area of future research is the influence of a literacy rich environment in the complexity of the wider play activity. The authors consider relevant to explore what other knowledge areas can use play as a context and are set apart by focusing primarily on literacy. They recommend keeping a balance between literacy and other knowledge areas in play environments and exploring new methodologies to study the play-literacy nexus.

Cognition and Development.

This category contains entries related to cognition and development in young children. Developmental theories and research on brain development are relevant topics for teachers and designers to consider in the design of rich classroom environments. This section is divided in three sub-categories: Cognition, Development and Brain Research, Influence of Policy in the Learning Environment and 21st Century Learning.

Cognition, development and brain research.

Bedrova, E., & Leong, D. J. (2006). Vygotskian perspectives on teaching and learning early literacy. *Handbook of Early Literacy Research, 2*(243), 256.

In this article, the authors summarize the main principles of Vygotsky's theories on learning and development. Focused on Vygotsky's views on the teaching of reading and writing in preschool, the article points out important issues to consider in the design of the space and the curriculum of preschool programs.

Driscoll, M. P. (2000). *Phsychology of learning for instruction.* (2nd ed.). Needham Heights, Massachusetts: Pearson Education Company.

In this book, the author covers several theories on learning and instruction. Aspects of behavior, cognition, meaningful learning and the biological views of learning are discussed.

The author presents instructional recommendations that are built upon these relevant areas of knowledge about the learning process.

Rushton, S., & Larkin, E. (2001). Shaping the learning environment: Connecting developmentally appropriate practices to brain research. *Early Childhood Education Journal, 29*(1), 25-33.

This article summarizes The National Association for the Education of Young Children's position statement (DAP) for children from birth to age 8. The authors connect the DAP position to brain research principles and classroom environment requirements as a way to explain how they are related and interdependent. A table presents each principle with its corresponding brain research principle and recommendations on instructional practices and classroom environment design.

Cognitive development theories and instruction.

Among the different existing approaches to cognitive development in early education, four main individuals are cited recurrently by researchers as influential on the creation of instructional methods by educators: Piaget, Vygotsky, Dewey and Gardner. Their theories have shaped the learning environments of preschool settings around the world and in some cases have modeled the teaching of reading and writing.

Jean Piaget's theory of cognitive development stands on a constructivist approach that considers "knowledge acquisition as a process of continuous self-construction" (Driscoll, 2000). In his view, the child develops and interacts with the world in a personal process that includes four main stages from age 0 to adulthood. He defined three mechanisms of children's progression through the four stages of development: assimilation, accommodation and equilibration.

Assimilation is the process by which new experiences are incorporated to knowledge by association to prior information. Accommodation happens when there is a need to modify existing concepts due to a new experience that doesn't fit in the existing schemes. Finally equilibration is a more sophisticated level of thought in which both accommodation and assimilation take place (Driscoll, 2000).

Piaget's views are opposed to the practice of direct instruction and consider that the environment is enriched when it provides the child with opportunities for a variety of activities to be experienced. The presence of manipulative materials to test and the interaction with peers in play activities are fundamental in Piaget's approach.

Lev Vygotsky believed that children developed by the interlacing of two processes, their natural development and their cultural development (Bedrova & Leong, 2006). As opposed to

Piaget, he considered that direct instruction in the form of adult guidance or planned activities contributed to development. Vygotsky questioned the appropriateness of teaching reading and writing to preschool children in the belief that they are cognitive complex behaviors that ignore the social origins of higher mental functions (Bedrova & Leong, 2006). He proposed that reading and writing are cultural tools that help children to develop these higher mental functions and that in the preschool years its more relevant to understand their potential for communication than to master their technical use.

Vygotsky proposed a guided instruction that is based in the concept of the child's zone of proximal development (ZDP). The ZPD is the distance between what a child can solve by himself and what can be solved with the help of a more capable peer. He considered that make-believe play creates the ZPD, as the child has the opportunity to pretend being someone else or knowing how to do things he doesn't really control yet. Drawing is another important tool proposed by Vygotsky as a way to record stories and messages emphasizing the need to communicate over the ability to write (Bedrova & Leong, 2006).

As Piaget and Vigotsky; John Dewey recognized the role of a rich environment in the learning process of young children. He believed that children learn from real life applications and that when various senses are used simultaneously, the probability of learning is greater (Rushton & Larkin, 2001).

Finally, Howard Gardner constructed the theory of multiple intelligence in which he proposes that cognitive development proceeds independently in at least eight relatively autonomous domains: language, music, logical-mathematical, reasoning, spatial processing, bodily-kinesthetic activity, interpersonal knowledge and intrapersonal knowledge (Driscoll, 2000). These domains are present in every individual and the learning process of each person is different depending on their preferred domains. Gardner agrees with Piaget, Vygotsky and Dewey in the influence that the environment has on the learning process and believes that biological potential can be affected by cultural factors in the environment (Driscoll, 2000).

The design of learning spaces needs to consider the child's development stages, the fruitful interactions that can be experienced with the environment and with peers and the different learning modes that individuals use to gain knowledge. Theories on cognitive information processing also inform the design process by exploring how the brain acquires and stores knowledge.

Cognitive information processing.

According to the Cognitive Information Process (CIP) the human learner is a processor of information coming from the environment. Input is processed and stored in memory and output as a learning capability. Adherents to the CIP model assume behavior is influenced and modeled by the information processing system (Driscoll, 2000). The memory system in the CIP model follows three basic stages: sensory memory, short-term memory and long-term memory.

Sensory memory is short and relates to the unconscious information provided by the senses. Short-term memory involves being conscious about ideas for a short time, and long-term memory is long lasting and has infinite capacity of storage. Information is transferred through these three stages by a series of processes: attention, pattern recognition, chunking, rehearsal, encoding and retrieval (Driscoll, 2000).

Information enters through the senses by auditory and visual stimuli and is made conscious by the processes of attention and pattern recognition. Attention influences learning as it can reduce the overwhelming information coming from the environment to focus only in some of it (selective attention). Pattern recognition is the process by which stimuli is recognized as concepts already in memory. Visual perception is influenced by pattern recognition. As Gestalt psychologist demonstrated in their studies, the human mind goes beyond the information given and can recognize visual patterns (Driscoll, 2000).

The classroom environment created by teachers should manage and control the visual and auditory stimuli to allow children to focus their attention. For example a classroom that is overloaded with an excess of visual information or implies a constant auditory effort of attention for the child will require more energy in trying to neutralize the stimuli than in learning.

Short-term memory (also known as working memory) is influenced by the processes of chunking and rehearsal. George Miller (1956) demonstrated that information is recalled better when it is reduced to chunks. He discovered that working memory retains and manages 7 plus or minus two bits of information. This means that grouping information in sets or chunks facilitates the learning process. Rehearsal also allows information to be processed to long-term memory but is not enough to ensure learning (Driscoll, 2000).

Long-term memory stores information by encoding it as concepts that can be retrieved when new information is presented. This process allows new input to be memorable and meaningful. Visual images are powerful encoding tools that can be used in multiple ways to help access information already stored in memory.

Long term-memory has been represented and understood in different ways. Network Models view concepts associated to one another in a hierarchical way and Parallel Distributed

Processing Models (PDP) propose that knowledge is stored in the connections among processing units (Driscoll, 2000). Paivio's Dual Coding Model proposes that there are two main systems of memory representation: verbal and non-verbal information. This model recognizes the power of visual images (non-verbal information) as a strong tool to gain knowledge, and the relevance of combining the use of verbal and non-verbal information for instruction.

Why is Cognitive Information Processing important in the design of rich classroom environments?

As children are in a fundamental stage of their development when assisting to preschool, the connections that they can build during these years are strong and meaningful. The environment influences the building of these connections by allowing the opportunities for multiple ways of learning to occur. Using multiple modes to present new information over repeating lists of content or focusing mainly on rehearsing has demonstrated to be a better way of encoding information for long-term memory storage. Elaboration is needed to process information in different ways, and a larger set of cues used in encoding provides more alternatives to facilitate retrieval (Driscoll, 2000).

Development, brain research and the learning environment.

Along with a cognitive approach, learning is also being studied from a neurophysiological perspective. Research in this area focuses on the biological and evolutionary aspects of learning. Correlations between the structure and function of the brain and between sprouting and spurning periods in synapses and critical periods in cognitive development have been found. When learning takes place, all the parts of the brain work together and when a child is engaged in a learning activity many areas of the brain are simultaneously activated (Driscoll, 2000).

Rushton and Larkin (2001) explored the relation between the learning capacities of the human brain and the characteristics of the classroom environment. Their proposal is based on the DAP (Developmentally Appropriate Practices) Position Statement developed by the NAEYC (National Association for the Education of Young Children) to guide childhood education practices. This constructivist approach is built on the premise that "children are social learners who actively construct meaning and knowledge as they interact with their environment" (Rushton and Larkin, 2001). The authors connect DAP principles with brain research (BR) suggestions on human learning to offer strategies that incorporate both DAP and BR. According to Rushton and Larkin (2001), brain research does not directly provide teachers with strategies, but it supports what educators have always known about learning environments and justifies the use of certain approaches over others. Brain research allows teachers to understand what they empirically know Rushton & Larkin, 2001).

Driscoll (2000) suggests four conceptual models found by brain research with implications on instruction: fixed circuitry, critical periods, plasticity and modularity. This conceptual classification of brain capacities is in line with Rushton and Larkin's instructional suggestions.

Fixed circuitry refers to connections that develop in the brain during gestation and critical periods in the brain development after birth, during childhood and as some researchers believe, until age 20. This suggests that there are some critical periods in life when the brain is developing actively in specific areas (Driscoll, 2000).

Plasticity is the capacity of the brain to change and adapt depending on the influences of the environment. Studies have compared the cognitive abilities of children raised in different types of environments and found that "an enriched environment can significantly enhance cognitive development, especially when the enrichment comes at an early age". (Driscoll, 2000 pg. 290). Rushton and Larkin (2001) explain that behavior and development are conditioned by human evolution and modeled by the unique environmental stimuli that each individual experiments. Plasticity of the brain is present all through life, but research has found that flexibility in learning decreases as people become older (Driscoll, 2000).

Modularity consists on the different learning domains described by Gardner as having separate neural mechanisms that can be differently affected by biological and environmental factors. According to Gardner's theory each learner has preferred learning modes, memory types and cognitive capacities and need opportunities to use their preferred intelligences as well as adapt to and develop their other intelligences (Rushton & Larkin, 2001). Even when there are different learning domains, they are all closely related and influence each other permanently. The use of multi-aged classrooms is proposed by educators as a way to facilitate learning for a number of children that may share interests and learning modes independent of their age (Driscoll, 2000).

Implications of brain research in classroom design.

Research has found that learning to read and write uses diverse brain functions and areas that are interdependent (Rushton & Larkin, 2001), and that neurological age is a critical factor in children's language development (Driscoll, 2000).

If the learning of reading and writing is focused only in some parts of cognition, then many students are not able to use their preferred capacities to engage in their learning experience. According to Driscoll (2000): "instructional strategies that appeal to multiple sensory modes and cognitive capabilities allow more learners to benefit from the experience and more ways to store memories for future recall".

Prior knowledge is another important consideration in the learning of reading and writing. On one hand, the learning experiences of the preschool years are fundamental as groundwork for future learning. On the other hand, there is research sustaining that language is biologically programmed (Pinker, 2007), and that instruction should take advantage of this prior knowledge and build from there (Driscoll, 2000). In both cases, learning will be highly influenced by experiences in the first years of life. As the child grows, he or she should be able to connect new information with well-established conceptual frameworks built over time (Rushton & Larkin, 2001).

The design of the classroom can use brain research to offer children a wide variety of learning opportunities. The first and most important suggestion is to consider that learning and memory are connected to emotions (Driscoll, 2000). If the child feels safe he or she can engage in learning. If part of the brain development is "hardwired" by human evolution and part is "softwired" by stimuli from the environment (Rushton & Larkin, 2001), then the classroom plays an important role in facilitating learning.

As many researchers have found (Roskos & Neuman, 2011; Vukelich, Christie & Enz, 2011), the presence of centers across the classroom with different problems to solve and materials to use can accommodate a variety of learners. An overall theme helps to create connections among areas and give more meaning to the learning experience. Diverse hands-on activities can stimulate different learning styles and various areas of the brain to create strong associations (Rushton & Larkin, 2001).

If teachers and designers understand the learning process they can design classrooms that stimulate specific areas of the brain, allowing meaningful connections to be made with prior knowledge (Rushton & Larkin, 2001).

Influence of policy in the learning environment.

Partanen, A. (2011, December 29). What Americans keep ignoring about Finland's school success. *The Atlantic Magazine*, Retrieved from http://www.theatlantic.com/national/archive

This article presents the experience of the Finish school system as an "education superpower" and compares it to the American educational system. The author explains how Finland's educational model is successful by valuing equality more than excellence.

Rushton, S., & Juola-Rushton, A. (2008). Classroom learning environment, brain research and the no child left behind initiative: 6 years later. [Electronic version]. *Early Childhood Education Journal, 36*, 87-92. Retrieved March 18, 2013, from http://link.springer.com/article/10.1007%2Fs10643-008-0244-5?LI=true

This article addresses some of the difficulties that arise form the No Child Left Behind act (NCLB). One of the major problems that the authors mention is the pressure that teachers and children experience by being permanently tested and evaluated. These common practices contradict information coming form brain research in relation to appropriate instructional practices. According to the authors, the creation of child-centered environments that foster learning is being threatened by the assessment implementation.

Teale, W. H., Hoffman, L., & Paciga, K. A. (2010). Where is NELP leading preschool literacy instruction?: Potential positives and pitfalls. [Electronic version]. *Educational Researcher, 39*(4), 311-315. Retrieved March 23, 2013, from http://edr.sagepub.com/content/39/4/311

This article examines the positive and problematic influence of the National Early Literacy Panel (NELP; 2008) report on pre-kindergarten and kindergarten instructional practice. The authors evaluate the report as “insufficiently clear” and “overly narrow” in relation to “what” should be taught and “how” preschool teachers should focus instructionally in early literacy.

How does Policy affect Instructional Practices and Classroom Environment?

The influence that policy has on educational practices is a relevant issue to consider when trying to understand the reality of preschool teachers and the design of their classroom settings in the U.S.A. Specifically in early literacy instruction, the NCLB act (2002) and the NELP (2008) are having positive and negative impacts in relation to what is considered the important content to teach and how that content is transmitted to the students (Rushton & Juola-Rushton, 2008;Teale, Hoffman & Paciga, 2010).

The NCLB is focused mainly in ensuring that no child is being left behind in relation to his or her capacity to read and write successfully when reaching fourth grade. Rushton & Juola-Rushton, analyzed the difficulties that arise form the NCLB and found that teachers face a complicated decision when they choose instructional practices to use with their students. Standarized assessment applied to the children to measure their knowledge is in many cases, modeling the curriculum and replacing meaningful learning for “teaching to the test” methods. The authors describe some basic principles of NCLB that contradict the brain compatible learning environment.

The receptive reaction of children to standardized assessment may vary depending on their background experiences, which makes it difficult to measure if they are all actually learning (Rushton & Juola-Rushton, 2008). Furthermore, grading American schools upon students’ test scores, affects the understanding and implementation that teachers have of the initiative.

The authors conclude that the difference between school quality is maintained because low performing schools tend to attract less prepared teachers and high performing schools tend to attract better prepared teachers and more funds.

Incorporating pedagogical practices based on brain research is hard for teachers when they are being evaluated by their students' results.

According to the authors, NCLB pressures teachers because accountability is based on student's achievement affecting their pay and school district funding. At the same time, the use of assessment tools does not accurately assess how the brain learns best or the retention of information in long-term memory. Children's emotional state may also be altered by assessment methods having the amygdala reacting with fear and anxiety instead of allowing the brain to concentrate confidently in learning (Rushton & Juola-Rushton, 2008).

The design of the classroom environment is also affected by the focus of the NCLB on assessment. If most of the time is devoted to teaching specific skills, the space looses its potential and becomes a static room were the teacher mainly transfers knowledge. In this case, the children loose the opportunity of learning supported by a classroom environment that could invite, motivate and challenge them to discover their own interests.

Teale, Hoffman & Paciga (2010), studied the instructional implications for 3 to 5 year-old students that arise from the research study conducted by the NELP (2008). The authors evaluated the report as "insufficiently clear" and "overly narrow" in relation to the instructional focus for teaching early literacy.

Even when the report enumerates the six main variables that predict future literacy conventional skills, it does not suggest appropriate instructional methods for teachers to follow. It is "insufficiently clear" because it forces the reader to understand and interpret the implications of the daily instruction related to early language and literacy (Teale, Hoffman & Paciga, 2010).

Teale, Hoffman & Paciga (2010) explain that the report is "overly narrow" because it may suggest to educators that the variables mentioned are the only components of literacy that should be taught. If that is the case, important abilities as listening comprehension, oral language, oral composing and content knowledge, could be ignored by educators. This problem is worsened by the fact that the findings in the report are based primarily in results from measurements applied to students from kindergarten to second grade and not from higher grades. The authors conclude that the NELP recommendations privilege skills over content, narrowing the foundation of future abilities that children will need in higher grades.

A very different approach to public education is the one developed in Finland. This "education superpower" has consistently obtained one of the highest scores in the PISA survey (conducted every three years by the Organization for Economics Co-operation and Development, OEDC) since 2000. The U.S. performance in the PISA survey has been middling at best (Partanen, 2011). According to Partanen, Finland's success is intriguing because, as opposed to the East Asian model of long exhaustive hours of rote memorization, Finish students have less homework and are engaged in more creative play.

In Finland there are no standardized tests and teachers create their own assessments for each individual child. The Ministry of Education tracks national progress by testing sample groups form different schools. Teachers are given prestige, decent pay and a lot of responsibility (Partanen, 2011). Schools don't compete with each other but collaborate instead. Pasi Sahlberg, member of the Finish Ministry of Education and author of "Finish Lessons: What can the World Learn from Educational Change in Finland?", explains that the goal of the program that Finland instituted years ago was not excellence but equity.

American's argue about nation's size and ethnic makeup for their difficulties in achieving good performance (Partanen, 2011), but Samuel Abrams (visiting scholar at Columbia University Teacher's College) argues that Educational Policy is more relevant for a successful school system. "Finland's experience shows that it is possible to achieve excellence by focusing not on competition, but on cooperation, and not on choice, but on equity" (Partanen, 2011).

21st century learning.

Partnership for 21st century skills. (2009). *Learning Environments: A 21st Century Skills Implementation Guide*. Retrieved March 23, 2013 from http://www.p21.org/index.phpPartnership for 21st century skills

The partnership for 21st Century Skills is a U.S. national organization with the mission to provide tools and resources to help the education system keep up with the demands of a global economy. To help practitioners integrate these skills to the teaching of core academic subjects, the Partnership developed the Framework for 21st Century Learning. This framework describes the skills and knowledge children will need in their future by blending content knowledge, specific skills, expertise and literacies.

Willis, C. (2006, December 10). How to bring our schools out of the 20th century. Time Magazine, Retrieved March 11, 2013, from http://www.time.com/time/printout/0,8816,1568480,00.html

This article discussed the importance of aligning teaching methods and school curriculums with 21st century skills. It describes relevant abilities that children will need to develop to live a lifelong learner's life in the modern world. The authors explain that the actual focus on achievement is a risk for future generations of adults that will need to live in a global economy and permanently solve abstract problems.What are the skills and knowledge that children need to develop in the 21st Century?

American school system, starting with the preschool years has focused on achievement measured by assessment and reading scores. Policy has been developed to lower the differences in performance between social classes (Willis, 2006), but the results of American students in international measurements are lower than those of students in Finland or Singapore (Partanen, 2011). What needs to change in American curriculums and educational policy?

According to Willis (2006), children need to be prepared to live in a global economy. This scenario demands that they know more about the world, learn to collaborate with people from other cultures and work in teams.

Communicational needs in a global world, requires future professionals to speak more that one language and to be able to discriminate between reliable and non-reliable sources of information. Developing creative and innovative skills is also fundamental to be able to think across disciplines and benefit from inter-disciplinary combinations
(Willis, 2006).

In an effort to bring American education in-line with the global economy, The Partnership for 21st Century skills, developed the Framework for 21st Century Learning as a unified collective vision of learning (Partnership for 21st century skills, 2009).

The framework proposes the incorporation of 21st century interdisciplinary themes into core subjects. These themes are Global Awareness, Financial, Economic, Business and Entrepreneurial Literacy, Civic Literacy, Health Literacy and Environmental Literacy.

It also includes Learning and Innovation Skills that allow to "think outside of the box", confronting complexity with a flexible view of today's world work environments. These skills include: Creativity and Innovation, Critical Thinking and Problem Solving and Communication and Collaboration.

Technology is given a relevant role to develop Information, Media and Technology Skills that allow people to adjust to evolving technological tools and discriminate information while being able to make individual contributions. These skills include: Information Literacy, Media Literacy and ICT (Information, Communications and Technology) Literacy.

Finally, the Framework for 21st Century Learning recommends educators to develop Life and Career skills in their students as abilities to live in a changing world with complex environments. These are: Flexibility and Adaptability, Initiative and Self-Direction, Social and Cross-Cultural Skills and Leadership and Responsibility.
Thinking skills and content knowledge should be complemented with interaction and self-developing skills to live in the globally competitive information age.

In order to create a positive learning environment for all these skills and abilities to be developed, the educational system needs to count on an innovative support system. The Partnership identified five critical support systems: 21st Century Standards, Assessment on 21st Century Skills, 21st Century Curriculum and Instruction, 21st Century Professional development and 21st Century Learning Environments.

The learning environment is the space where most of the educational activities and interactions take place. It needs to be thought as a flexible place where educators and children feel safe and comfortable. They need to be able to modify the classroom in ways that support the different activities that each day brings and allow students to explore their own interests. Teachers are responsible of creating these spaces and therefore they need to know about design methods, processes and tools that can help them incorporate the different requirements of 21st Century classrooms.

The next section will review initiatives that relate Design to Education. Methods and tools used by designers can be helpful for educators to create thoughtful learning spaces with the use of their own knowledge and experience. Design as a relatively young field, has borrowed some of these practices from the social sciences and has developed its own way of using them to organize the design process and discover innovative solutions and opportunities in a wide range of applications.

Design Methods and Tools

Entries in this category contain information about initiatives that have been developed to explore the relation between Design and Education. It also presents design methods and tools that are applicable in the field of education to create curriculums, systems and learning environments.

Brown, T. (2009). *Change by design. How design thinking transforms organizations and inspires innovation.* New York: HarperCollins Publishers.

In this book, Tim Brown (CEO and President of IDEO), describes the Design Thinking process and its potential for innovation. He explains the main principles and methods of the approach in a comprehensive way, by contextualizing it with his real experiences as the President of IDEO.

IDEO. (2013). *The design thinking toolkit for educators (version 2)*. Retrieved July 22, 2013, from http://designthinkingforeducators.com/

IDEO developed this adaptation of the design thinking process to guide educators in their permanent design experiences. It contains a Manual and a Designer's Workbook with recommendations on how to approach each phase of the process.

Kolko, J. (2011). *Exposing the magic of design. A practicioner's guide to the methods & theory of synthesis*. New York: Oxford University Press Inc.

Jon Kolko is a Principal Designer at Frog Design and the Director of Austin Center for Design. In this book he explores the creative process of synthesis in design practice. He presents a variety of methods and tools to structure synthesis and make it visible for clients or other professionals participating in design projects.

Laurel, B. (2003). *Design research methods and perspectives*. Massachusetts: The MIT Press.

In this book, Brenda Laurel guides designers in the development of their research projects and validates the use of qualitative research as a successful approach for business. The book expands the limits of design as it is commonly known and explains the relevance of design synthesis for the creation of innovative products and services.

Redlab (2013). http://www.stanford.edu/group/redlab/cgi-bin/

"Redlab (Research in Education & Design Lab) was founded in 2009 to study the impact of design thinking in education". This web page was developed to spread their experience in conducting research to understand the potential of design thinking in K-12 educational settings.

Design and education.

Although traditionally design has been related mostly to the creation of objects or products, it has been amplifying its limits over the years. Today designers create tangibles and intangibles such as artifacts, systems and experiences.

Design and education have many aspects in common. Both disciplines require creative thinking, permanent problem solving and are human-centered. Methods and tools used in design are applicable to solve educational issues and can help teachers manage the complexity of their different challenges.

As mentioned earlier in this chapter, Bruce Mau in collaboration with OWP/P Architects and VS Furniture developed The Third Teacher, a book that presents 79 ways in which design can be used to transform teaching and learning. The book describes the challenges that students will face in future generations and questions the characteristics of the learning spaces that we use in relation to a series of aspects as health, sustainability, creativity and future challenges. One of the main messages in the book is that teaching and learning should shape the design of learning spaces and not vice versa. It is a call for attention in relation to listening to the students and their needs and designing with empathy by observing real behaviors and challenges.

The Design School at Stanford University created Redlab in 2009 to study the applicability of design thinking in education. The Stanford School of Education and the Hasso Plattner Institute of Design (d.school), joined in this project to explore together the feasibility of using design thinking as a way to teach and learn. They created a space of experimentation and ideation were students learn about the design thinking process and about its potential to enrich their learning experience.

Design thinking.

Tim Brown (2009) describes design thinking as an interdisciplinary non-linear process that seeks discovery and innovation. It is a collaborative experience that finds design opportunities through a process of careful and empathic observation of behaviors. By understanding people it is possible to design experiences that create opportunities for active participation by the user (Brown, 2009).

The collaborative nature of the process allows for ideas to be shared in real time and for every participant to have an opportunity of expressing his or her opinion.

A fundamental aspect of the design thinking process is that it combines divergent and convergent thinking. This combination opens the possible solutions for a design problem and generates a playful environment for creativity to flow.

The design thinking toolkit for educators.

This toolkit was developed by IDEO as a resource for educators to use a structured design method to solve their many problems. The design thinking approach offers teachers design tools to conduct their own research activities as insiders with unique knowledge.

The method is intentional, collaborative, innovative and human-centered. By developing creative abilities, teachers can transform difficult challenges into opportunities for design (IDEO, 2013).

IDEO presents the toolkit for educators as a method applicable to a variety of design challenges as the design of learning experiences (curriculum), learning environments (spaces), school programs and experiences (processes and tools) and systems, strategies, goals and policies (systems). The main driving force of the process is to listen to the needs of real users by being empathic, optimistic and experimental. As Tim Brown explains:

> Our objective, when it comes to the application of design thinking in schools, must be to develop an educational experience that does not eradicate children's natural inclination to experiment and create but rather encourages and amplifies it. (Brown, 2009, p.223)

The design thinking process.

The process consists of five iterative phases that encourage learning by doing. These phases are: discovery, interpretation, ideation, experimentation and evolution.
Although the method is structured, teachers are encouraged to adapt it, cut it up, reconstruct it and make it their own. (IDEO, 2013)

Figure 3, in the following page, describes the phases of the process as suggested by IDEO. The model illustrates the combination of divergent and convergent thinking that characterizes the approach.

Phase 1; Discovery: The first phase is about finding design opportunities by exploring and becoming inspired. It is a divergent phase intended to understand the challenge, prepare for research and gather inspiration.

Phase 2; Interpretation: Interpreting is related to finding meaning in the data and transforming it into design insights. This phase uses design synthesis methods to narrow down stories into meaningful design opportunities. It is a phase where observations converge and opportunities are framed.

Phase 3; Ideation: This phase consists in opening up to a variety of possible design interventions to solve the detected problems. Tools as brainstorming, sketching and making ideas visible are suggested to experience creative thinking in collaboration.

Phase 4; Experimentation: In the experimentation phase, possible solutions are prototyped and tested. By creating diagrams, mock-ups and models, the team is able to get feedback from the users.

Phase 5; evolution: The last phase of the process is fundamental to understand the impacts of the design solutions. By reflecting on the results and documenting them, the team can move forward to a new cycle.

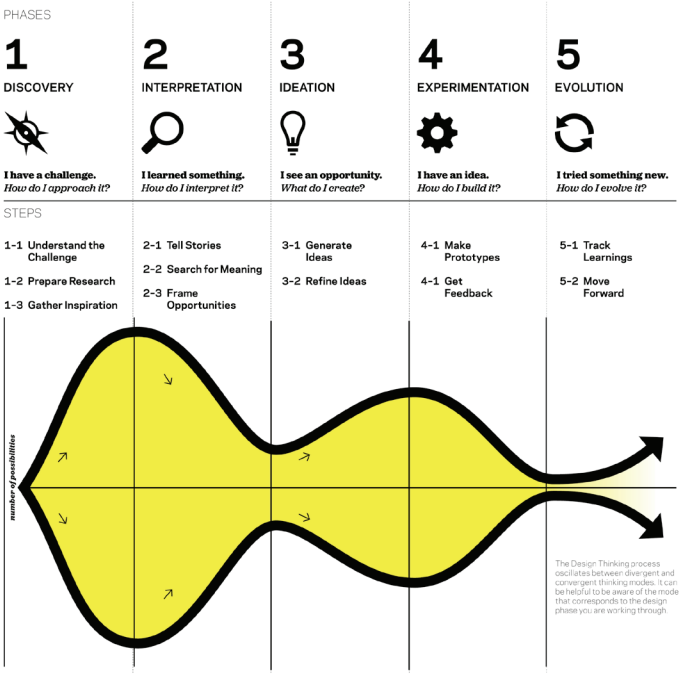


Figure3. The design thinking process defined by IDEO in the Design Thinking Toolkit for Educators (second version, 2013, pg. 15).

By using a structured method as design thinking, educators are empowered to create spaces inspired on the real needs of their students. Design thinking emphasizes the search for innovation over tracking existing conditions and assumption (Laurel, 2003). Therefore, it is a useful method to incorporate 21st century learning challenges into the design of learning spaces. As Laurel describes: “Real innovation is inherently risky and involves change. Design Research provides the rationale for organizations to understand why considering a change is worth the risk”. (Laurel, 2003, pg. 150)

Design synthesis tools.

Any design project contemplates a synthesis phase. This part of the design process is commonly seen by clients as a mysterious talent that designers naturally posses, and is not formally taught in design schools. The synthesis phase is fundamental for innovation and should be teachable, repeatable, understandable and useful for anyone involved in the design process (Kolko, 2011).

In order to create actionable design opportunities, ideas need to be externalized and available for all the members of the design team. Externalizing ideas makes them visible and accessible to be discussed, defined, embraced and rejected (Kolko, 2011). At the same time, externalizing ideas helps to connect disparate concepts and offload data from working memory, liberating space to imagine and innovate (Kolko, 2011). Ideas can become visual in the form of charts, diagrams, graphs or sketches helping to visualize changes over time and describe spatial relationships. The following tools are commonly used in design processes to visualize information:

Mental Models: Are abstract structures to represent ideas. Concept mapping is used as a formal representation of mental models (Kolko, 2011).

Brainstorming: The objective of brainstorming is to produce a broad spectrum of ideas (Brown, 2009). These ideas are created in collaboration and are all accepted.

Memoing: Using memos to explore data and search for meaning helps to move from the divergent to the convergent phase of a design project (Brown, 2009). Also, memoing can be a collaborative process where ideas are available for all members of the group creating a shared sense of ownership (Kolko, 2011). Memoing allows to prioritize the data and to find connections between themes and patterns. As Kolko describes:

> By taking the data out of the cognitive realm (the head) and removing it form the digital realm (the wall) in one cohesive visual structure, you are freed of the natural memory limitations of the brain and the artificial organizations of technology. Content can now be freely moved and manipulated, and the entire set of data can be seen at one time. Implicit and hidden meanings are uncovered by relating otherwise discrete chunks of data to one another and positioning these chunks in the context of human behavior. (Kolko, 2011 pg. 65)

Prototyping: According to Brown (2009), prototypes should be fast, rough and cheap. This means that creating simple models should be useful to imagine a solution or a context for an idea without the need of an elaborated prototype.

Scenarios and Storytelling: The use of scenarios helps the team to visualize real situations and anticipate possible outcomes (Brown, 2009). Storytelling “humanizes the design experience” (Kolko, 2011), by focusing on the real context that the design will offer to the user.

Changing the scale: Zooming in and out of the design problem helps to visualize opportunities that might have been hidden in a different perspective (Kolko, 2011). Visualization tools such as diagrams, charts and concept maps may be useful to understand and compare the different perspectives of the context, as well as to suggest possible solutions.

Conclusion to the Literature Review

The design of literacy rich classroom environments in preschool settings is affected and modeled by factors coming from different and complementary areas. The literature review explored four main areas that inform this specific research: Child Development Laboratory Schools, Preschool Design Knowledge, Cognition and Development and Design Methods and Tools.

As the research site was a child development laboratory school, it was important to understand the context with its particular challenges and opportunities. Information from preschool design knowledge helps to situate and justify the research in relation to the need of analyzing the design process that teachers follow to design their classrooms. Cognition and development knowledge is fundamental to understand the implications of the design decisions and the influence that the environment has in the learning experience of the children. Finally, design methods and tools are presented as a way to connect design and education and to analyze the findings from a designer's perspective.

CHAPTER 3
METHODOLOGY

Introduction to the Methodology

The study of literacy rich classroom environments has been approached generally in prescriptive research studies. Usually some aspect of the classroom environment is modified in order to observe and register the changes that the alteration produces (Reyes, 2010; Wayne et al., 2007; Morrow & Rand, 1991). These numerous studies have been useful in testing possible configurations and types of materials relevant for literacy activities, but they have not considered the teachers' design process as part of their inquiry.

As described in the first chapter, a case study was conducted at The Mary Lou Fulton Teachers College Preschool. The data was collected in three iterating phases; participant observation sessions, semi-structured interviews and literature review. The literature analysis process created a valuable scope for triangulation during data analysis. The three phases of data collection are described in detail later in this chapter.

Data was analyzed using Thematic Coding Analysis (Robson, 2011) and the recommended set of analytic moves suggested by Miles and Huberman (1994). Interviews were also analyzed using meaning interpretation (Kvale & Svend, 2008).

Justification of the Methodology and Methods

The case study approach was selected for two main reasons. First, it allowed me to be present in the classroom and teacher meetings collecting empirical and particular data. The main purpose was to rescue teachers' experience and knowledge from their everyday life at the preschool. Second, ethnographic methods of data collection used in case studies such as interviews and observation, allows others to understand the culture described because it produces "thick data" (Robson, 2011).

The use of multiple methods of data collection provided the findings with a wider perspective and reduced bias. I could understand, contrast and contextualize teachers' testimonies and stories by observing their daily activities.

The purpose of this study was to describe and explore the design process experienced by the teachers in one specific site with its particular structure and characteristics. As suggested by Robson (2001), the study could be confirmed or compared with other studies in the future, using a more confirmatory focus.

Finally I wanted to empathize with teachers' experience and be able to understand their actions and decisions in context by having a direct contact with them and their lives at the preschool.

Case Study Setting and Subjects

The Mary Lou Fulton Teachers College Preschool offers full-day programming for children between the ages of 2,5 and 5 years old. It is a private preschool located at the Mary Lou Fulton College of Education Building at ASU Campus and financed totally by tuition fees. The setting contains three rooms with one teacher in charge of each room. Each room has a specific thematic orientation. One is orientated to art activities, the second offers science and block building experiences and the third focuses on dramatic play. The preschool students use a fenced playground area outside of the building for outside play and often visit the "secret garden" with their teachers (a nearby grass and tree area surrounded by buildings).

The main participants in the study were the administrator and the three teachers at the preschool. For the purpose of discussing findings, the teachers were assigned pseudonyms and each room a number (classroom 1, classroom 2 and classroom 3).

As secondary participants, the children enrolled in the preschool were considered in the observation sessions anonymously. Their identities were not registered and no pictures of them were taken. Table 2 describes the participants, classroom number and theme.

ROOM	TEACHER	ROOM'S THEME OR USE
Administrator's office	Administrator	Observation Room
Classroom 1	Nina	Math and Science
Classroom 2	Rachel	Dramatic Play
Classroom 3	Vicky	Art

Table 2: Participants and their respective classrooms

Data Collection Methods and Procedures

Literature review.

A review of literature was done initially as an approximation to the topic and with the intention of searching for existing research on the topic. Familiarizing myself with the particular circumstances of the context was essential to understand and consider the issues involved when planning the study. It informed the formulation of the research question and helped structure the interview guide. As the field of study was new to me, I used this phase to immerse myself with the general concepts and terminology. This enabled me to communicate with the participants

in a fluent and informed way. The revision of the research and publications of diverse authors was organized in four major topics: Child Development Laboratory Schools, Preschool Design Knowledge; Cognition and Development and Design Methods and Tools. Each of these topics where divided in sub-topics as shown in the table 3.

Literature Review Topics			
CHILD DEVELOPMENT LABORATORY SCHOOLS	PRESCHOOL DESIGN KNOWLEDGE	COGNITION AND DEVELOPMENT	DESIGN METHODS AND TOOLS
History, mission and challenges of laboratory schools.	Classroom environment design.	Cognitive development theories and instruction.	Design and education.
Laboratory schools' opportunities and potential as research sites.	Desirable characteristics of the classroom environment.	Influences of policy in the learning environment.	Design thinking.
Reggio Emilia schools in Italy.	Classroom design approaches.	21st century learning.	The design thinking toolkit for educators.
	Literacy rich classroom environments.		The design thinking process.
	Dimensions of the literacy rich classroom environment.		Deisgn synthesis tools.
	Classroom organization and layout.		
	Literacy enriched play environments.		

Table 3: Literature review topics and sub-topics.

Participant observation sessions.

Observation as a method was used in two different ways. First, it served as an exploratory method to familiarize myself with the setting and understand its particular codes. Second, it was used as a supportive method to complement and contrast information obtained in the interviews. The participant observation sessions were all conducted at the preschool in two specific moments.

Teachers' meetings observation sessions.

First, I assisted to two teacher meetings at the beginning of the school year (prior to the starting date for the children). These meetings had the objective (for the preschool staff) of discussing on the design of the classrooms and deciding how to proceed with the implementation. For me as a researcher, it was an opportunity to present my research intention and to get to know the staff outside of their daily interaction with the children. Observations were unstructured and the goal was to sense the atmosphere and general functioning of the setting. The first meeting was held at lunchtime. I presented myself briefly and explained the purpose of the study to the teachers. They were able to ask questions and familiarize with the procedures I would be using.

It was also an opportunity for me to discuss the relevance of their participation and my interest in their personal experiences and views. Consent letters were read and signed by the director and the three teachers. During the meeting, teachers spoke about their ideas and desires on their particular classrooms in an informal way among other topics. The meeting was registered using an audio recorder.

The second meeting was a work session, where the teachers organized independently (or with the help of the director) their own classroom setting. I was mainly an observer on these meetings and tried to limit my participation to the minimum. As I was coming as an outsider to their environment, I was careful to follow certain expected behaviors that would ensure our future trust and collaboration. I suggested some ideas when the teachers asked for my opinion (without any previous analysis), and I helped move some furniture. These actions are not considered part of the research but were necessary and important for me to understand their real experience.

Classroom observation sessions.

The second part of the observation sessions was done during the school year. Two sessions were conducted in each of the three classrooms (a total of six sessions, two hours each time). Each day of the week had some routine and some specific activities scheduled. Some days had research studies being conducted and the presence of teaching assistants was variable.
I scheduled the observations sessions on two different days for each classroom as a way of reducing bias. The time of observation was set from 9:00am to 11:00am coinciding with the main "free working time" scheduled by the staff. At 11:00am, the children went outside to play in the playground and at 12:00pm they had lunch. After lunch they had a naptime of 2 or more hours and were picked up between 3:35pm and 5:00pm. Afternoons were usually spent outside if the weather allowed or playing inside without a structured schedule of activities.

During the observations sessions I only wrote notes and was constantly located in an "out of the way" spot (Robson, 2011). As a research preschool setting, the children were habituated to the repeated presence of researchers. I had minimal interaction with them, using mainly a smile or nod in respond to their call for attention.

A variety of dimensions were included in the descriptive observation process (Robson 2011, after Spradley, 1980). Space; actors; activities; artifacts; actions; time; goals and feelings were considered.

In-depth semi-structured participant interviews.

Personal interviews were conducted at the preschool with the administrator and the three teachers. Interviews were scheduled with each one of the participants on a time slot were they could be at their workplace without the children. The setting for the interviews was essential in the process. The teachers could use their classroom to give examples whenever they needed, as the materials, distribution of objects and furniture were visible for us to discuss. Only one of the teachers' interviews was not conducted in her room, but I knew her space well thanks to the prior observation sessions and could understand her examples clearly.

All interviews were semi-structured and followed an interview guide. The administrator's interview considered some added specific questions related to her position and her own experience directing the preschool. Her interview was held at her office.

The interview questions were distributed and organized under the following main topics: background information; materials in the classroom; classroom design and literacy and design process. The questions under each of these topics were formulated to describe the different areas of design decisions that the teacher faces and to explore different dimensions of their design process. The interview guide is included in the appendix.

During the interview I followed the interview guide in an unstructured way. I tried to cover the topics as they appeared naturally in the participants' narration to allow them to expand freely on each one.

The interviews were audio recorded and no notes were taken. They were transcribed for data analysis. After each of the interviews, photographs were taken to recall details of the conversation.

Limitations of the Methodology

The main limitation of the observation sessions was that I was the only researcher collecting data and that they were not videotaped for later analysis. It was challenging to maintain focus in each of the simultaneous activities happening in the classroom. To manage this limitation I tried to attend specifically to the situations were explicit literacy activities were taking place and to the needs of literacy material by the children during their free working time.

Data Analysis Methods and Procedures

The data was analyzed using Thematic Coding Analysis (Robson, 2011) and the recommended set of analytic moves suggested by Miles and Huberman (1994). The procedure was to first code the interview transcripts and observation notes by the use of memos to visualize

the information simultaneously. Common themes related to the research question were classified using a table and all direct extracts of the interviews were organized under each topic. Themes were then grouped as they described phases of the design process and variables affecting each one of them. Interpretation was constructed and made visual by the use of diagrams and concept maps. Interviews were also analyzed using meaning interpretation (Kvale & Svend, 2008).

Ethical Issues

The research was planned to respect the privacy and confidentiality of the participants. Their positions at the preschool were not at risk by their involvement in the study, and the children's identities are not exposed in any way by the results.

CHAPTER 4
FINDINGS

Introduction

This chapter contains the findings obtained with relation to the process that the teachers utilize to design literacy rich classroom environments in the research site. The various methods of data collection used; interviews, participant observation sessions, and literature review were fundamental to address the research questions. The first part of this chapter briefly describes the research site and its characteristics to help visualize the setting, understand its principles and contextualize the comments and discussions that will be presented. The second part of this chapter addresses each of the research questions presented and uses the data gathered to answer them.

Research Context

The research site employed was The Mary Lou Fulton Teachers College Preschool at Arizona State University. The Preschool is located in the first floor of the Farmer Education Building at the Tempe Campus. The space consists of a reception area with a working station for the receptionist, the administrator's office, three classrooms, a teacher's kitchen and a bathroom for the children. The office and the three rooms are connected by a hall, at the center of the configuration is the reception area facing the entrance.

Brief History of the Preschool

The preschool was founded twenty-two years ago by the Dean of the College of Education with the idea of starting a preschool for gifted children from disadvantaged areas. A year later, the Early Childhood Education Department took over the preschool and decided that it would be a space available for all children. They had been testing children and determined that identifying gifted qualities in very young children was difficult and that the preschool was needed for all families within the ASU community and beyond. The current administrator was hired the second year and has been working at the preschool for twenty-one years.

The preschool first began by operating two classes, one in the morning from 9:00am to 11:30am and one in the afternoon from 1:30pm to 3:00pm. After some time the administrator decided to try a full day schedule in response to the need of many families for full day child-care services. They developed a system were some children attended on a part-time schedule and others on a full-time one. This system was successful for a while. With time, it became difficult

to make all the necessary changes for all the children, and at the same time the preschool's operation needs required full-day tuition income. They were gradually becoming less a state-funded and more a tuition-based preschool. Today, the preschool is a completely tuition-based program that does not require any additional funds from the state.

Participants

Four participants took part in this research: the administrator who had worked in the preschool for twenty-one years, and the three teachers in charge of each one of the classrooms. Nina was responsible for Room 1 and had been a teacher at the preschool for more than ten years. Rachel had worked at the preschool for fourteen years and was using Room 2. Vicky was starting her second year as a teacher in the preschool and was in charge of Room 3.

Curriculum

Since the beginning under the Early Childhood Department, the curriculum was centered on the belief that play is the way children learn. Their activities are focused in the "learning through play" approach where the teacher is a partner for the children, a challenger and a problem poser, and a facilitator that extends the play following children's interests. The administrator explained that education research carried out here over the years, suggested to them that their role as a partner for the children is to allow the children to be the major force in the play activity, supporting them only when needed.

The curriculum as described by the teachers and administrator is "eclectic" and "emergent", borrowing principles from the "creative curriculum" and the Reggio Emilia approach (administrator). It is in constant evolution based on developing "what's inside the child's mind and not the teacher's mind" (Vicky). It is "child centered" and "child interest driven" focusing on children's developmental stages, needs, motivations and personality types. Children's opinions are considered and valued when deciding on materials, activities and topics of discussion.

Developing social skills and respect for diversity and multicultural realities are driving forces of the curriculum. The staff described the ASU Tempe Campus as an "endless environment" that allows children to interact with people from different cultures and offers a wide range of exploration possibilities. As a Child Development Laboratory School, the curriculum is also influenced by research activities that contribute by adding new topics and areas of development for the children.

Thematic Classrooms

When the preschool was first opened, it had three “self-contained” rooms. This means that there were three rooms with one teacher each that had the exact same materials for the children to work with. Each teacher was responsible for the children and activities in her own room, and they stayed there with their children for the working-time hours. After some time the administrator and teachers realized that this system generated conflicts between them because they were constantly comparing the amount of materials each room had.

After the intervention of a researcher, they decided to develop a new system based on having the three rooms differentiated by themes. Classroom 1 was assigned to be the Science and Math Room, Classroom 2 was assigned for Dramatic Play and Classroom 3 was assigned for Art. Today, each classroom has its own particular teacher and materials and each child belongs to one specific room, but they have the opportunity to move freely to the other rooms during work-time. Combined, the rooms offer a complex and diverse set of materials for children to use, having building blocks as a neutral material in the three classrooms. As a common opinion for the staff, the concept of “shared rooms” created a sense of community and collaboration and minimized conflicts. The idea of shared thematic rooms also benefitted the organization and optimization of the space in each room and saved money on materials. The administrator describes her impression: “And by specializing in each area it seems as though we have more room to breathe, to move”.

Even when each classroom is focused mainly on one theme, a variety of learning experiences are also present. For example, Nina mentioned that dramatic play takes place everywhere: “It can happen while you are standing on the street”.

One problem seen by Nina in the use of thematic classrooms is that it requires a sophisticated plan more demanding on the child to make the connections between related activities that are not visibly close. For example if a child is reading a book and then looks at the painting materials, he or she can have the idea of painting something related to the book, but if the paint is not present in that moment, that connection may not happen spontaneously. To ensure children take full advantage of the opportunities in each room, the teachers help those children that are not comfortable with moving to the other rooms by bringing in materials and activities from those rooms into their own.

To encourage the teachers development and engagement in the different themes each room offers, they switch rooms every year. This allows the three teachers to experience the use and design of each one of the rooms. The switching of rooms is seen by the team as an opportunity to understand each space and its particular characteristics. As Nina explains:

> Room 2 is the most challenging room but if you haven't been in there you cannot appreciate what you had or see what can be done. Everybody will have their favorite room but every time you go into another room you change it and that's good. And everybody will see the room differently. You can make it the way you want it. And then the next year somebody else will make it differently. But I think that's a good thing because it keeps it fresh. (Nina)

The distribution of the children in each classroom is an important decision for the staff. The three classrooms contain a multi-age group of children from 2.5 to 5 years old. The decision of having children of different ages sharing the same space is based in the belief that older children are mentors for younger ones and that development is not strictly associated to age. It is also an opportunity for children without siblings at home to experiment the interaction with younger and older peers and to learn important parenting and social skills. Teachers face the challenge of designing classrooms that will be motivating and safe for a wide range of developmental stages coexisting in the room.

In the past, teachers made home visits before the school year began to get to know the children in their natural environment. This input helped them in the creation of the conditions that would benefit each of the children in the classrooms and gave them valuable information to decide on class grouping.

However, the weather in Arizona and the long driving distances made it hard for the teachers to continue with this practice. After consulting with the children and their families, they decided that the children should visit the preschool before the school year starts and familiarize themselves with the staff and space.

Although all of the participants were aware of the benefits that come with the home visits, they believe it is also important for the children to visit the preschool and see the place that they will be coming to. The meeting I observed for the planning of the classroom design happened the day before the new children were coming to visit the preschool for the first time.

Classroom Descriptions

As a way to understand and visualize the comments and observations in the following section, I will describe the main characteristics and materials found in each room. Each classroom was divided in "centers" to encourage different activities to occur simultaneously offering options for the children to choose from, while functionally organizing the space. Some of the materials or furniture were located in between centers as transition zones or independent structures.

To organize the information I named the areas or centers of the room with descriptors that are not necessarily terms used by the staff, but are functional to the analysis in the following sections.

Administrator's office.

This office was used for three main purposes. First, it was the personal workspace of the administrator. Second, it was used as a meeting room and a space were the staff had lunch while the children took their naps. Finally, it was used as an observation room because it had two one-way glass windows looking into Classrooms 1 and Classroom 3. The office contained a workstation with a computer, a round table with several chairs, a bookshelf and a coffee table.

Classroom 1: Math and science / teacher: Nina.

Classroom 1 was an L shaped space with one entrance and a small window that allowed natural light to enter. It was the largest room at the preschool used by an average of 18 children simultaneously. It had two working tables that could sit seven to nine children. The tables were used for a variety of activities including eating. The teacher and her assistants used child size chairs to observe and assist children in their activities. The rest of the furniture consisted mainly of shelves to store the materials and a wooden rocking boat. The objects and materials in this room were related to the exploration of Math and Science. This thematic classification implied that this room had a large number of small blocks to build different types of structures, unit blocks, counting materials, and science artifacts to explore and experiment. At the time of this research Room 1 was used by Nina. Photograph 1 shows general views of Classroom 1. Table 4 describes centers, activities and materials present in this room.

Photograph 1: General views of Classroom 1.

Classroom 1 / Teacher: Nina		
CENTERS	RELATED ACTIVITIES	OBJECTS AND MATERIALS
Block Construction Center	Construction, pretend play, sorting objects by size and shape, collaborative building projects.	Variety of small blocks, trains, cars, people,traffic signs, plastic ramps, tree branches, animals, dinosaurs.
Science Center	Experimenting, predicting, measuring, material exploration, play-doh experiments.	Microscopes, natural material samples, sample containers, plants, scale, body parts, markers, paper, teacher's personal objects.
Reading Center	Reading, building, dancing, pretend play, playing music, jumping, gross motor exploration, balancing, writing.	Books, musical instruments, fabric, cushions, blackboard, chalk, erasers, alphabet wooden box, big blocks, radio, wall alphabet.
Writing Center	Drawing, writing, stappling, reading, puzzles, hiding, pretend play, resting.	Pencils, markers, crayons. glue, paper, cushions, puzzles, scissors.
Exploration Zone	Observation, feeding the fish, touching objects, arranging objects.	Fish tank, sea shells, unit blocks, abacus, nuts & bolts, plants, seeds, pumpkins.
Water Table	Touching water, moving water, using funnels, group explorations, pretend play.	Aprons, cups, funnels, water toys, sand.

Table 4: Centers, activities and materials present in Classroom 1.

Block Construction Center.

The Block Construction Center was located in a corner of the room in a carpet area. It contained many different types of small blocks organized by shape and size. It also contained plastic animals, and miniatures of traffic signs. On a shelf that worked as a divider, there were train parts, toy characters, toy dinosaurs and pieces of wood.

Photograph 2: Block Construction Center in Classroom 1.

Science Center.

The Science Center contained materials that help in the exploration of natural objects such as a scale and two microscopes. It also had containers to store samples and some writing materials for the children to document their predictions or findings. The teacher used this area as her personal desk to work and display some personal items such as her own pictures with the children.

Photograph 3: Science Center in Classroom 1.

Reading Center.

The Reading Center was a carpeted area located in one of the two rectangular spaces that form the classroom. It contained a big shelf on one of its walls that exposed a large amount of books for the children to choose from. On the other two walls, there was a big blackboard and a set of large blocks. This center also contained musical instruments, fabrics and cushions for the children to use. The Reading Center was the area of the room where “Circle Time” happened two times every day.

Photograph 4: Reading Center in Classroom 1.

Writing Center.

The Writing Center was located between the Reading and the Block Construction Centers. It had a small table and chairs and was provided with writing materials and puzzles. On one of its sides, as a space divider, there was a table with a fish tank and under it a soft cushion area that was used as a resting and hiding place by the children. On the other side there was a shelf with the writing materials at child's reach.

Photograph 5: Writing Center in Classroom 1.

Exploration Zone.

I defined Exploration Zone for Classroom 1, as the area where the fish tank was located. The table supporting the fish tank was placed close to a shelf that contained natural materials to explore. This shelf was situated to act like a "wall" for the Block Construction Center, but in practice it functioned as a transition space where the children manipulated, observed and compared materials.

Photograph 6: Exploration Zone in Classroom 1.

Water Table Center.

The Water Table was a center on its own because it was a self-supported structure where children could explore the use of water and its behaviors. The tank was filled with water by the staff for limited periods of time and children were supervised in its use. The materials associated to the Water Table were kept inside the tank, under the table or were hanging around at child reach.

Photograph 7: Water Table Center in Classroom 1.

Classroom 2: Dramatic play / teacher: Rachel.

Classroom 2 was the smallest room with no natural light available. The space was rectangular and had three different doors connecting to the bathroom, the teacher's kitchen and the hall. This was the only room that had a loft allowing children to experience two different levels of observation and play.

This classroom was used by a maximum of 14 children and had the highest concentration of very young children (2.5 and 3 year olds). It had two working tables located close to the writing materials and used for several activities including play-doh, magnet building, reading and drawing.

Most of the furniture consisted of shelves to store material and divide areas. The objects and materials in this room were intended to engage children in dramatic play. Costumes, dolls, stuffed animals, a child size kitchen with utensils, toy food and the presence of the loft offer a space with potential for imaginative and pretend play interactions among the children. This room had a larger carpeted area than the other two rooms, allowing children to use more floor area to play. At the moment of the research, Room 2 was used by Rachel, who brought in playing structures such as tents for the children to use and create new spaces in the classroom. Photograph 8 shows general views of Classroom 2. Table 5 describes centers, activities and materials present in this room.

Photograph 8: General views of Classroom 2.

Classroom 2 / Teacher: Rachel		
CENTERS	RELATED ACTIVITIES	OBJECTS AND MATERIALS
Block and Music Center	Construction, pretend play, dancing, reading, building with magnets,talking, group discussions.	Big blocks, music instruments, books, cds, radio, stuffed animals, puzzles, alphabet and numbers posters, boxes, mirror.
Kitchen Center	Pretend play, writing, material experimentation, drawing, reading, talking, group planning, measuring.	Kitchen furniture, kitchen utensiles, pretend play food, play-doh, books, menus, table cloth, writing materials.
Loft	Reading, playing with dolls, going up and down the stairs, sitting, observing, hiding, pretend play.	Books, dolls, stuffed animals, plant, poster, cushions, fabric, alphabet poster.
Writing and Activity Center	Drawing, writing, stappling, reading, puzzles, hiding, pretend play, resting.	Pencils, markers, crayons. glue, paper, cushions, puzzles, scissors.
Dressing Up Center	Pretend play, dressing up, talking, dancing, reading.	Costumes, shoes, dresses, hats, books, fabrics, note pads, trasure box, register toy machine, mirror.

Table 5: Centers, activities and materials present in Classroom 2.

Block and Music Center.

The Block and Music Center was located in between two of the doors. It was contained by the use of shelves with materials placed within the children's reach and had a carpeted floor. It had a set of big blocks and a variety of musical instruments. Puzzles were also visible in the shelves. This space was used for "Circle Time" at the beginning of the day and as a free space to allow movement such as dancing or jumping.

Photograph 9: Block and Music Center in Classroom 2.

Kitchen Center.

The Kitchen Center was an active space located in a corner of the room. It contained a reproduction of a real kitchen where children pretended to cook, play family, organized tea parties and wrote. It had a dinner table, two stoves, a microwave, shelves and a sink. The furniture contained a variety of kitchen utensils such as plates, cups, pots, and toy food. Books and menus were included in this center and other materials such as play-doh and leaves, were brought in by the children, teacher or her assistants. It faced the stairs of the loft generating interaction between both areas.

Photograph 10: Kitchen Center in Classroom 2.

Loft.

The Loft was located in a corner of the room providing it with a second floor. It had carpet on the stairs and a soft material on its walls. In the Loft there was a shelf containing books and a large set of dolls. On the lower level, there was a small hiding and resting place that offered privacy and a place to calm down. For safety reasons only two children could use this space as the same time.

Photograph 11: Loft in Classroom 2.

Writing and Activity Center.

The Writing and Activity Center consisted of two tables and one shelf containing writing materials such as markers, crayons, paper, scissors, glue etc. This area was used for many different activities such as reading, playing with puzzles or magnets and eating. Due to the young age of many of the children in this room, some materials were brought in by the teacher or her assistants to guide their use and control safety. Larger materials such as puzzles or magnets were available for children to find by themselves.

Photograph 12: Writing and Activity Center in Classroom 2.

Dressing Up Center.

The Dressing Up Center was located in front of the classroom's entrance by the Loft. It contained many different costumes, shoes and hats in a variety of colors and materials. The children used these materials freely and could wear them even if they went to another room during free playtime. The shelf also contained books and some objects related to the costumes as a toy cash register and a fireman's helmet.

Photograph 13: Dressing Up Center in Classroom 2.

Classroom 3: Art / teacher: Vicky.

Classroom 3 was a spacious room with a window that provided natural light and two doors. The bathroom was connected to this room, making it necessary to leave a free space for children walking from the hall. The space had an L shape but allowed the teacher to have good visibility from any corner of the room. This classroom was used by 13 children and had a mixed age combination between 3 and 5 year olds. It had one big painting table where all of the children could work together using large pieces of paper and two smaller working tables used for a variety of activities. The objects and materials in this room were intended to engage children mainly in art and fine motor experiences. Paint, brushes, papers, glitter, stamps, books, beads and play-doh were the main materials used in this classroom. Due to the messy nature of painting activities, this room did not contain enough cozy objects for children to rest or relax. The option of going to a different room helped to satisfy these needs.

At the time of this research Vicky was in charge of Room 3. She was just starting her second year as a teacher in the preschool. Photograph 14 shows general views of Classroom 2. Table 6 describes centers, activities and materials present in this room.

Photograph 14: General views of Classroom 3.

Classroom 3 / Teacher: Vicky		
CENTERS	RELATED ACTIVITIES	OBJECTS AND MATERIALS
Block, Music and Reading Center	Construction, pretend play, dancing, reading, building with blocks, playing with cars, playing music, talking, group discussions.	Big blocks, music instruments, books, cds, radio, stuffed animals, puzzles, alphabet and numbers posters, mirror, blackboard, chalk, scarves, legos.
Painting Center	Painting, drawing, writing, cutting, experimenting, talking, collaborating.	Paint, brushes, stamps, glitter, paper, feathers, paper shapes, glue, scissors.
Free Movement Areas	Dancing, running, jumping, using cubbies, playing with cars, sitting in the floor, laughing, stretching.	Cubbies, aprons, water table, hangers, books, wooden xylophone, cars.
Writing and Activity Center	Drawing, writing, stappling, reading, play-doh exploration, eating, talking.	Pencils, markers, crayons. glue, paper, scissors, alphabet stamps, play-doh, beads, pipe cleaners, stickers, books, alphabet poster.

Table 6: Centers, activities and materials present in Classroom 3.

In the case of Classroom 3, the space was divided into fewer centers than the other two classrooms. The classroom was intended to allow the children to explore art activities that are usually messy. There was one carpeted area that was used for Circle Time and reading and two other working tables to develop a wide range of activities including eating. This room did not have an evident hiding or resting place for the children, but it was the only room that contained a teacher's reading chair that was also used by the children to rest.

Block, Music and Reading Center.

The Block, Music and Reading Center consisted of a carpeted area located in a corner of the room that contained mainly materials to be used in musical exploration, building and reading. This center was used by children to read, dance, build and rest, sharing it for quiet and noisy activities. Children that were not working in art activities used this space independently or in groups with or without the teacher's direction.

Photograph 15: Block, Music and Reading Center.

Painting Center.

The Painting Center contained a large table that was used for collective painting and a plastic wall surface that could be used to paint with or without paper. In a corner there was a prism shaped aisle that could be used by three children simultaneously. Materials available for the children to choose were visible in shelves, while paint was kept in a different high shelf away from children's reach.

Photograph 16: Painting Center in Classroom 3.

Free Movement Areas.

I designated the empty spaces in this classroom as Free Movement Areas. These spaces were located in between centers and were not intended for a particular activity. Around the painting table and between the table and the cubbies, children moved, jumped, danced and circulated in and out of the room. The other constant flow area was from the hall to the bathroom and was used by children from all three rooms.

Photograph 17: Free Movement Areas in Classroom 3.

Writing and Activity Center.

The Writing and Activity Center was used for activities that didn't include paint. There were a rectangular and a circular table located close to shelves containing writing materials and books to read. These tables were also used for eating.

Photograph 18: Writing and Activity Center in Classroom 3.

This section has outlined the essential spaces of the preschool and provided descriptions as well as images. The following section is organized by presenting each of the main research questions and relating how the data obtained answers them.

Introduction to the Design Process

The fundamental research question addressed under the heading of The Design Process is: What is the process that preschool teacher's follow to design literacy rich classroom environments?

Before describing the design process identified for the creation of literacy rich classroom environments in the research site, it is important to understand the staff's perceptions about literacy and in their opinion, which materials and tools they considered relevant to the development of literacy abilities in children. These beliefs determined many of their design decisions and influenced the different phases of their design process.

Literacy as a Wide Concept

As relatively new to the topic of the design of classroom environments but deeply interested in the learning of language and literacy, my main research question was directed at identifying the elements in the classroom that could enhance literacy learning in children. The general belief from the staff was that literacy begins with the need to communicate, as explained by the administrator: "When they want to communicate with their peers because there's a lot of things that they want to say, they really begin to use ways of doing that a little bit more."

Over the course of my research at this preschool it became clear that literacy was connected to every type of activity and could be associated with many different materials that did not specifically have words or letters. Nina described this idea:

> But blocks can stimulate literacy too. You can talk about what you are building. You can talk to somebody else about how to plan things. You can make signs, with this sign. I had a girl who did that. Then she had a line through it, because she didn't want people in there. (Nina)

Literacy was understood by the teachers, as a faculty that could allow children to communicate visually and verbally in a meaningful way, and as a functional tool that helped them to achieve their purposes and document their work and learning. This wide concept of literacy directly influenced their design process and implied that in the design of the classroom environment the teachers considered literacy aspects embedded in the layout and employment of all kinds of materials. As they explained, materials are an opportunity for conversation and discussion helping in the development of literacy. The variety of activities done daily were also related to literacy and considered crucial to the acquisition of literacy skills as part of the learning obtained through focusing on play as the driving force of the curriculum.

The Design Process

When interviewing the preschool staff I realized that the term "design process" was not used when deciding on their classroom layout or material election. They used the term "design" to describe the "re-arrangement" of elements already present in the classroom or referred to their actions as a "makeover".

The reoccurring themes and topics arising from interview and observation data include: the election of materials and activities, teacher's beliefs on the relevance of literacy, the systems of problem solving and communication used, and the staff's knowledge and experience on child development and cognitive capacities. Analysis of these themes proved very important to examining what factors were involved in the Design Process.

Although consciously the staff did not describe a systematic design process, findings revealed what I defined as an ongoing intuitive process of evolution. The process is cyclical and iterates over time based on a "child centered" philosophy and using observation as the main tool to determine design appropriateness. Teachers reflected on the significance of observed behaviors among the children to decide on modifications in the layout, materials and activities they offered. The process is based on an empathic and caring approach by the staff, which

was often described in terms their own childhood memories as a way to understand how the preschool children might feel. As Vicky described: “I strive to have it make sense for the children.”

I mapped their design process and identified five main phases involved: Layout, Observe, Modify, Evaluate and Evolve. These phases repeated over time as many times as necessary during the school year to adjust to the requirements and interests of the specific group of children using the room. Therefore, the design of the classroom was not fully predictable due to this iterative process.

Time, was identified as a defining aspect of the process, as teachers considered time of exposure to the design of the space and the materials as highly influential in children’s behaviors and learning experience. Time is also relevant because the development of children at this age is fast, which means that the design is subject to constant evolution to adapt to children’s new interests and motivations.

Collaboration between staff members was identified as another constant and valued variable throughout the process. Teachers discussed their observations and ideas with the administrator and among themselves daily and at a weekly meeting. The staff was also open to the collaboration of outsiders. As expressed by the administrator: “Oh, yes. I think having more than one person chit chat about how to design something is so important. Having and outside person come in and make suggestions or just be part of it.”

The presence of researchers and ongoing research activities going on at the preschool was another important source of collaboration, as teachers were exposed to new topics and participated actively in the data collection process. Teaching assistants collaborated by bringing in their current knowledge and at the same time learned empirically by their interactions with the experienced staff and the children. Figure 4 shows a map of the design process and its components. Each phase and its main characteristics will be described.

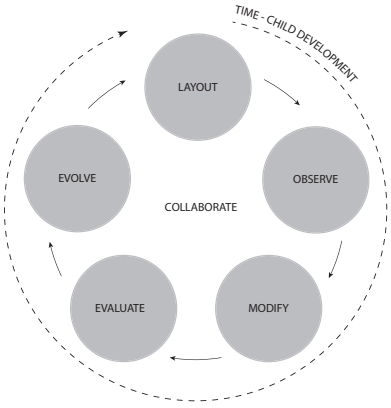


Figure 4: The Design Process.

Layout.

The starting point of the design process was the initial layout of the classrooms designed by each teacher in collaboration with the administrator. These initial designs were based mainly on prior experience and knowledge that the staff had accumulated over the years. Observations and reflections were based on their memories and were not documented in a systematic way. The layout responded to four different types of requirements: Curriculum requirements, Physical requirements, Emotional requirements and Social requirements.

These four aspects defined the appropriateness of the disposition of the elements in the classroom and determined the types of materials included. Activities were related to these requirements and emerged from the daily observation of the children.

Figure 5 shows a map of the variables and requirements considered in the layout phase.

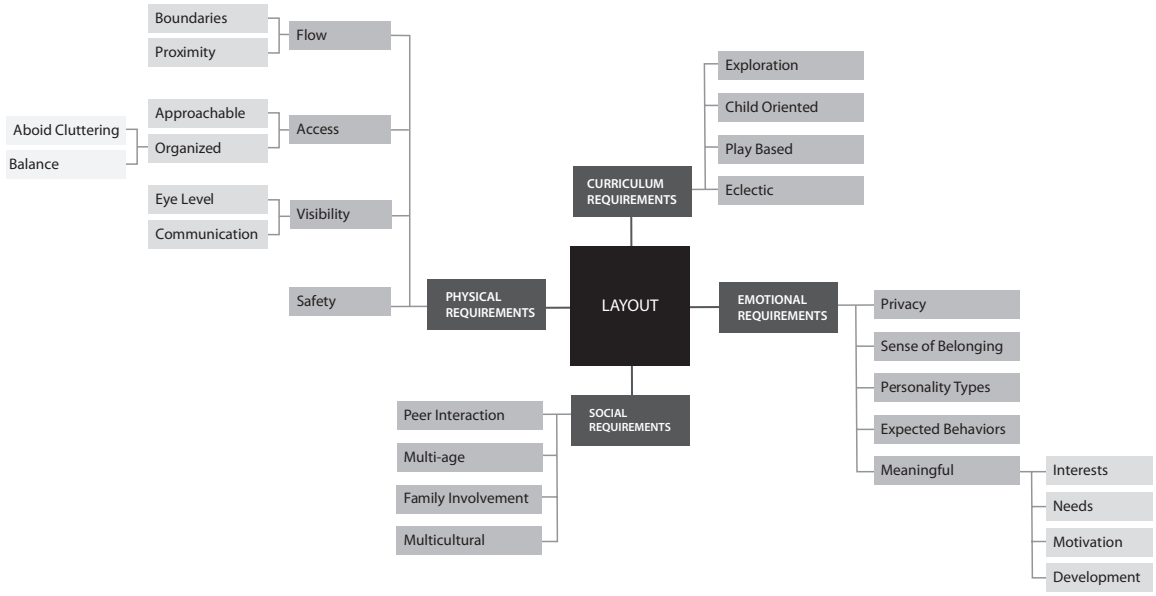


Figure 5: Map of the main variable and requirements considered for the initial layout phase.

Curriculum requirements.

The play philosophy described earlier was the main focus of the curriculum. Decisions on the layout were related to foster exploration, fun experiences and the development of an open-minded spirit in the children.

Physical requirements.

I grouped Physical requirements in four main aspects to consider; safety, visibility, access and flow.

Safety considerations imply creating a safe space for the multi-aged group of children. A major consideration described by the teachers was to limit the running in the classroom. The space was divided in centers and furniture was places strategically to eliminate open areas conductive to running.

Visibility is related to the capacity of the space to communicate how it works. The staff explained that the children should be able to understand visually how the elements are arranged, where to store materials and how to use each area. It considers placing materials at their eye level and allowing good visibility from any point of the classroom. It also focuses on helping the children create visual connections between the different areas.

Access, refers to the need of locating elements where children can approach them easily and to the placement of the materials in an organized way. This means that there needs to be a balance between the amount of materials and their accessibility to prevent cluttering.

Flow is related to allowing play to happen naturally and at the same time creating a space that offers controlled movement and activity. This is managed by the creation of physical boundaries that divide the space and placing related areas close to each other. Proximity between materials and the area where they are going to be used helps to reduce their transportation.

Emotional requirements.

As Rachel expressed, the preschool classroom is “home” for the children during many hours a day and that implies that their emotional requirements have to be considered when deciding on the layout. The teachers observed the different personality types of the children and reflected on the behaviors they expected to have. They also created a sense of belonging in the rooms by including images of the children and their families and by displaying their work on the classroom walls. Most of all, teachers wanted to create a meaningful space capable of fostering the different stages of development, needs, interests and motivations of the children. Two of the three rooms included a hiding place where children could rest if they needed privacy.

Social requirements.

The administrator compared the class group to a beehive moving and exploring together. The layout considered fostering peer interaction by creating a space that contained multi-cultural materials and references, welcomed multi-aged groups and allowed family involvement.

Election of materials.

The election and disposition of the materials present in the classroom was another aspect of the layout phase. Considerations, requirements and origin of the materials are shown in figure 6.

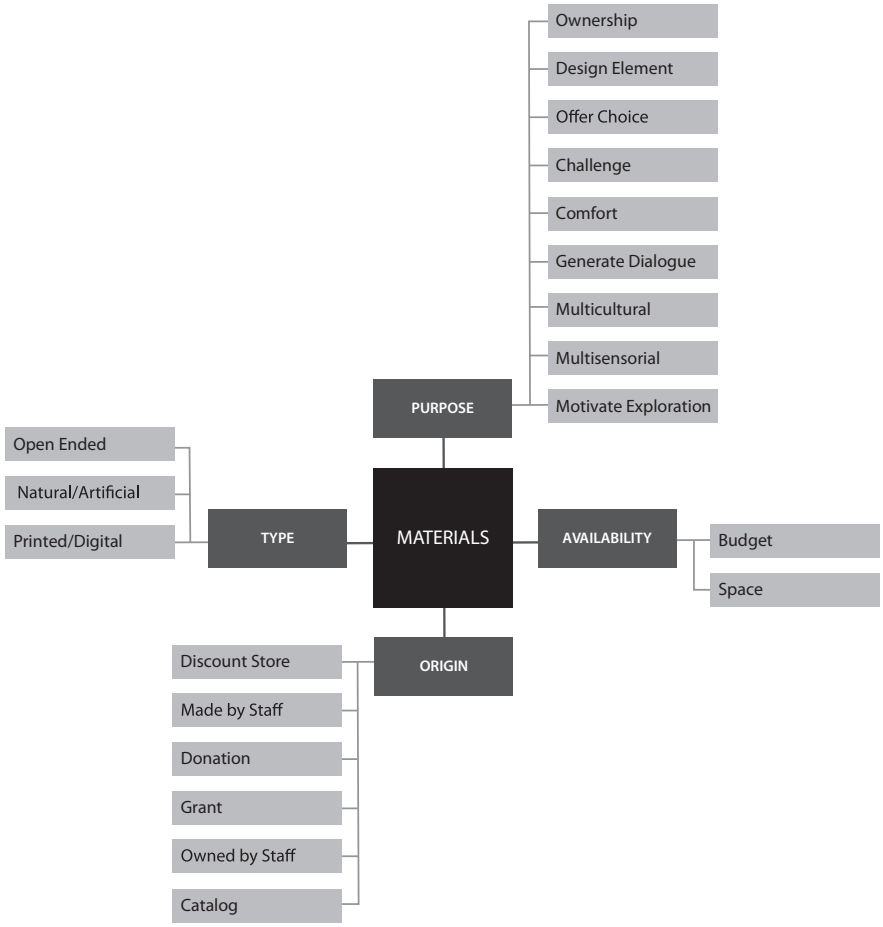


Figure 6: Map on the variables implied in the election and availability of materials.

Purpose of the materials.

Materials were brought into the preschool following a purpose. The main purposes described by the teachers are as follows:

Design Element: Teachers saw the materials as elements that the children had to create their own plans. While talking with Nina about the types of material in her classroom she explained:

> The materials here lend themselves to an orientation probably towards math and science, but if you really look at blocks, you can be very creative with blocks. You can be artistic and you can have lots of interesting design elements within the framework of what they would consider a map area. (Nina)

Comfort and Multi-sensory: Materials were chosen to allow children to experience and explore different textures, temperatures, sounds and tastes as a way to develop their senses.

Generate Dialogue: Materials were included in the classroom to stimulate communication between the children. For example the kitchen area in Classroom 2 recreated a real kitchen with its furniture and objects and children pretended to cook while they talked, wrote, argued and fed pretend food to baby dolls.

Multicultural: As a way to promote respect for different cultures and to allow all children to feel comfortable, materials present in the classroom were multicultural.

Ownership: Open-ended materials allowed for children to work on their own creations and generate sense of ownership.

Challenge: As the classroom included children going through different developmental stages, materials needed to present a variety of complexities to challenge all of the children.

Types of materials.

I grouped the different types of materials present in the classrooms in three categories:

Open-ended Materials: Materials that allowed children to experiment and create what was in their mind with freedom. Nina explained the nature of blocks as an open-ended material:

> But blocks are certainly the most open-ended thing you could almost work with, other than maybe some art materials. That you can do many things. That's why children are instinctively drawn to that, because they are the masters of what happens there. They can have a lot of control over what happens there. (Nina)

During the observation sessions I conducted in Nina's classroom, I saw a group of girls that used the blocks to make beds were they pretended to read together. They used cushions and pieces of fabrics to cover themselves and the oldest read stories to the other two smaller girls. Blocks were being used to play and sustained a spontaneous literacy activity created by the children.

Natural and Artificial Materials: The classrooms contained a combination of natural and artificial materials as a way to include as many experiences as possible for the children. Natural materials as pieces of wood or sea shells, changed constantly and were brought into the classroom permanently by the teachers or the children. Rachel explained:

> I can even take a leaf like that. If somebody cuts that leaf, I just take it in and they say: "What are you going to do with it?" There's a thousand different things you can do with it. They paint it, they trace it, they write their names on it, they color it .(Rachel)

Printed and Digital Materials: Printed materials included a wide variety of formats such as books, restaurant menus, recipe handouts and letters. As a digital material, teachers used their computers to search for information needed, show the children videos or images and play music. Technology was used as a tool but not as an end in itself. Technology was also included in research activities occurring at the time of this research. For example, there was a study taking place on the use of the ipad as a learning tool.

Origin and availability.

The origin of the materials present in the preschool was diverse, including: catalogs, discount stores, donations, bought with grants, brought by the teachers from home and done by the teachers. The availability of the materials was based mainly on budget limitations and on space restrictions.

Although the main focus of this research was to determine the design process that teachers used to design literacy rich classroom environments, the fact that the research site was a preschool located in a university campus cannot be ignored. Teachers described the campus as an endless environment and a fundamental part of the preschool reality. This context presented opportunities and advantages for the teachers as a space were experiences could be extended. Classroom discoveries could be related to the outside space and vise-versa.

Exploring the campus offered the opportunity to engage children in a process of constant discovery. By visiting the different schools and facilities and observing the multicultural reality of ASU, the children could find new interests and topics to engage with. For example, Rachel pointed out the usefulness of observing and using the functional signage present all over campus as an excellent opportunity to reflect with the children on the relevance and use of literacy in an empirical way. At the same time, research activities going on at the preschool opened the range of topics for the teachers to discuss with the children, making their experiences richer.

Observation.

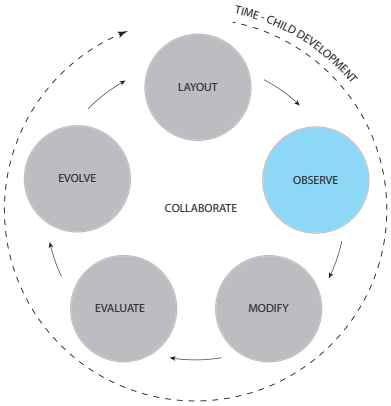


Figure 7: Observation Phase of the Design Process.

The second phase of the design process is Observation. After the teachers decided on their initial layout, they allowed some time to observe the behaviors and reactions of the children on the designed space. Nina explained: “We tend to look at what they are interested in and pick up on that.” At the same time the particular characteristics of each group of children are taken into account by observing: “So much of what we do is determined by the children that we have, both the extraordinary things, sometimes challenges.”(Administrator)

Observations allowed teachers to evaluate the initial layout by looking at what children were doing and how they were using the space and the materials. Taking time to observe was described by the teachers as a tool that helped the learning experience to flow. This means that the activities and materials to be used in the classroom depended on the behaviors of the children and that teachers kept an open mind to facilitate the discoveries and interests observed, by making changes when necessary. As the administrator explained: (...)”the proof of the pudding is in the eating, not how the pudding looks. It’s true with food. It’s also true with the classroom design.”

The observation phase was done personally by each teacher and was not documented in a systematic way. It was an intuitive activity that depended on the teacher’s experience and personal tools. The administrator refers to her own observation experience:

> I’m the kind of person that constantly wanders around, seeing how things are going. When I walk into a room, then I’m seeing it as an outsider looking in. It’s a pretty good chance for me to see how the room is being used. (Administrator)

After the initial observation phase confirmed certain behaviors and repeated situations, the staff moved on to the third phase. This stage of the process involved the modification of the initial layout to adjust to the intuitive conclusions or ideas about the design of the classroom and the materials in use.

Modify.

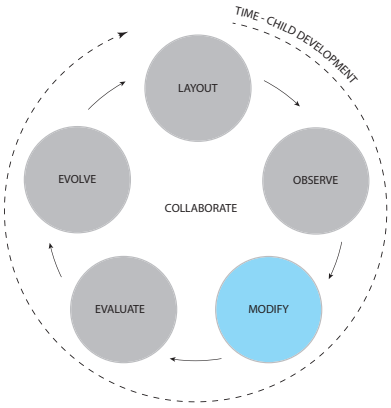


Figure 8: Modification Phase of the Design Process.

The modification phase consisted of introducing changes in response to observations and other influential aspects affecting the classroom environment. These changes were done with specific purpose. Sometimes the staff introduced a large modification and other times they performed minimal adjustments. As the administrator described: “just tweaking here and there.” I divided the variables that intervene in the modification phase in two types: One group considers the set of variables that induce the need for change, and the second group, corresponds to the different types of changes introduced by the staff. Figure 9, on the next page, maps the modification phase and the main factors that defined it.

Variables that induce change.

Observed Behaviors: As previously explained, observed behaviors suggested the teachers actionable modifications to the initial layout. These actions were related to diverse aspects. Some observations were related to problems in the physical layout such as safety issues, not enough flow in the room, accessibility or difficulties in peer interaction. Other observed behaviors had to do with potential opportunities for challenging the children to learn specific skills. For example, Rachel noticed that the kitchen was sometimes a conflict zone in the classroom but

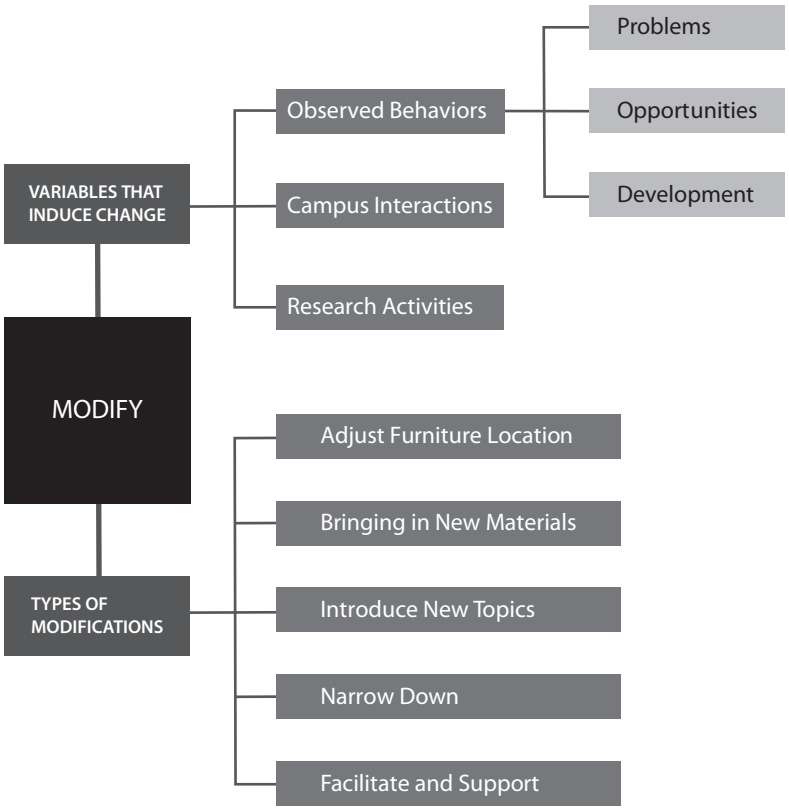


Figure 9: Map of the variables implied in the modification phase of the design process.

considered it was an opportunity for the children to learn problem-solving skills. She then decided to keep on introducing new materials and developing activities with small groups of children in the kitchen. She explained:

> Yeah, and that's one thing I like. Even if they're having some kind of conflict in the kitchen, I don't like to interrupt. I rather hear it, because, if you interrupt whatever the conflict is, they're not really in problem solving themselves, amongst themselves. (Rachel)

A high number of modifications depended also on children's development. As time passes, children grow fast and are in need of new and different opportunities that stimulate their growth and learning. For example, teachers introduced new topics or materials that they thought could be motivating for the children as they grew.

Campus Interactions: A second source of modifications was generated by the experiences that happened by exploring campus. Sometimes, new topics of discussion were

introduced in response to questions the children expressed while walking around. New interests could arise from a visit to a school or facility or new materials could be brought in from the outside surroundings.

Rachel recalled an opportunity when walking through campus the children were intrigued by the clothes Muslim people wore. That interest motivated the teacher to develop a research activity with the children to find out where in the world did people wore those kind of clothes, they searched for images on the internet, read stories and created a map to visualize the geographical and cultural characteristics of Muslims. The new knowledge was then incorporated to their everyday experiences on campus.

Outside Research Activities: Research activities going on at the preschool also induced change. It could be a new topic to discuss, a need of more space for certain activity, a modification in the daily schedule influencing play time or the incorporation of new materials to explore.

Types of Modifications.

I identified a series of types of modifications executed by the staff. The more frequently occurring modifications are described to illustrate the wide range of changes introduced. Some were physical and others were related to the teacher's role as the guiding adult in the classroom. Adjusting furniture location: Furniture was moved to a different location or its disposition changed. Sometimes shelf height was changed or a new piece of furniture was brought in.

Bringing in new materials: New materials were brought in response to a series of factors. Sometimes, teachers predicted materials that could be attractive for the children and could help them make connections between their different interests. In other cases the incorporation of a new material was done to support and challenge children's development. For example Vicky mentioned she changed the puzzles in her room when she noticed they were not used anymore because the children already knew how to solve them. She also recalled changing paint colors in response to observing that the children were not using the initial colors as much. Changes in materials were done daily in Classroom 3, due to the need of a constant diversity of materials to do artwork. Changes in the materials in the other two classrooms were not done as often.

Introducing new topics: Teachers changed materials also to introduce new topics. For example they brought in a new book or some natural objects to awaken the interest in the children. Other times, the teachers created their own materials and included them when reading a specific book.

Narrowing down: Teachers stated that too many objects and materials in the room could be overwhelming for the children. They changed materials and their disposition as a way of narrowing the choices that children had to make. Children would then have less options to choose from.

Facilitate and support: The teachers and assistants acted as a facilitators of the activities performed by the children. They modified some materials or changed their location to facilitate their use. For example Vicky mentioned that she realized that the children were not using the art materials when they were placed in containers with a lid. She modified by taking the lids away and observed a very different behavior in the way children approached the same materials. Teachers also modeled the use of certain materials following children's interests and curiosity, to show them how they could be manipulated. For example, one of the teachers would sit in the carpeted area and start moving and grouping blocks. The children would join her, and after a while she would move away.

After the modification phase, teachers observed the reactions of the children and the new interactions happening in the classroom. These observations and reflections were recorded in different ways, which I have grouped as the fourth phase of the process. "Evaluate" is related to the process of acknowledging and internalizing facts by the use of preferred tools that the staff had at hand or had experience using.

Evaluate.

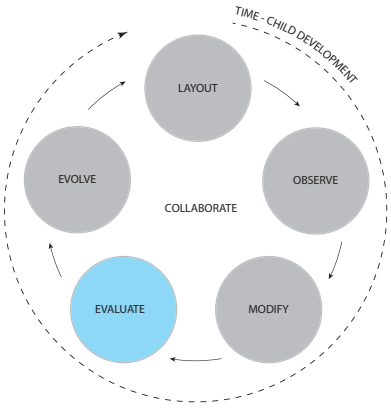


Figure 10: Evaluation Phase of the Design Process.

The evaluation phase of the design process had two main parts. First it considered reflecting on the observed behaviors and interactions and second, it included acknowledging or documenting those reflections.

Reflecting.

The teachers and administrator reflected on the effects of their classroom design individually and collectively. They were permanently asking themselves questions about why things were how they were and how could they change. They also expressed using "dialogue" as a valuable tool for evaluating their observations and to foster collaboration as a team. After conducting in-depth interviews with the teachers and administrator it became evident that reflection was an active part of their design process. Nevertheless, the act of documenting their reflections or thoughts did not follow a defined method or considered the use of a common tool, obstructing future access and recall.

Acknowledging and documenting.

By acknowledging I refer to the fact that some information was recognized and given thought but was mainly stored in the staff's mind. Documenting refers to manually or digitally recording information to be available for future consultation.

Both acknowledging and documenting were activities done individually by each staff member at the preschool. The administrator explained that teachers kept informal records, but did not use a specific format.

The teachers confirmed not having a shared system to document their observations or reflections and instead using their own personal ways to record the information they collected. All of them took photos, and some of these photos were posted on the classroom walls to make the children's learning process visible. Vicky explained that her main tool was to keep "mental notes" of her observations:

> I don't really say I would take notes, maybe mental notes, I would take. I just want to make sure, if it's not being utilized, why is it not being utilized? Is there something that I need to change? Is there something I need to add? Is there something I need to take away? I mean, mentally take notes of an area that's being used. (Vicky)

Rachel expressed that she took notes in the moment that things happened as a way to understand children's purposes and as a tool to help her remember in the future:

> That's why note taking is really important because you need to know what their plan is and how that socialization of the playing goes with that. Note taking and observations, you are doing that all the time, whether you are minding it. Even if you just write a little notepad, that's fine because then you understand, "Oh yes, he did this." Then you remember. (Rachel)

Nina explained that her system of documentation was related to the assessment tool used in the preschool that came from the “creative curriculum”. She expressed feeling comfortable with that system because she had the experience of using it for many years. Although the staff used some tools and methods to document their observations, they relied mostly on their memories to remember relevant information. For example, when asked about the tool or method of documenting her observations, Vicky explained: :Mentally I’ve been observing it and making sure it’s going to work for the kids, for me you know...It seems to be OK”. (Vicky)

Keeping records was an individual and informal activity done by the different members of the preschool staff. It was mainly related to the assessment of the children and did not incorporate synthesis methods that could inform the design process in the future. At the same time, the informal spirit of the documentation process made it hard for newer teachers to access the background knowledge of the teachers who had been there for a longer period of time.

Evolve.

The last phase of the design process is: “Evolve”. In this phase the teachers and administrator made sense of the information collected throughout the previous stages, confirming some of their assumptions and obtained new knowledge. This process could be individual or collective, but was mainly an internal experience. New knowledge built up by experience constituted the starting point of the following cycle.

In sum, the design process observed considerable tangible and intangible variables and was a personal experience for each of the staff members. The design of the classroom is only one of the many responsibilities that the teachers have, and time is not devoted specifically for this purpose. The prior experience and knowledge of each staff member was the main source of information for the decision-making and the starting point for the initial layout of each classroom. Valuable insights on relevant aspects of the design of the classrooms were kept mostly in the staff’s mind and were not systematically documented for future use or collaboration. Although the different phases of the design process were not structured or followed in a conscious way, they appeared to iterate in a circular fashion that reoccurred at certain intervals over time.

Teacher’s Experience and Knowledge

Other fundamental research questions are related to understanding and describing the teachers’ experience designing the classroom:

How does the process determine the design of the space?

The staff described their design process as a “re-arrangement” or a “makeover”. This means that the possibilities of the resultant design were limited by the elements at hand or already known for the staff. The process observed was mostly convergent, focused on solving a current problem and not in detecting design opportunities. The un-structured style of the design process benefited the staff by allowing them to act freely based on their own knowledge, but at the same time this limited collaboration between the staff.

As the teachers were the driving force and decision-makers in the design process, their beliefs, self-efficacy and accumulated knowledge strongly impacted the resulting space. The design process was experienced only by the preschool staff, without the collaboration of parents or other professionals, which could bring in new considerations and tools to the process.

What are the tools that the teacher uses to design her classroom?

As mentioned in the description of the design process, the main tool that the staff uses is observation. Discussion and dialogue were also tools used to reflect on their observations and thoughts.

As a way to find inspiration for their classroom design, the teachers sometimes consulted the Internet or reviewed photographs from their own databases. They also used their own memories to empathize with the children’s motivations and interests.

Sketches or drawings were rarely used; however, Nina did used a fast drawing of her classroom to plan the disposition of furniture materials and the sleeping spots for the children.

Documentation in the form of notes and photographs were kept by some of the teachers, but not used directly to generate information during the design process.

Literacy Behaviors

Secondary questions are related to the effect of the process in the designed classroom and how it affects or models literacy behaviors in the children.

How do the election and disposition of the materials influence children’s behaviors?

It was the belief of the staff, that literacy and play were intimately related. The administrator explained: “In my way of thinking you design an environment that works well for play with children and bring in literacy.” This means that the election and disposition of the materials were based first in promoting play and once that objective was accomplished, literacy was introduced in a natural way. Literacy became a complement in any type of activity and therefore materials related to reading and writing, were included in every area of the classroom. Books were used as open-ended materials incorporating them into all kinds of activities. They

served as references of certain topics and as an invitation to explore endless areas of discovery. The books were readily available in all of the classrooms and could be carried around by the children to different areas.

Literacy was also introduced in the classroom in a functional way to teach the children that it is a tool that can be used for a purpose. Every day, the children came into the preschool and signed themselves in at a board placed in the reception. They wrote or pretended to write their names with the help of their parents and could then go to their classroom. Once in their classroom, they took out their “ticket to play” from their cubbies and placed it in the ticket board.

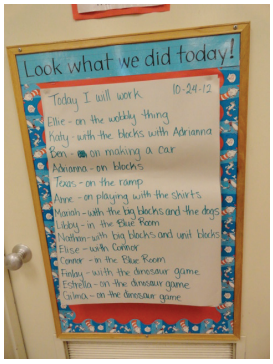
Each child created their own ticket at the beginning of the year by choosing an image and placing it together with their name. Tickets to play allow children to identify others by their image while learning about the letters in their names. Play, literacy, identification, and function of print are all related in a functional object used by all children. Photograph 19 shows the ticket to play board that was present in each classroom.

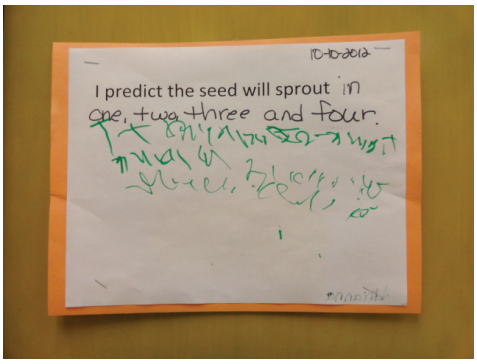
Photograph 19: Ticket to Play Board.

Materials were organized with the use of labels that include the corresponding word and image to represent each object. The children participated actively in the organization of the classroom by “reading” the labels and at the same time learning about the relation between image and text.

Photographs 20 and 21: Toys and materials labeled using words and images.

Literacy was also used as a tool to document children's opinions and work. Teachers wrote the plan that each child had for the day and also wrote for them dictations of their predictions on discussions going on in the classroom.





Photograph 22: Plan for the day wrote by Nina.
Photograph 23: Prediction on the time it would take for a seed to sprout wrote in collaboration between Nina and a child.

According to the teachers, children's behaviors changed depending on the room they were in and the materials it offered. Vicky described her observations on children's conduct adjustments as they started moving to different rooms:

> Oh yeah, definitely. One of my kids is doing the water table in Room 1 today, which was very calming for him. He's a very energetic boy usually and he was very calm in there. Then, I have another one who was in Room 2 today who seemed to be playing very well, versus sometimes in here he doesn't. Yeah, I've noticed, knowing the different areas, how they can play differently or even behave differently. (Vicky)

After her observations, she concluded that each child has particular needs, interests and personalities, which influence their involvement with the materials making one room better for a certain child than another. The opportunity offered by changing rooms diversified the options that children had by enriching their involvement with the materials.

Some materials were made by the teachers as a way to help the children in the transition period of learning how to write their names. For example, Nina developed a personal transition device that was used by each child in the different centers of the classroom. This tool was a sentence strip with each child's name that they could recognize by color, by the first letter or by the whole word. She explained the need for this specific material:

> Sometimes they need to see these things. If you're showing somebody how to write their name, they could sit there all day and never figure out how to write their name. You have to show them how to write their name. (Nina)

This hands on experience of practicing writing their name with the assistance of the material generated by the teacher, allowed children to practice and developed their control and competency.

In conclusion, the type, availability and disposition of literacy materials directly influenced children's literacy behaviors. In a play based setting, literacy materials are introduced as tools that extend, complement and develop the natural playing of the children. Literacy is presented as a useful resource and a fun element to include in every type of activity in a spontaneous and diverse way.

Peer Interaction and Literacy

How does the classroom environment model the interactions between children?

Circle Time was the first activity done each day and consisted of using the reading area in each classroom to sit and listen to a story read by the teacher or one of her assistants. During this moment, the children asked questions, shared their own experiences and communicated with each other moderated by the adult in charge.

The multi-aged grouping in each classroom produced a variety of dimensions in the interactions between the children. The staff agreed that age-mixture offered richness of experiences for all of the children. Nina explained how the grouping generated modeling and mentoring between the children:

> But you know what? Other children can learn from that too, because not only am I "the teacher" in here. There's children of various levels and capabilities and they serve as mentors or models for their peers. (Nina)

She also mentioned that in her experience, the motivation for a child to play with another child, is drawn by attraction and preferences of materials:

> They usually are drawn to the materials first. Then, therefore they tend to play with the same children. Children at this age, don't think, "I want to expand my horizons with my friends and I'll go work with someone else today." (Nina)

The size of the classroom space was also described as an important promoter of literacy interactions among the children. The administrator explained:

> I think that we've just above the right number of kids with the space, so that there's a lot of interaction with children, amongst children. I think if you have a very large area, then the children who want to be by themselves finds it very easy. I think it's perfectly OK for a child to be by himself, but to have close proximity of people who are having fun and who are nearby is very helpful. So a very large area would not be the best.

The use of information signs to communicate expected behaviors and to show where thing go is another powerful tool to encourage collaboration and communication between the children. At the same time it is a promoter of parent involvement, as they too have to respect and follow the preschool signage.

Among the literacy activities mentioned by the teachers, there are some that specifically encouraged peer interaction such as playing music, dancing and singing. These were collective activities done in groups, where children had the opportunity of communicating, laughing and playing together while learning language, rhythm and rhyming between words.

In conclusion, using literacy for a purpose, and not as an isolated skill to learn, is the primary principle that guides the staff in the creation of the classroom environment. Materials are chosen and organized with the child in mind and focused on creating a wide variety of learning opportunities by interacting with adults and peers.

CHAPTER 5
CONCLUSIONS

Introduction to the Conclusions

This chapter contains the conclusions based on the findings of the case study. The primary focus of the research was to explore the design process that teachers follow to create a literacy rich classroom environment. The design of the classroom is a complex design problem that requires balance between the creation of a caring space and the management of a wide variety of considerations and objectives.

Findings revealed an iterative and cyclic design process that is repeated over time adjusting to the influence of numerous factors. Considering these factors as a standpoint allows for further exploration to determine a design process suitable for teachers when designing their learning environments. Although the findings correspond to a specific site studied, the implications are wide reaching as problems and opportunities expressed by the staff are common to other educational settings with similar characteristics.

Teacher's Beliefs About Literacy

As described in the previous chapter, the design decisions and process are highly influenced by teacher's beliefs on how children learn and by their interest in helping them discover and acknowledge the usefulness of acquiring literacy skills for their future. The method used to design their classrooms is defined by the belief that literacy is embedded in any kind of activity and that exploring and playing with all sorts of materials can build a solid foundation for future learning.

As in Vygotsky's view (Bedrova & Leong 2006), the participating teachers consider that reading and writing requires higher mental functions that children have not yet developed in their preschool years. Instead of directly teaching literacy skills, they incorporated literacy in the daily activities of the children as an essential tool for communication. In doing this, the teachers satisfied both the physical and the psychological literacy needs of the children in a balanced way (Guo, Justice, Kaderaveck & McGinty, 2012).

Although findings demonstrate that the staff has formulated solid background knowledge of child development and literacy over the years, they confirm previous research suggesting that teachers need to manage a design process capable of developing their creative abilities to respond to the needs of a constantly challenging environment (Curtis & Carter, 2003; Roskos & Neuman, 2001; Roskos & Neuman, 2011).

Design Aspects Considered in the Creation of the Classroom

The teacher's way of understanding literacy as a global and functional tool for communication, determined the following design considerations:

Functionality of print: Print and visual codes are relevant in understanding how the space works and emphasized the relation between texts and images. This relation was repeated all over the classroom including tickets to play, drawing and writing, predicting and reading books. The teachers frequently asked questions to the children as a way of making them reflect on the meaning of images and their relation to text.

Visual explanations and signs: Visual explanations and signs create a common language to communicate inside the preschool that is known and respected by all its members. The use of signs in relation to physical objects or expected behaviors motivates the need for the children to be able to interpret visual codes composed by images, text and symbols.

Writing to communicate: Writing is given due relevance by associating it with communicating with others and being able to identify personal work. The children wrote letters to their parents and classmates and were motivated to write their names in every piece of work they did. The need to identify something they felt proud of made the children want to learn how to write.

Reading everywhere: Reading had a special space in each of the rooms, but at the same time was considered by the teachers an activity to be done all over the classroom. By observing the children I noticed that reading was incorporated in play activities and was not necessarily restricted to quiet areas. Some children lay on their stomachs in the middle of the room simply reading to themselves, while others included reading in their pretend play scenarios in a very natural way.

In conclusion, the methods used by the teachers to create literacy rich classrooms considered visual images as powerful encoding tools. The combination of visual and auditory stimuli created a multi-sensorial experience, facilitating long-term memory storage. The different types of encoding information helped create a literacy foundation for future retrieval. As Driscoll (2000) emphasized, if the set of cues used in encoding is large, there are more alternatives to facilitate retrieval.

Conclusions on The Design Process

Findings revealed that the design of a literacy rich classroom environment is facilitated by the design of a learning experience in a given space. As an experience, it cannot be calculated solely through quantitative measures of the amount of books in the classroom or counting the times a child picks up a book to read. An important part of the experience is determined by the interactions that happen in the classroom based on the materials used and their specific placement. As the Reggio Emilia approach explains, balance is obtained only when the space is inhabited (Ceppi & Zini, 1998).

The design of the classroom environment considers a set of tangible and intangible variables. The use of a systematic and collaborative design process could produce a wide range of ideas for design interventions, related not only with the location of furniture and materials, but also with the planning of activities and the implementation of the curriculum.

Teachers' knowledge is a potential source of innovation for themselves and others working in the design of classroom environments. The process should incorporate tools to visualize and synthesize observations, concepts and ideas and at the same time document them for future use and recall. The absence of a clear repeatable method to follow when designing the classrooms, sets more responsibility on each teacher and blocks the flow of communication and knowledge transmission between the staff team.

Relevant aspects to consider in the design process.

There were five main phases identified as part of the design process utilized by the teachers (layout, observe, modify, evaluate and evolve). Those phases correspond to an intuitive way of approaching the design problem that is difficult to repeat over time and that depends mainly on each teacher's beliefs, accumulated knowledge and experience.
Nevertheless, they are informative and complementary with design suggestions from other sources helping to generate the design considerations listed below:

Observe, empathize and understand the needs of real users.

In the case of the research site, observation was the main instrument of data collection. The teachers arranged an initial layout based on their prior experiences to observe children's behaviors and identify problems to solve. When a problem was detected, the teachers tried out different arrangements of the furniture or incorporated new materials and observed again.
Most of the time the process of observation was not formally documented as this data was simply kept in the teachers' memories. Although the staff discussed their observations with each other

in an informal way, those interactions were not documented, losing the option of systematic collaboration to generate future ideas.

The most important aspect of the observation phase is to observe with empathy. In the creation of their classroom environments, each teacher focused on creating a caring, loving and safe place for the children to learn. As discussed in the literature review, creating the conditions to focus on learning is basic for the environment to work. Understanding that learning and memory are connected to emotions (Driscoll, 2000) is vital in the creation of the classroom.

Alternate divergent and convergent thinking in the design process.

An important aspect to consider in the formulation of a creative design process for teachers is to alternate divergent and convergent thinking (Laurel, 2003). As the design thinking for educators toolkit (IDEO, 2013) proposes, incorporating a divergent phase of discovery allows for the identification of numerous design opportunities. The process observed contemplated mainly the use of convergent thinking as the flow of innovative solutions was limited. For example, by considering a-priori that the solution to a problem is re-arranging existing elements, the design possibilities become limited and there is a high chance that opportunities for innovation will be overlooked or ignored.

Divergent thinking can produce valuable insights and design opportunities to face 21st century challenges. As Tim Brown explains: “Research needs to be designed for discovery, not to track existing conditions and assumptions”. (Brown, 2009 pg. 148)

Design a playful process to create playful environments.

The design process should incorporate playful interactions between the participants to allow creativity to flow and wild ideas to emerge. If learning by play has proved to be a positive way for children to learn, why not design their spaces in a playful way too? The Design Thinking process created for educators by IDEO incorporates optimism and fun activities to stimulate the collective creativity of the team.

Design a structured, flexible and evolving process.

As the Reggio Emilia approach describes, the classroom space should be constantly re-designed as a result of the experimentations of teachers and children. (Ceppi & Zini, 1998). The classroom is alive by the different groups interacting each time and therefore the design process should be in constant evolution.

As findings showed, the design of a classroom environment in highly influenced by the factor of time. The time of exposure in the space influences children's response and interactions and at the same time the personal growth of each child modifies their motivations and use of the space. Utilizing a structured process is a way of understanding and documenting changes in time. However, this system needs to be flexible to adjust and modify the classroom environment according to the interactions, behaviors and challenges permanently faced by the team.

Design a collaborative process.

Even when the teachers consistently collaborated during the design process, ultimately each one of them worked independently in their own classroom design. Incorporating collaboration in every phase of the process could generate innovative insights produced by the combination of diverse points of view and prior experiences. By collaborating, each member of the team has the opportunity of being heard and at the same time has access to the group's knowledge enriching their individual experience (Brown, 2009).

The late Anita Olds (2000) emphasized the importance of collaboration in the design of child care environments. According to her, having the time to listen to different perspectives and discuss concerns allows the participants to think about how they are currently doing things and how they would like to do them in the future. At the same time, working in collaboration with other professionals provides an opportunity for the preschool's staff to open their expectations to innovative solutions for their environment (Olds, 2000).

In the context of developmental laboratory preschools, the participation of designers and members of the university community (as parents, researchers and faculty) could bring in new ideas and knowledge to the design process. At the same time, collaboration motivates a more horizontal communication between the staff members.

Collaboration could be promoted by the use of different tools. Brainstorming, memoing and prototyping could generate a wider range of ideas to choose from and aid the team in discovering innovative insights to explore together.

Reflect and synthesize.

Although the teachers reflected individually on their observations, the data they obtained were not formally processed, analyzed or compared. The design process needs a phase of comprehension and synthesis where the different observations can be analyzed collectively. This stage could assist them in transforming their memories in actionable insights and design opportunities.

Make the process visible.

One of the main problems detected by the research was the absence of a documented system to externalize and discuss ideas. The use of representation tools such as diagrams, graphs or sketches could be useful for the teachers to make their ideas visible. As Kolko (2009) explains, visual explanations help to understand changes over time and describe spatial relationships. At the same time, using systems to work with data helps to connect information and eliminate it from working memory, allowing the brain to create new ideas.

Explore possible solutions.

The Design Thinking method considers a prototyping phase that allows the team to test different ideas by developing simple models or sketches. By collaborating in this process, there is a larger set of ideas and more members of the group can discuss them. If the participating group in the design process is diverse, then the teachers can be more confident of their ideas because there is a team that can manage to try different solutions.

Document.

While observing the daily activities of the teachers at the research site, I witnessed that time was always a primary concern. It is essential that teachers carefully watch over the activities of children and it should be acknowledged that constantly documenting their observations and perceptions would take up a great deal of time. However, some basic or quick documentation would certainly be beneficial.

One of the participants mentioned keeping observations in her mind for future use. Research in cognition and memory storage has demonstrated that working memory is limited and that in order to incorporate new information, mental space needs to be liberated from the task of remembering (Driscoll, 2000). At the same time, memories are influenced and distorted by new incoming information according to actual perceptions and experiences (Driscoll, 200). In the classroom, different situations occur spontaneously at any unexpected moment. The act of documenting should be incorporated to the normal functioning of the preschool in order to be a successful way of gathering information for innovative ideas to flourish.

As Loris Malaguzzi believed, the teacher “cannot work without a sense of meaning” (Rinaldi, 2006, pg.56), and therefore he or she can be regarded as a permanent researcher that should document processes as they happen. Carlina Rinaldi (Rinaldi, 2006), also suggests the use of documentation to analyze children’s processes and understand their meaning. Howard Gardner (Driscoll, 2000) considers documentation an assertive tool for assessment and evaluation to complement traditional quantitative measuring instruments.

In conclusion, documenting is a fundamental tool to include in the design process helping the participants to recall, transmit, perpetuate and share their knowledge.

Evolve.

The design process needs a phase of reflection, examining the impacts of the design interventions. As IDEO describes (IDEO, 2013): The evolve phase is an opportunity to track knowledge and move forward. By evaluating the impact of a design intervention, the team is able to visualize future challenges and areas of opportunity. Evolving is a way of keeping the design thinking process alive. It keeps the creative cycle flowing and open for future innovations.
In the research site, the teachers produced knowledge throughout their design processes and used it in their future interventions. This was done intuitively by mainly using their memories as the source of data. If the process is structured and documented, the evolution can be tracked, understood and shared while at the same time the knowledge obtained can remain available for further explorations.

Conclusions about the Research Problem

Educational policy in the United States establishes that the teachers are responsible for the design of their classrooms. Teacher education does not necessarily give them the tools to apply a structured and repeatable design process, leaving them with an overwhelming task. On the other hand, design has developed systems to solve complex problems and identify design opportunities applicable to a wide range of scenarios. Even when those methods are structured and repeatable, they need to consider relevant context information in order to be applied successfully. By using a collaborative process between both disciplines, teachers can incorporate design knowledge in their activities and designers can learn about the real necessities of the context.

The goal of creating a literacy rich classroom environment can be made more achievable by the collaboration between disciplines of education and design. If the process is informed by the challenges and aspirations of teachers and students, it is aligned with the reality of the context. If it is repeatable and documented it can be incorporated in the activities of the school allowing for an iterative design process that benefits educational goals.

Implications for Theory or Existing Models

The literature review presented three different and complementary approaches for the design of a classroom environment from an educational perspective.

The interpretive approach developed at The Harold E.Jones Child Study Center at The University of California in Berkeley shares similar characteristics with the design process identified in this research. Both studies were conducted in laboratory preschools that focus in play as the central motor for children to learn. Also, both systems use observation of children's behaviors as the main tool of data collection, followed by reflection on the obtained data to modify the space by adjusting it to real needs of the users.

The design approach suggested by Anita Olds (2000) emphasizes that at least one of the members of every design team should represent the child's needs. This requirement states the importance of the teacher's knowledge and experience in being able to anticipate and understand children's behaviors. In a collaborative process between designers and educators, the teacher's views allow the team to keep the focus in the final user over other design considerations. Olds suggests the use of behavioral mapping in order to make spatial needs visible and evaluate the effects of future interventions. Her understanding of the learning space as a place were a variety of activities happen simultaneously, reminds the design team of the complexity of creating an environment were a diverse group of people coexist for long periods of time. The need of using visualizing tools is coincident with the findings of this research.

The Reggio Emilia design tools developed in collaboration with The Domus Academy (Ceppi & Zini, 1998), are fundamental recommendations that can be used as a foundation for the development of a process that is centered on the children that will be using the space. These guidelines describe the significance of design attributes as light, color or texture as a way to enhance children's experience when using the space. Space is considered alive and in constant modification according to the needs of its users (teachers, parents and children).

From a designer's point of view, the Design Thinking Toolkit for Educators developed by IDEO (IDEO, 2013), incorporates useful methods and tools for educators to create their learning spaces. Although the process is highly applicable in the creation of classroom environments it is complex to learn and demands a reasonable amount of time to be mastered and implemented.

Teachers are designing constantly in their daily activities, and the design of the classroom is one of their many responsibilities. If their learning spaces are not designed carefully and thoughtfully, the experience of their students may be obstructed. A possible way of managing this problem is to consider that a complex activity like designing a classroom requires a team of experts where the teacher is a fundamental participant. It is necessary to employ a structured method that is shared to offer tools for the team to communicate and visualize ideas.

Applying a design method as Design Thinking requires practice and may be overwhelming to explore while managing all of the other responsibilities that teachers deal with on a daily basis. Developing workshops to teach the method is useful and a beneifical starting point, but it reaches a limited amount of people. If it is not incorporated to the functioning of the whole school system it may turn out to overwhelm those trying to use it.

The inclusion of design methods and tools knowledge in the curriculum of future teachers may be a viable way to reach a high population of future teachers and at the same time it may give them enough time to master and explore its potentialities. Amplifying the concept of "design" in the educational field could open teacher's explorations into new dimensions of the process. For example, introducing knowledge on design methods could change teacher's focus from simply the re-arrangement of elements to the discovery of design opportunities to enhance the learning experience. As Howard Gardner explains, the process of observing, documenting and interpreting children's spontaneous activities and behaviors help teachers realize their potential to learn how to teach (Rinaldi, 2006, pg.68).

Implications for Further Research

Findings form this research can be used as a starting point for the development of a model of design process specifically formulated for the design of literacy rich classroom environments. The model could be applied and tested to obtain feedback based on empirical information on its potentialities and problems.

Future research could also compare the use of the same process by different types of design teams. For example a team including designers, parents and educators in contrast with a team including only designers or only educators. This comparison can offer information on the benefits and difficulties of working in collaboration to develop the design of classroom environments. Real interactions between educators and designers can inform and complement the formulation of the design process.

Another area of exploration could be the role of technology as a material and a play tool, and its potential use for learning literacy in the context of the classroom environment. As Roskos and Christie (2011) suggest, the presence of technology in children's everyday life is introducing new ways of relating to the act of reading and writing. Exploring the interactions that children have with technology can inform the development of applications designed specifically to learn literacy. At the same time, analyzing technologies and their use by children can inform about new literacy challenges in the 21st century.

The involvement of teachers in research, especially in laboratory school, is essential for their future development. Becoming generators and disseminators of their own knowledge empowers teachers to transmit their wisdom and share their experiences.

Teachers working in laboratory schools are direct witnesses of valuable learning experiences that are not always documented and can add relevant knowledge to the study of learning environments from an insider's perspective (Mc Bride, et al., 2012). Amplifying the scope of current research on child development to the study of the design of the learning environment empowers teachers to conduct their own research activities.

Finally, future research could also explore the role of the classroom in developmental laboratory schools. As detailed in the literature review, these settings offer a particular experience for its students by using the campus environment as an extension of the learning space. By incorporating the campus to the children's learning setting, the classroom acquires new characteristics and presents challenges that are not necessarily present in other types of preschool environments.

Teacher's Emotions in the Design Process

In the research site, the staff has built substantial knowledge based on their observations, reflections, past experiences, intuition, knowledge, empathy and sensibility.
The combination of these aspects allows them to make decisions about relevant and appropriate activities and materials to use in their classrooms.

By conducting this research, I realized that the teachers have a deep emotional attachment with their working space. They compared their classrooms with their own homes and mentioned that the space reflects who they are and what they like. During the interviews they expressed feeling that external design interventions in the past had not considered their knowledge and experience, suggesting isolated physical modifications without a full understanding of their daily experiences. The staff's feelings, emotions and knowledge should be a vital part of the design process specially when working with external collaborators.

Final Reflection

I started this research deeply interested in exploring the materials that teachers use to create literacy rich learning environments. As a designer I was curious about how the formal attributes of the materials could affect the experience of the children.
Through this research I learned that even when the characteristics of each material is essential, it is the configuration of the space and the role of the teacher as partner that results in a

profound learning experience for the child, and this is the foundation of an effective design for literacy development. Creating meaningful spaces using empathy and reflection depends on the interactions that the participants in the process experienced. As a designer I believe that education and design are intimately connected and that both disciplines benefit from each other in order to create productive and livable spaces for young children. Building connections between design and education humanizes the act of designing and generates empathy with the real user (children, teachers and parents). The design of a learning space is the design of an experience, hopefully one that will be stimulating, caring and meaningful for the children that live it.
As one teacher noted:

> I think it would be a great idea to have something that would connect education and the design together. I think that's something that each school should have and somehow, some way, kind of get that into the schooling system- just like they have a curriculum that each school has. They have standards that they have to abide by. Maybe long way down the road, you'll have the design implementation that each school has or something like that. (Vicky)

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APPENDIX A

HUMAN SUBJECTS INSTITUTIONAL REVIEW BOARD (IRB) APPROVAL

ASU Knowledge Enterprise Development

Office of Research Integrity and Assurance

To:	Mookesh Patel AED
From:	Mark Roosa, Chair Soc Beh IRB
Date:	08/10/2012
Committee Action:	**Exemption Granted**
IRB Action Date:	08/10/2012
IRB Protocol #:	1208008109
Study Title:	Designing Literacy Rich Classroom Environments for Young Children: A Study of Teacher's Design

The above-referenced protocol is considered exempt after review by the Institutional Review Board pursuant to Federal regulations, 45 CFR Part 46.101(b)(1) .

This part of the federal regulations requires that the information be recorded by investigators in such a manner that subjects cannot be identified, directly or through identifiers linked to the subjects. It is necessary that the information obtained not be such that if disclosed outside the research, it could reasonably place the subjects at risk of criminal or civil liability, or be damaging to the subjects' financial standing, employability, or reputation.

You should retain a copy of this letter for your records.

APPENDIX B

ADMINISTRATOR'S INTERVIEW GUIDE

Designing literacy rich classroom environments for young children: A Study of teacher's design processes and tools.

INTERVIEW GUIDE

INTRODUCTION

Research Purpose: The purpose of this research is to study the design processes that teachers use to design their classrooms in preschool settings. As a designer I want to be able to analyze the tools that teacher's use and how they apply their knowledge and experience in the designs they create.

Use of the research: The research will be used to propose a design process or toolkit that supports teachers when designing literacy rich environments for young children.

BACKGROUND

1) Can you tell me a brief story of this preschool?
2) Could you describe the organizational structure of the preschool?
3) What is your degree of autonomy directing the preschool?
4) Do you have to follow a certain curriculum at the preschool?
5) How many different languages do children speak at the preschool today?

LITERACY AND MATERIALS

1) Where do the materials present in the rooms come from?
2) How do you select the materials to use in the classrooms?
3) Do you follow any specific curriculum for the selection and use of materials?
4) What do you think about literacy materials in preschool?
5) What can be done to stimulate children's interest in literacy activities?
6) Do you have a classification system for the materials you use in the classrooms?

CLASSROOM DESIGN AND LITERACY

1) How do you design your classrooms?
2) What aspects are the most important for you to consider when organizing the space?
3) Do you follow any process during the year to assess the use of the space by the children?
4) What methods do you use to introduce literacy in the daily activities?
5) Do you notice differences in behavior between the same kids in different rooms?

PROCESS

1) Do you keep records of the interactions happening in the classrooms?
2) Do you think the classroom design affects in the children's interests?
3) Do you change your design during the school year? If you do, how do you do it?
4) Do you work with other professionals when designing your classrooms?
5) Do you know about any design process you could apply when designing your classroom?

WRAP-UP

1) Is there something else you would like to add that we may not have asked about?

APPENDIX C

TEACHER'S INTERVIEW GUIDE

Designing literacy rich classroom environments for young children: A Study of teacher's design processes and tools.

INTERVIEW GUIDE

INTRODUCTION

Research Purpose: The purpose of this research is to study the design processes that teachers use to design their classrooms in preschool settings. As a designer I want to be able to analyze the tools that teacher's use and how they apply their knowledge and experience in the designs they create.

Use of the research: The research will be used to propose a design process or toolkit that supports teachers when designing literacy rich environments for young children.

Confidentiality: Your names and any other identifying detail will remain confidential.

BACKGROUND

1) How long have you been a preschool teacher?
2) How long have you worked at this preschool?
3) What rooms have you used at the preschool?
4) How many children do you have in your room today and what are their ages?
5) How many different languages do children speak in your classroom?

MATERIALS AND LITERACY

1) Where do the materials that you use in the room come from?
2) Do you participate in the selection of materials?
3) Do you follow any specific curriculum for the selection and use of materials?
4) What kind of materials do you use to engage children in literacy activities?
5) What can be done to stimulate children's interest in literacy activities?
6) How do you organize the different types of materials in your classroom?

CLASSROOM DESIGN AND LITERACY

1) How do you design your classroom?
2) What aspects are the most important for you to consider when organizing the space?
3) Do you follow any process during the year to assess the use of the space by the children?
4) How does the design of the space influence the use of the classroom by the children?
5) Do you notice differences in behavior between the same kids in different rooms?

PROCESS

1) Do you keep records of the interactions happening in your classroom?
2) Do you think the classroom design affects in the children's interests?
3) Do you change your design during the school year? If you do, how do you do it?
4) Do you work with other professionals when designing your classroom?
5) Do you know about any design process you could apply when designing your classroom?

WRAP-UP

1) What suggestions would you have for redesigning your classroom today?
2) Is there something else you would like to add that we didn't ask about?

APPENDIX D

ADMINISTRATOR'S INFORMATION LETTER

INFORMATION LETTER FOR INTERVIEWS (DIRECTOR)

Designing literacy rich classroom environments for young children: A Study of teacher's design processes and tools.

Date:

Dear _____:

I am a graduate student under the direction of Professor Mookesh Patel in the Design School, MSD Program, Visual Communication Design concentration at Arizona State University. I am conducting a research study to analyze the design processes that teachers use to design their classrooms in preschool settings in order to understand their needs and experience.

I am inviting your participation, which will consist of three parts:

First I will ask you to assist to a 30 minute meeting in which I will let you know the purpose and methods of the research. This will take place at the preschool were you work (The Mary Lou Fulton Teachers College Preschool).

The second part will be an in-depth semi-structured interview. You will have a one hour conversation with a researcher at your office. The interview may include some drawing, diagramming and photo shoots to help articulate what we talk about. You have the right not to answer any question, and to stop the interview at any time.

The third part consists on the observation of two of your planning meetings when you discuss the classroom design for the school year. These meetings will be recorded in audiotape.

Your participation in this study is voluntary. If you choose not to participate or to withdraw from the study at any time, there will be no penalty at your workplace.

Being a part of this research may help you gain deeper insight into your design process and it may inform other teachers about design tools available for them. Your students will also be benefitted from your knowledge when they use your classroom during their preschool experience. There are no foreseeable risks or discomforts to your participation.

All information obtained in this study is strictly confidential. The results of this research may be used in reports, presentations or publications but your name will not be used. Your identity will be replaced for a "subject code" (e.g. Participant 1). The researcher will keep all information obtained in a locked cabinet in The Design School, College of Design North Room 66 only to be accessed by the investigators. At the end of the research the information will be shredded and recycled.

I would like to audiotape, videotape and or photograph this interview. The interview will not be recorded without your permission. The visual material (videotape and or photographs), will only be used by the researcher in the process of data analysis to identify and recall key elements of the interview. It will not be published or presented in any way and will be deleted after the

If you have any questions concerning the research study, please contact the research team:

Catalina Cortes
Phone: 480 3347282
E-mail: catacortes@asu.edu

Assistant:Professor Mookesh Patel
Phone: 480.965.0968
E-mail: mookesh@asu.edu

If you have any questions about your rights as a subject/participant in this research, or if you feel you have been placed at risk, you can contact the Chair of the Human Subjects Institutional Review Board, through the ASU Office of Research Integrity and Assurance, at (480) 965-6788.

Participant Signature Print Name Date

I agree to be videotaped

I agree to be photographed

APPENDIX E

TEACHER'S INFORMATION LETTER

INFORMATION LETTER FOR INTERVIEWS

Designing literacy rich classroom environments for young children: A Study of teacher's design processes and tools.

Date:

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If you have any questions concerning the research study, please contact the research team:

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I agree to be videotaped

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