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The traditional North American elementary classroom is dominated by traditional passive furniture. With the continual use of the traditional typologies of desks and chairs, the classroom furniture fails to challenge the student's development and engage the imagination of the users. As research shows that children learn most through movement, emotions, and exploration, the passive furniture hinders a well-rounded learning experience.

In this study, the approach for designing new furniture that fosters a sense of creativity, independence, and active learning is not only guided by the researcher's experiences, but also involves insight from elementary students and teachers. This thesis investigation used a participatory approach to enable the examination of the current activities and interactions occurring within the first and second grade classroom. Using the characteristics of middle childhood, the third teacher theory, and affordance, the researcher developed a line of furniture for active learning that enables the students to shape their learning environment and experience. The resulting classroom furniture provides for intimate interactions, physical activity, social development, and personal customization.

PRIMARY OBJECTS: DEVELOPING A NEW TYPE OF FURNITURE FOR THE EARLY ELEMENTARY CLASSROOM

by

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APPROVAL PAGE

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TABLE OF CONTENTS

Page

LIST OF FIGURES vii

CHAPTER

I. INTRODUCTION 1

Purpose of the Study 3
Justification of the Study 3
Research Questions 10
Research Procedures as Objectives for the Study 11
Assumptions and Limitations 12
Summary 12
Definitions 12

II. REVIEW OF LITERATURE 14

The Way Learning Looks 14
Passive and Active Learning 14
Emotional Learning 17
Aesthetics 18
Thinking and Learning Styles 20
Cultures of Thinking 22
Classroom and Behavior 24
Hidden Curriculum 25
Modifying the Environment 27
Environmental Awareness 28
Classroom Territory 30
Classrooms to Enhance Learning 30
Interactive Environments 30
Third Teacher Philosophy 31
Educational Philosophies 33
Design and Context 35
Stimulation 36
Affordances 37
Playground as Precedence 39
Designing for Development 41
Children's Furniture 43
Furniture Typologies 43
Despecialization 44

Designing for Change 46
Ergonomics 47
Participatory Design....51
The Student's Perspective....52
Visual Cultures of School....53
Participatory Precedents....54
Summary....54

III. METHODOLOGY 56

Purpose of Study....56
Research Questions....56
Research Procedures as Objectives for the Study....57
Theoretical Foundation of the Methodology 58
Design as Epistemology....58
Reflexive Approach 59
Constructivist Approach 60
Participatory Design Approach....61
Brief Overview of the Study Design....63
Methodologies....63
Methods....64
Case Study 64
Classroom Inventories 65
Photo Ethnography....66
Behavioral Mapping....68
Semi-Participant Observations....69
Validation Discussions....71
Drawing Activities 72
Critique Groups....74
Creative Methodology 75
Creative Methods 75
Process Documentation....76
Design Visualization....76
Product Design....77
Ethical Obligations....85
Sharing Information 85
Timeline 85

IV. RESULTS....87

Case Studies....87
Observed Actions....87
Arrangements and Inventories 98
Behavioral Patterns 98

Drawing Activities 99
Design Process 102
Observations and Sketches 103
Schematic Design 103
Design Development Phase One 110
Prototype Construction Phase One 111
Design Development Phase Two 114
Prototype Construction Phase Two 117
Photographs and Visualization Phase Two 122
Design Critique 125
Design Development Phase Three 126
Prototype Construction Phase Three 134
Photographs and Visualization Phase Three 141
Future Explorations 143

V. CONCLUSIONS 148

Design Relationships 148
Participatory Design 149
Challenges 150
Future Studies 150
Designing for and with Children 151

REFERENCES 153

APPENDIX A. CONSENT FORMS 162

APPENDIX B. EXISTING CLASSROOM FURNITURE 182

APPENDIX C. SEMI-PARTICIPANT OBSERVATION ANALYSIS 187

APPENDIX D. BEHAVIORAL MAPS 189

APPENDIX E. STUDENT DRAWING ACTIVITY AND ANALYSIS 194

APPENDIX F. PROGRAM DOCUMENT 204

APPENDIX G. FOAM PROTOTYPE CONSTRUCTION 213

APPENDIX H. FOAM PROTOTYPE PHOTO SHOOTS 219

APPENDIX I. WOODEN PROTOTYPE CONSTRUCTION 227

APPENDIX J. WOODEN PROTOTYPE PHOTO SHOOTS 233

LIST OF FIGURES

Page

Figure 1.1. Plywood School Chairs in Frisco Kramer Style.....5

Figure 1.2. School Desk by Jean Prouve 5

Figure 1.3. Bertier Desk.....6

Figure 1.4. Passive Classroom Arrangement.....6

Figure 2.1. Active and Passive Learning Model.....16

Figure 2.2. Twelve Senses for Child Development 19

Figure 2.3. Diagram of Divergent and Convergent Thinking.....21

Figure 2.4. Field of View in a Passive Learning Environment.....23

Figure 2.5. Tools for Children to Understand Environmental Awareness 30

Figure 2.6. Environment of the Reggio Emilia School.....32

Figure 2.7. Despecialized Objects 46

Figure 2.8. Chair ‘2000’ Redesigned for Improved Ergonomics 49

Figure 2.9. Mismatch of Furniture.....50

Figure 3.1. Sample Photograph of a Case Study Classroom 67

Figure 3.2. Example of Behavioral Maps 69

Figure 3.3. Sketches from Observations.....71

Figure 3.4. Design Process Diagram.....78

Figure 3.5. Schematic Design Phase Blocks.....80

Figure 3.6. Small Scale Classroom Model.....80

Figure 4.1. Photograph of Classroom Furniture After Clean-up 91

Figure 4.2. Bins Holding Supplies in the Classrooms 92
Figure 4.3. Example Diagrams of Inhibited Views 94
Figure 4.4. Behavioral Maps of All Case Study Classrooms 99
Figure 4.5. Student Drawings 100
Figure 4.6. Student Drawings Showing Improvements 101
Figure 4.7. Student Drawings Showing Movement 102
Figure 4.8. Sketches from Observations 103
Figure 4.9. Schematic Sketches 104
Figure 4.10. Silhouettes of Initial Blocks 105
Figure 4.11. Initial Blocks in Classroom Model 105
Figure 4.12. Preliminary Digital Models 107
Figure 4.13. Model A Digital Renderings 107
Figure 4.14. Model B Digital Renderings 108
Figure 4.15. Model C Digital Renderings 109
Figure 4.16. Model D Digital Renderings 110
Figure 4.17. Revised Classroom Products 111
Figure 4.18. Small Object Foam Prototypes Phase One 112
Figure 4.19. Large Object Foam Prototype Phase One 113
Figure 4.20. Process Images of Large Object in Foam 114
Figure 4.21. Sketch Models 115
Figure 4.22. Testing of Dowels on Small Foam Object 117
Figure 4.23. Construction Process of Final Small Foam Prototypes 118

Figure 4.24. Construction of Final Large Foam Prototypes 119

Figure 4.25. Final Foam Prototypes.....120

Figure 4.26. Removable Bins.....121

Figure 4.27. Small Scale Models of Prototypes.....122

Figure 4.28. Samples of Furniture Arrangements.....123

Figure 4.29. Digital Renderings of Foam Prototypes 124

Figure 4.30. Child Modeling Products.....125

Figure 4.31. Small Wooden Frame Models 127

Figure 4.32. Digital Models of Ribbed Structure 128

Figure 4.33. Digital Models of Ribbed Products 129

Figure 4.34. Small Study Models 129

Figure 4.35. Small Model Process for Assembly 131

Figure 4.36. Removable Surface Renderings 132

Figure 4.37. Removable Bin Renderings.....133

Figure 4.38. Photograph of Varying Material Thickness 134

Figure 4.39. Small Object Cardboard Prototype.....135

Figure 4.40. Joints and Labeling for Assembly 136

Figure 4.41. Large Object Cardboard Prototype.....137

Figure 4.42. Revisions to Edges 137

Figure 4.43. Small Object Prototype Assembly.....138

Figure 4.44. Large Object Prototype Assembly.....138

Figure 4.45. Revisions to Final Prototype 139

Figure 4.46. Removable Surface.....140

Figure 4.47. Removable Bin.....141

Figure 4.48. Final Products in Classroom.....142

Figure 4.49. Sample of Possible Configurations.....142

Figure 4.50. Product Use Photographs.....143

Figure 4.51. Color Studies.....145

Figure 4.52. Examples of Additional Accessories Used with Products.....146

CHAPTER I

INTRODUCTION

Designing a product is designing a relationship.- Steve Rogers

As a designer and a student, I respect and understand how the environment can shape the learning experience. I feel a need to examine the educational environments used today especially with the continual interest in designing developmentally-nourishing spaces. With an understanding of the benefits of user-based design, I recognize the importance of identifying a specific user's needs while seeking their input. This knowledge of the user and their insights can be attained through direct participation.

The focus of this research is to develop a new type of furniture for use in the early elementary classroom that allows for divergent forms of child/object interaction. The design of the learning environment has been continually under-valued with its potential positive effect on occupants (Knirk, 1979; Wannarka & Ruhl, 2008). In the early elementary classroom, specifically first and second grade, the students focus on developing reading, writing, and math skills as well as the enhancement of cognition and socialization skills within a developmental period known as middle childhood (Gestwicki, 1999; Kellert, 2005). Formal education begins in first and second grade, making these years important for establishing basic learning habits.

While children are being introduced to new topics in the first and second grade, they also are beginning to develop learning styles that are not only unique to each student but also for each task. Periods of educational reform have marked the emergence of exceptional educational philosophies that embrace the different ways in which children learn, examined by individuals such as Dewey, Steiner, and Montessori (Lim, 2004; Burke & Grosvenor, 2008). Their ideas, although with some overlap, vary greatly in regard to approaches to learning mirroring the variety of learning styles and thinking styles present in young learners.

Differences occur within structures of first and second grade academic programs in areas such as teaching styles and methods, learning styles, school organization, subjects, and academic policies. Despite these differences, the classroom furnishings used continue to fall within the same general typologies. These general typologies can be defined as a combination of a chair and desk, and a chair and table, along with the kidney bean table, and study centers. Through exploration and attention to the different learning styles, the classroom as educator, and child development, in conjunction with design development, a more appropriate typological response can be created.

Participation by children is a vital aspect in designing child-responsive environments and objects. This process is effective when conducted in a planned and attentive manner (Burke, 2007). Participatory design is used to better inform user-based design research and, more specifically, child-based design research. Carefully incorporating participation with children along with the in-depth observation of children

in educational environments provides the information necessary to better design classroom furniture to benefit a student's cognitive and physical development.

Purpose of the Study

In evaluating the current discourse surrounding elementary classroom and furniture design, there is a clear need to develop spaces and products that can be used to create a more active learning environment to foster cultures of independent thinkers and moments of interactive learning (Salmon, 2008; Strong-Wilson & Ellis, 2007). In recognizing the variety of learning styles and the imaginative capacity of children, more flexibility in furnishings may benefit all types of learners in the classroom. By treating the classroom and objects as a Third Teacher, the furnishings can be used to further develop language and divergent thinking, in addition to physical development and social development (Tarr, 2001). Through adopting a participatory design approach to develop a new type of classroom furniture, there are greater opportunities to build a body of knowledge around product design and user-based design involving the childhood experience in the school setting. This knowledge, along with process, contributes to the creation of more viable options for providing children with interactive learning environments. The process documentation produced through this investigation will extend the understanding of how interior product designers should design for and, more importantly, *with* children.

Justification of the Study

There is today a clear trend in classroom design towards utilization of passive learning environments (Kowaltoski, Fihlo, Labaki, Pina, & Bernardi, 2004; McGrath-

Speaker, 2001; Burke et al., 2008). Despite the efforts of educational reformers, classroom furniture has remained within a historically-determined typology. Passive environments send the message that learning occurs best in a structured, forward facing manner rather than through independent exploration and through interactions with the environment. The furniture available for classroom environments is designed to manage and support the rigid upright posture rather than the support of cognitive development or divergent thinking (Burke et al., 2008; Panagiotopoulou, Christoulas, Papankolaou, & Mandroukas, 2004).

Beginning with the first public schoolhouses, school design has been limited to a passive nature (Burke et al., 2008). Efforts to experiment with the design of objects used in the classroom were undertaken by Modernists such as Kramer in the 1920s, continuing with Prouve, Lindau, and Lindekrantz, and more recently with Berthier (Burke et al., 2008). These experimentations led to new designs; however, all remained within already existing types of current school furniture, experimenting largely with materials and ergonomics rather than function and affordances (see Figure 1.1, Figure 1.2, & Figure 1.3).

Figure 1.1. Plywood School Chairs in Frisco Kramer Style. Adapted from Vintage School Chairs by Vintage Furniture & Design Studio. Retrieved from http://www.fuseinteriors.ie/blog/vintage-school-chairs.

Figure 1.2. School Desk by Jean Prouve. Adapted from School desk | Wright by Architonic. Retrieved from http://www.architonic.com/dcsht/school-desk-wright/4107044.

Figure 1.3. Berthier Desk. Adapted from Ozoo, Par Le Maître De Plastic Kids Furniture, Marc Berthier by Allen (2010). Retrieved from http://daddytypes.com/2010/10/20/ozoo_par_le_maitre_de_plastic_kids_furniture_marc_berthier.php

The dominance of passive classroom furniture types echoes the dominance of passive learning environments in typical North American classrooms. The assumption behind the existence of passive furniture and the typical row arrangements is that children learn and behave best in this forward facing scenario (Knirk, 1979, see Figure 1.4).

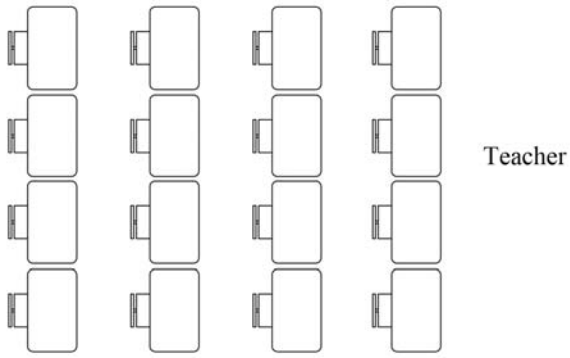

Figure 1.4. Passive Classroom Arrangement

However, the discourse surrounding education and learning supports the theory that students are naturally predisposed to different learning styles and not all learn effortlessly through formal, teacher-directed instruction (Fleming & Mills, 1992). Many students struggle with sitting for long periods of time to receive verbal instruction from a teacher (Gestwicki, 1999). Through the introduction of flexible classroom furniture, students may acquire an understanding of how environments can modify behaviors. Through this practice, students can be given the opportunities to modify their individual behavior and to take a more active role in their own education.

Imaginative Thinking

Vygotsky's theory of imaginative thinking involves the combination of two cognitive behaviors: past experiences and imagination (Eckhoff & Urbach, 2008). In one study illustrating Vygotsky's Law pertaining to creating products, it was demonstrated that children had the ability to imagine products and create them in their minds. This study further emphasized the imaginative abilities of children through participatory methods and through the produced object(s), which ultimately enables the imaginative process of children to be interpreted and expressed through learning, creating, and socializing.

Third Teacher

The "Third Teacher" philosophy, developed in the village of Reggio Emilia, advocates viewing the built environment as an active educator (Tarr, 2001). The classroom is used as a learning tool and seen as a unique environment that engages the child and supports such activities as language development and cognitive thinking.

As such, the schools' curriculum and environment involves a cycle of design, documentation, and discourse (Strong-Wilson & Ellis, 2007). The emphasis is on the process of education and opportunities to learn rather than the finalization of a product.

This ability to learn from and with the environment requires an emotional and physical connection between student and their surroundings (Eckhoff & Urbach, 2008). The early years are the most valuable for the development of aesthetic appreciations due to the utilization of senses during the processes of exploration and meaning-making (Lim, 2004). With the use of multiple senses children undertake the processes of assigning value or associations to things and experiences that influence their individual 'ways of knowing.' Accordingly, learning takes place when there is a relationship between the body and movement, or in other words when the body is in movement. Thus, through allowing movement in the classroom, there are greater opportunities presented for aesthetic and sensual learning, along with cognitive, physical, and social experiences.

Affordance

The stimulation of a child's emotions and creativity is heavily influenced by the efforts and actions of adults (Chak, 2002). Adults, commonly recognized as the gatekeepers to children's worlds, are responsible for assisting or hindering a child's curiosity. Through developing an understanding of affordances, designers can provide children with environments and products that challenge their abilities and provide risks that advance the child's development (Gibson, 1979; Kytta, 2006). There is a delicate balance between mundane and confusing design that must be reached within these environments and products. By understanding children's abilities, designers can move

away from relying purely on traditional typologies and can explore their capabilities and affordances presenting the user with occasions to dictate the function of an object that was not created to instill the form or purpose of typical furniture (Carreau & Pelletier, 2004). The decisions in designing then are based on the abilities, creativities, and past experiences of a child and are dependent on perceived affordances in the form and surfaces of the object.

Participatory Design

To further understand how children perceive environments, researchers and designers utilize participatory design processes in designing children's environments and furniture (Burke, 2007; Penrose, Thomas, & Greed, 2001). Students have insights to offer from their experiences that can be presented during a participatory research process, leading to the discovery of what matters to those children in their everyday interactions (Burke, 2007). Students have been exposed to participatory design through three main types of participation methods including: 1) participation in planning, 2) giving advice, and 3) free expression (Rossi & Baraldi, 2009). These methods can be manifested through one activity or a series of activities such as art projects and group discussions. Using the three main types, valuable data is collected that identifies children's voices and characterizes their thoughts. The environments and products designed through participatory efforts respond to the needs recognized by the users rather than simply depending on personal experiences of the designer that may stem from stereotypical assumptions or misrepresented information (Charmorro-Koc, Popoviv, & Emmison, 2009).

Using a participatory approach the children that participated in this study took on the role of subject rather than object (Christensen & James, 2000). The intention of this study was not to construct a final design solution but to consider how the design process for school furniture should be and in doing so propose one potential design using that process (Hayes & Oppenheim, 1997). The attributes of participatory design research enable the researcher to both document and respond to the experiences of the participants in order to apply the information obtained to the creation of an appropriate design response.

Research Questions

The primary research question for the study was: *What new types of furniture can be developed for the early elementary classroom to support active learning?* In order to address this question, the researcher first examined the following sub questions:

1. What are the physical relationships between the students and the existing classroom furniture?
2. How does a user-based design approach affect the process and outcome of designing classroom furniture?
3. What does participation from the user group offer the design process?
4. What elements of the design of classroom furniture are viewed as most important by stakeholders?
5. What aesthetic and functional elements can be adopted to create a new type of furniture that allows for active interactions?

Research Procedures as Objectives for the Study

The procedures of the study as objectives were to:

1. Conduct a critical review of literature on the educational environment and its effects on learning and behavior, child development and child needs, and the process of designing *with* children as an appropriate framework for the study.
2. Conduct a critical review of methodologies as part of the development of an appropriate research strategy for this study.
3. Work with participants to implement the research using case studies, semi-participant observation, validation discussions, and behavioral mapping.
4. Document the case study classrooms using photo ethnography, written observations, sketches, and inventory studies.
5. Analyze the information collected from the case studies.
6. Conduct the drawing activities. Work with participants to examine and interpret the drawings created in the drawing activities in relation to the purpose of this study.
7. Conduct a design process synthesizing the collected information and design a series of products in response. Incorporate the assistance of undergraduate student, Laura Snoderly.
8. Critique furniture produced during the design process and revise final prototypes.
9. Conduct final analysis of results. Write final documentation.

Assumptions and Limitations

This study focused on the classrooms and participation from first and second grade at a Guilford County School in Greensboro, NC. Utilizing a mix of quantitative, qualitative, and creative methodologies, participants were given the opportunity to express their ideas and individual interpretations during the preliminary drawing activities and discussions, along with product presentations. The result of this study are not intended for generalization but rather to gather a collect of experiences and interpretations of the interactions between participants and the first and second grade classroom environment and use that information to develop new types of furnishings for the classroom. It can be assumed, however, that there will be implications for other classrooms and like environments, along with applications for participatory design processes.

Summary

This study provided a framework to explore the interactions and experiences that occur within the first and second grade classrooms by students to answer the question: The primary research question for the study was: *What new types of furniture can be developed for the early elementary classroom to support active learning?*

Definitions

Typology – a classification of products according to shared characteristics

Learning Environment –Built environments specifically for learning and educational purposes

School Stakeholders – Those who have an immediate and direct relationship with the learning environment, particularly students and teachers

Third Teacher – Philosophy developed in the Reggio Emilia Schools to treat the environment as the third actor in education, equal in importance to the teacher and student

Participatory Design – A design approach that involves the end-user being involved in the research and design process

User-Based Design – A design approach that considers the experiences, values, and abilities of the end user and is not solely driven by the designer's experiences

Visual Voices – The language and interpretations of a user in relation to their visual and tangible surroundings (Burke, 2007)

Affordance – the visual perceptions an individual makes based on their physical abilities, past experiences, and cognitive understandings about what an environment or object will allow them to do

Despecialization – the process of creating an object that is read as surfaces and a form that the user determines the purpose of based on their individual perceived affordances

CHAPTER II

REVIEW OF LITERATURE

The Way Learning Looks

Both education and design concern the practice of envisioning the future. While design allows for the prediction and anticipation of human interactions with an object, space, or product, the discipline of education requires the prediction of the future thinking practices for which children are educated (Robinson, 2006). Beginning with the first public schoolhouses, the majority of school environments and, consequently, furnishings found within were limited to passive configurations and construction (Burke & Grosvenor, 2008). It was during the mid-century modernist movement that the focus of school design shifted "from monumental to functional design," demonstrating the transition "towards recognizing the scale at which children operate" (Burke et al. 2008, p. 19). Designers, architects, and educational reformers began to examine the school environment to determine where improvements could be made, studying closely the mechanisms by which children think, learn, and develop.

Passive and Active Learning

A profusion of theories concern the distinct practices by which children in first and second grade classrooms learn new ideas or deepen their understanding of those they have already acquired. *How* children learn is often more important than the specific

information that children are learning especially in regards to the design of the educational environment (Sternberg, 2003; Stokols & Krovets, 1977). During the early years of education the habits of learning are established and children develop their ability to recognize the types of environments where learning takes place and how learning looks. These physical associations with environments for learning instill a lasting relationship between the process of learning, learning activities, and student positions.

Learning activities presented in an elementary classroom may be characterized as either passive or active, although in some cases both activities exist (Knirk, 1979). Passive activities are those directed by a teacher, wherein the teacher "selects, organizes, and transmits instructional stimuli to a receptive but relatively physically inactive student [audience]" echoing an unresponsive surrounding environment (p. 15). The original trend of passive learning, which monopolized the traditional North American elementary school, influenced the educational consumer demand for traditional, static furniture and fixed layouts for a classroom which continue to populate the furniture available. On the other hand, active learning activities are those used to help students to learn and understand by doing and participating involving high levels of independent movement (Knirk, 1979). In comparing active learning and passive learning, the difference is in the higher number of learning sources and opportunities for socialization and interaction in an active learning environment from teachers, classmates, and the environment (see Figure 2.1). Through exploring and investigating the benefits of active learning, educational reformists have continually advocated this type of education; however, this form of learning is still hindered by the continued dominance of passive classroom

environments, available educational furniture, and the standardization of teaching and learning requirements (Burke et al., 2008).

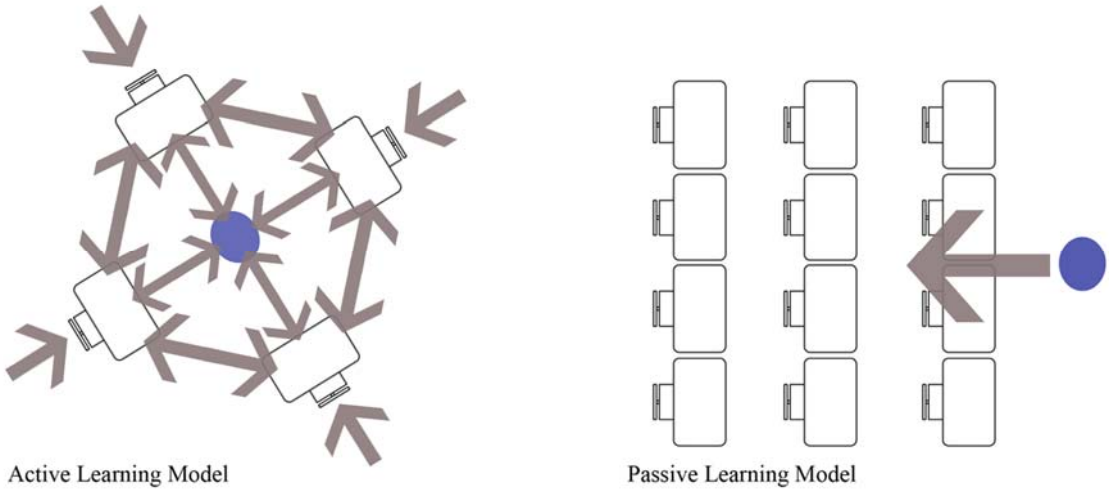

Figure 2.1. Active and Passive Learning Models

In the discourse surrounding a shift from passive to active learning in early elementary classrooms, a distinction is observed in the difference between accepted adult learning methods and child learning styles. These differences are characterized by variances in basic language development, emotional development, aesthetics, and cognitive development, along with physical development and social development (Winick, 1974; Lim, 2004; Klevberg & Anderson, 2002). Children interact with the world and think about the world differently than adults and, for this reason, the approach to elementary furniture design should reflect this distinction. For example, language development in children is advanced through high levels of social interaction in the form of spoken and written words and, at the same time, physically building or working

together (Lim, 2004). Through large quantities of social interactions children develop linguistic sophistication and enhanced empathetic capabilities. This approach to active social learning manifests through both verbal socialization but also unspoken interactions associated with body movements and observations. The Vygotskian framework for social learning states that non-verbal learning consists of four factors: “personal experience to expand imagination, others stories to expand our imagination, the importance of emotional learning, and imagination in product creation” (Eckhoff & Urbach 2008, p. 180). The impact of these factors has been demonstrated in the classroom through the practices of child story-telling and craft projects. Through these practices, primary patterns and themes demonstrate a circular process of imagination, in which a child’s reality causes the development of a product in the mind. These mental images are then expressed in physical form through a story or drawing and the idea thus becomes a reality which enables the process to continue through the inspiration of more ideas. Children’s learning in social and interactive situations can be stimulated by the demand for creativity and by organizing “their life and environment so that it leads to the need and ability to create” individually and in conjunction with the world and people around them (p. 184).

Emotions in Learning

In addition to the value of socialization in learning for children, Vygotsky recognized the power of creativity in enhancing learning in the classroom through the use of varying emotions (Lindqvist, 2003). With the introduction of emotions into the learning environment, there exists an occasion for multifarious levels of creativity and more opportunities for students to refine their cognitive skills and thought processes (See:

Lidqvist, 2009; Russ & Kaugars, 2000; Burke et al., 2008). When the learning environment is designed for emotional interactions such as delight, sensibility, warmth, and passion, students benefit from diverse connections with their senses and development of personal experiences. The design of emotional environments engender "a renewed interest in physiology and neurology in relation to the learning process, which is reflected in an interest in designing learning environments that mirror…the ways that memory works, individual learning styles and the mechanism of brain function" (Burke et al. 2008, p. 166). Environments that provoke an emotional response engage the senses of a child. Kellert (2005) described the maturation of emotional interaction and sophistication through a five stage process: 1) receiving, 2) responding, 3) valuing, 4) organization, and 5) characterization by a value. Receiving begins with the senses through stimuli, which arouse a reaction. The act of valuing is then subjective and results in a personal organization and ultimately a definition is given and an association is developed with the experience. Although this process is discussed in relation to the outdoor environment, the process may be recognized in interior spaces in the relationships between a child and their environment, be it living or non-living.

Aesthetics

When introduced to environments that immediately incite a response, young students undergo aesthetic experiences through interactions with visual and physical stimuli. Children differ from adults in their conceptions of aesthetics and creativity (Lim, 2004). Rather than seeking aesthetic explorations in purely constructed environments, such as a museum where art has been isolated and classified as art, children identify and

feel fascination and wonder in everyday objects. Accordingly, children are more receptive to everyday aesthetics and wonderment neglected and bypassed by adults. Children are credited with the use of not five but twelve senses that enable them to explore their worlds (see Figure 2.2; Lim, 2007; Day, 2007). These senses relate to not only the basic cognitive senses identified by most adults but also their will and feelings (Day, 2007).

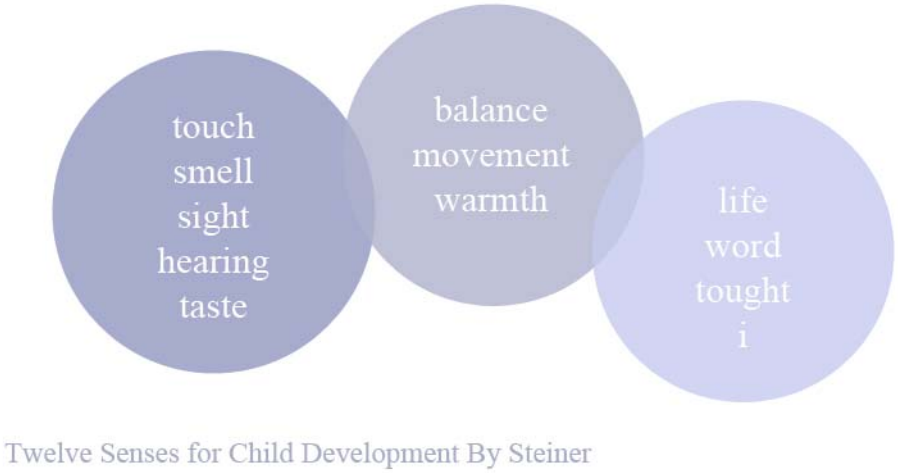

Figure 2.2. Twelve Senses for Child Development

In providing educational environments that engage the senses, the decline of senses used later in learning is limited because they will have been habitually used in thought patterns established early in life (Lim, 2004). This incorporation of senses and aesthetic appreciation is vital in young children because "[a]fter the age of eleven the

‘creative power’ in most children ‘becomes dormant’ and the ‘power of appreciation’ becomes dependent on specialized teaching” (Grosvenor 2005, p. 517).

Thinking and Learning Styles

When students are taught in ways that are natural and complimentary to their individual thinking processes they demonstrate higher achievement (Sternberg, 2003; Gestwicki, 1999). Numerous learning styles and theories of intelligence aid in understanding how children acquire the information that allows the creation of knowledge. Acknowledging these differences among students and understanding how differences in learning styles can be addressed may be manifested through positively modifying the learning environment to compliment various styles. Thinking in the classroom is broadly classified into two forms: convergent and divergent (see figure 2.3; Sternberg, 2003). The processes for convergent thinking are not the same as those used for divergent thinking. Convergent thinking is the generation of thoughts in relation to already established answers to previously asked questions. Convergent thinking is often associated with standardized testing wherein only one answer is correct. Divergent thinking offers the opportunity to develop new answers to new questions. Practicing divergent thinking in the classroom requires acknowledgement of existing knowledge, individual thinking styles, mixed personalities, personal motivations, and the environmental context (Sternberg, 2003). These components point to the concept that intelligence cannot be measured or even captured in a single context but instead is based on the individual and their context. When variables are introduced into education

assessments and thinking challenges, different thought processes and thinking strategies materialize through the concept of successful intelligence.

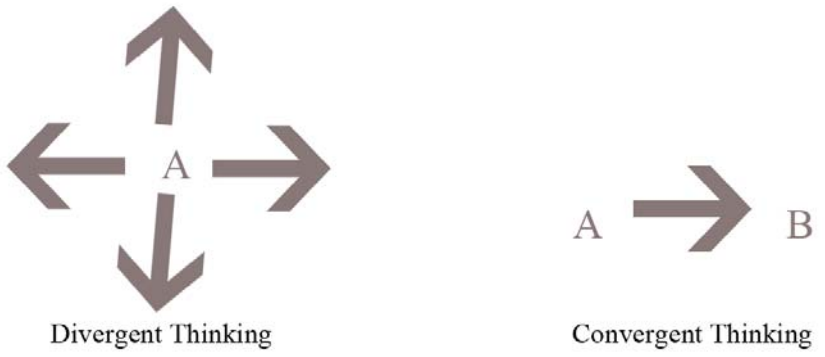

Figure 2.3 Diagram of Divergent and Convergent Thinking

Just as thinking can be demonstrated differently, learners respond to information differently based on the presentation of that information (Fleming & Mills, 1992). Teachers often experience difficulty when matching their desired teaching style to a student's learning style because of the diverse range of learning styles exiting in a single classroom during different activities. Shifting that burden of differentiation to the student both allows for that variation and empowers students to discover their own learning styles. Students can use that experience to take an active role in their education. This builds the skills necessary to become life-long learners, in other words, people who both value education outside of school and know how to engage in the processes of self-teaching. By challenging the misconception that the school culture benefits most when the environment is designed around standardization or a particular teaching method, the

focus can now shift to designs that enables teachers and students alike to shape their environments, behaviors, and perceptions of learning.

Cultures of Thinking

As teachers and constructors of the educational environment, adults have the responsibility of cultivating "a culture of thinking in young children [through] implementing thinking routines" (Salmon 2008, p. 457). Thinking routines are presented during visualization exercises to aid students in portraying and envisioning their own thought processes. This can be manifested through physical, oral, or mental form. An objective of these routines is to create "places in which a group's collective, as well as individual, thinking is valued, visible, and actively promoted as part of the regular, day to day experience of all the group members" (p. 458). The aim of these exercises are for students to experience ownership of their thinking when it occurs in a visual or physical medium and patterns of learning are clearly presented to them. When exposed to the process of visualizing and considering their thinking, they begin to make deeper connections with their own thought processes that can manifest in multiple medium (Prosser, 2007).

It is not only beneficial to partake in thinking routines in a single moment but equally important to instill a practice of greater effort in thought retention through the use of multiple senses during activities, this enables improved retention of information (Salmon, 2008). During the stage of Middle Childhood, ages 6 to 12, children gain a sense of empathy and others. Through engaging students to not only think about their own thought process but those of their peers, children's cognition and comprehension can

be further improved and understood using a manipulation strategy theory (Glenberg, Brown & Levin, 2007). In children ages 6 to 8, manipulation leads to better memory due to the incorporation of multiple senses. An overwhelming difference is presented in memory retention during reading/manipulation activities and purely reading activities in favor of the manipulation activity wherein participants achieve higher memory retention. This idea of learning from doing, experimenting, and observing is exercised in the active learning approach while the passive learning approach remains fixed on the structured, convergent thinking method. This ability to see what other students are doing is prohibited in a passive arrangement with fixed surface heights and standard arrangements (see Figure 2.4), limiting learning opportunities that may stem from manipulation and observation.

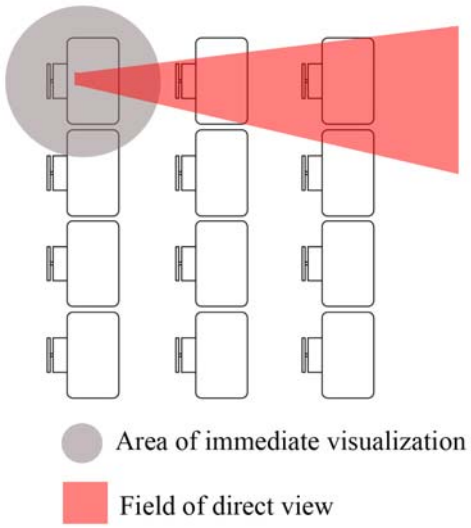

Figure 2.4. Field of View in a Passive Learning Environment

Shifting from a convergent to a divergent approach in education causes a shift in focus from a retrospective perspective to a prospective concept (Eckhoff et al., 2008; Lindqvist, 2003). While it is important to look to the past, the answers should be found in the future. By cultivating learning environments that support imaginative, progressive thinking, the next generation of thinkers adapts divergent, creative approaches. In discussing a divergent approach, art is an example that combines both creativity and aesthetics to foster imagination. The method of introducing art into the classroom has been achieved successfully when presented through a divergent approach by encouraging abstract thought and embracing subjective solutions rather than looking for one particular outcome (Winick, 1974). When the goal of education shifts from the production of a specific object, the pressure for perfection and restriction associated with convergent thinking is alleviated and the concept of working for a process rather than a specific product becomes the focus.

Classroom and Behavior

The classroom visually communicates with its users and occupants through scale and proportion creating either an inviting space or prohibitive environment (Knirk, 1979). A hard-surfaced, formal, mechanistic environment sends a message that the student is a passive agent and "[t]he environment thus becomes intimidating and destructive rather than encouraging and productive. Attitudes towards schooling often are different where the furniture is soft and the student is encouraged to actively promote his or her own schooling" (p. 22).

Hidden Curriculum

The ability for the environment to shape behavior has been identified through the idea of the hidden curriculum in that "[t]eachers' and pupils' everyday behaviours shape and in turn are shaped by school culture which is manifested visually in the built environment as well as the patterned behaviors that constitute social structure" (Prosser 2007, p. 16). This comes as no surprise given the long researched relationship between the built environment and human behavior. Among these factors, that contribute to the overall effectiveness of the classroom environment, are air quality, color, noise, density, and environmental awareness (Horne Martin, 2006). When appropriately addressed the classroom serves to "foster personal identity, encourage the development of competence, provide opportunities for growth, promote a sense of security and trust, and allow for both social interaction and privacy" (p. 92). The arrangement of the classroom has a monumental influence on children's recognition of where and how learning takes place, in addition to socialization. When the learning environment is carefully planned and equipped with the proper furnishings, developmentally appropriate learning is supported. This is evident in elements such as lighting that can "affect a child's behavior, cognitive performance, and visual fatigue" through reflectance, lighting levels, and distribution of lighting determining how a child perceives that space and the presented aesthetic qualities (p. 97). The effectiveness is also witnessed in material selection, relating to air quality, touch, and trust in their ability to identify their surroundings (Day, 2007).

Regarding student and teacher performance within a learning environment, "two major interacting elements [exist] in a classroom that will either strengthen or limit the

environment's contribution to education: architectural facility and arranged environment" (Horne Martin 2006, p. 93). Even though an educator's influence over the architectural aspects of an educational facility may be minimal; the environmental arrangement is invariably established by the teacher. The classroom arrangement conveys signals regarding expected behaviors and relationships. In comparison to standardized testing, technology, and curriculum, the immediate environment has rarely been examined in order to recognize its role in misconduct or behavioral excellence of its student occupants. Simply turning furniture or re-directing pathways, creates opportunities for new patterns of learning and behavior.

Through embracing the power that "spatial organization" may have over behavior, teachers may take advantage of the belief that a rooms "arrangement is more than a casual responsibility or a matter of aesthetics, because spatial organization influences so many behaviors" (p. 94). Through understanding the hidden curriculum displayed by the environment, objects within that environment, and the arrangement of those objects, educators and designers establish a set of signals that act to support or hinder learning, as well as, their roles in participation and leadership (Prosser, 2007; Knirk, 1979). Student participation level has been shown to be correlated to the location in which a student sits in a classroom, with students either at the front or middle of an arrangement of furniture taking on the leadership positions and being a more vocal participant within the classroom discussions (Knirk, 1979). By altering the arrangement periodically and permitting movement in the classroom, students in the class may realize a number of different roles and can explore their "participation patterns" (p. 128).

Modifying the Environment

Studies have shown that minor changes to a classroom's layout can produce predictable changes in student behavior (Weinstein, 1977). Spatial patterns of behavior were observed in the second and third grade classroom environment prior to the modification with acknowledgement of physical features such as absence of "windows, aesthetic quality, furniture arrangements and interior design" (p. 249). The results both supported and disproved the hypothesis in that some of the modifications resulted in the predicted behaviors while other discouraged involvement. This lack of involvement was witnessed in a private reading space that was created in the corner of the modified classroom with very few children using this area during the observations. The vacancies were speculated to be caused by the simple fact that the private space was too private and children did not want to be visually separated from the other members of the class. As a result, this study demonstrated that the physical and symbolic meanings of a classroom can be examined and changes can occur that do not disrupt the learning environment but rather improve it. The immediate environment that surrounds an individual can either encourage or hinder involvement. In a classroom this involvement or seclusion directly affects patterns of learning. The ability to make even minor changes in the environment can change patterns of learning and interactions affecting students' development in socialization.

Environmental Awareness

Not only is it viable to recognize the effects of classroom modification by an adult researcher or educator but also to encourage an emphasis on instilling the practice of environmental control in a student, more specifically a young student. Children may be entrusted with the understanding of how environments can be adaptable to suit a variety of their perceived needs. Equally important is the practice of educating children about their environment through Environmental Education (EE; Kowaltoski et al., 2004). Information and teaching methods have been aimed at educating children about the built environment and the comforts that an environment, specifically one in which learning takes place, can afford. An occupant may react to an uncomfortable environment in one of two ways: 1) environmental numbness or 2) environmental awareness. When reacting with environmental numbness an occupant exhibits indifference towards the objects and environment and in result "will rarely display an attitude to an unpleasant environment" (p. 20). This signifies a lack of understanding in environmental control, creating a passive environment in terms of comfort, interaction, and learning. On the other hand, when reacting with environmental awareness a user will display an "active perception" of their surroundings and engage with the environment (p. 20). When a user acts with environmental awareness a cooperative effort is expressed between that user and the environment through a non-verbal beneficial interaction.

In an effort to understand environmental awareness, the false understandings about ways to establish comfort can to be discredited by designers (Kowaltoski et al., 2004). An investigation was conducted to test the child's understanding of environmental

controls and determine truths and falsehoods. Through the use of a post occupancy study evaluation, a questionnaire, and a booklet, it was demonstrated that aspects of comfort levels and controls can be taught to students in the first and second grade. The teaching material illustrated a range of topics presented in the form of a take-home activity booklet (See Figure 2.5). By establishing a relationship with the idea of environmental comfort, occupants can express themselves and, in the case of a child, can begin to not only understand their own comforts but establish the ability to notice the comforts of those in their surroundings. This acknowledgement of personal comfort and group comfort points to the notion that "[e]nvironmental comfort is important for social development" (p. 22). In review of the study, although focused on the environment, little information pertained to the furniture in the environment, which are the elements that a child-user would have the most control over in a situation occurring in the classroom and the most direct contact with. Through empowering children to modify the environment and understand how these modifications affect behavior, they are building the knowledge needed to seek active relationships with their surroundings and engaging in socialization through physical acts (Day, 2007).

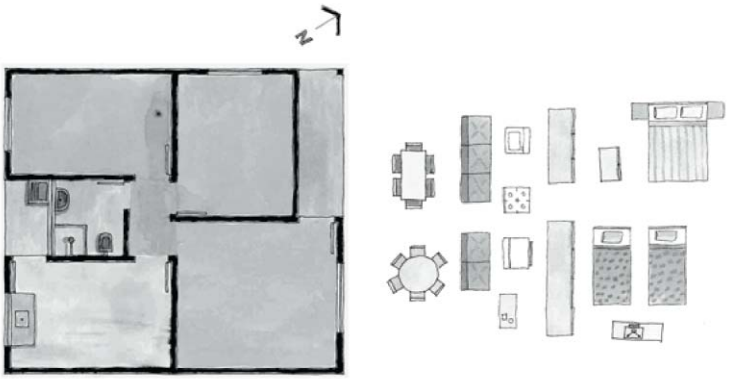

Figure 2.5. Tools for Children to Understand Environmental Awareness. Adapted from "Teaching Children About Aspects of Comfort in the Built Environment," by D. Kowaltoski, F. Borges Filho, L. Labaki, S. Pina, & N. Bernardi, 2004, *The Journal of Environmental Education*, 36, p. 28. Copyright 2004 by Heldref Publications.

Classroom Territory

Just as the environment communicates with daily occupants, the design and items selected for that environment "reflects the user of the room and provides insights into how the occupant would like others to behave" while in their world (Prosser 2007, p. 17). Through the practice of marking their territory, both teachers and students protect and acknowledge their areas and belongings that are of private use. Through specific spatial arrangements and modifications of the space, the relationships and expectations of the users are displayed to those outsiders who may enter the classroom.

Classrooms to Enhance Learning

Interactive Environments

Passive learning is the usual practice in the elementary classroom and the introduction of a more interactive and participatory environment has begun to enter the educational discourse surrounding school design (McGrath Speaker, 2001). The use of interactive exhibits found in children's museums act as a precedent for elementary

classroom design. Environments that offer opportunities for interaction are those that do so in an effort to "provide children with concrete learning activities" through developmentally appropriate actions using a variety of presentation styles specifically focused around hands-on learning (p. 611). When using an interactive model, children learn through direct experience which enables the development of cognitive skills such as "interaction- inquiry, reasoning, information organization, and translation" (p. 613). Through the application of interactive exhibit theory guided by the cognitive skills, "environments that stimulate higher order thinking" are presented for children's daily learning (p. 612).

Third Teacher Philosophy

Not only can classrooms be designed specifically to stimulate a child, they can also act as an educator. Under the Reggio Emilia philosophy the classroom environment is viewed as the Third Teacher (Tarr, 2001). The significance of this philosophy places an "emphasized role [on] the building, its interiors, textures, colours and dynamics, as 'the third teacher'" (Burke et al., 2008, p. 119).The classroom environment offers a unique encounter to create "meaning and make sense of their world through living in complex rich environments" (Tarr 2001, p. 36; see Figure 2.6).The environment is developed as a studio where children are encouraged to create and even use real tools intended for use with wood (Day, 2007).

Figure 2.6. Environment of the Reggio Emilia School. Adapted from "Aesthetic Codes in Early Childhood Classrooms: What Art Educators Can Learn From Reggio Emilia" by P. Tarr, 2001, Art Education, 54, p. 36. Copyright 2001 by National Art Education Association.

Eight principles are distinguished to utilizing the environment as Third Teacher: "aesthetics, transparency, active learning, flexibility, collaboration, reciprocity, bringing the outdoors in, and relationships" (Strong-Wilson et al. 2007, p. 41). These principles, when used in designing for children, compliment the developmental expectations associated with children in the first and second grade. Transparency in the learning environment allows for the child to develop an awareness of those around them. Through transparency children are afforded a sense of security and comfort with knowing their surroundings (Day, 2007). This is presented through multiple senses and created through attention to scale, materials, and lines of sight. Flexibility can be achieved through a malleable environment both physically and mentally, limiting an overwhelming attention to structure. Infusing change in the classrooms demonstrates that the surroundings are flexible and forgiving. With any active environment, collaboration is formed between the occupants and with the environment. Reciprocity represents a give and take

understanding present when participating with the surroundings. Through bringing the outdoors in, such as with the discourse surrounding nature and child development, opportunities are presented for greater moments of learning through language development, meaning making, and value in living things (Kellert, 2005). These relationships present between occupants, the environment, and education work in harmony to allow for spontaneous patterns of learning.

In examining the Reggio Emilia emphasis on process over product, there is constant focus on *how* things are done (Lim, 2004; Strong-Wilson et al., 2007). The Reggio Emilia School uses this technique to "focus on opportunities to learn, in addition to or even instead of learning outcomes" (Stuhlman & Pianta 2009, p. 324). This results in the use of the environment to capture and further highlight *what* they are learning as well as *how* they are learning and giving the students reign in creating their educational experience.

Educational Philosophies

Just as in Reggio Emilia, educational philosophers, such as Steiner, Dewey, and Montessori, understood the benefits of active learning practices for children and each engaged in educational reform by recognizing and prioritizing the needs of the child. The Waldorf educational philosophy, created by Steiner, focused on educating the whole child (Easton, 1997). By providing an active learning environment in which a child can develop their appreciation of aesthetics and spiritual understandings, a balance is struck between intellectual and artistic abilities. The Waldorf educational model constructs not only the curriculum but also the environment in keeping with child development, art and

academic experiences, and a collaborative effort between teaching styles and learning styles.

Similarly to the Waldorf approach, the Montessori philosophy utilizes a holistic belief that emphasizes aesthetic elements while encouraging the educator to step back and observe, thus allowing the child to direct their own learning (Mooney, 2000). Montessori revolutionized the educational environment through the introduction of child-size furnishing to suit the scale of the students. This realization of the importance of the environment resulted from Montessori's belief in the idea "that children learn language and other significant life skills, without conscious effort, from the environments where they spend their time" (p. 24). Organized and, more importantly, accessible environments therefore are shown to provide children with the platform to take responsibility for their own learning with movement and independence.

Resulting from his focus on the infusion of movement into the classroom curriculum and environment, Dewey was a dominant pioneer in educational reform. Dewey theorized the importance of the child's experience (Lim, 2004). Through his belief in the importance of a child's experiences, the primacy of aesthetics in the classroom is recognized, particularly in quotidian situations. Four impulses are acknowledged in the child's mental world: 'communicative', 'constructive', 'expressive', and 'inquiry' and when used by a child they become an active participant and explorer of their world (Lim 2004, p. 476). A child is ultimately a "doer before a knower" (p. 476). In understanding this explorative approach that children possess, Dewey embraced the

active learning method to education and development with the appreciation that children learn much about the world and themselves through movement and exploration.

Although these philosophies are revolutionary their impacts were curtailed as a result of the furniture available. With context having such an impact in the success of education, an educational philosophy can only influence the momentary learning opportunity to such an extent. In Montessori's search for suitable classroom furniture, she "carried out a vitriolic critique of the ubiquitous bench-table, suggesting that its use was an outward sign of pedagogic slavery" (Burke & Grosvenor 2008, p. 69). In her dissatisfaction with school furniture options, she resorted to making the materials used in the educational setting rather than purchase pre-made furnishings (Mooney, 2000). Furthermore, Dewey's efforts to provide appropriate desks and chairs resulted in a compromise due to the simple fact that suppliers failed to create furniture for creative actions (Burke & Grosvenor 2008). These philosophers, in their quest for appropriate furnishings, understood the effects that the right surroundings and tools would have on a child's education and overall behavior.

Design and Context

As the majority of "[c]hildren's experiences are limited to the places they inhabit… [adults] must pay close attention to the design of their environments" (Strong-Wilson & Ellis, p. 43). Adults, commonly recognized as the gatekeepers to children's world, are responsible for facilitating or inhibiting a child's curiosity through the design and construction of children's built environments (Chak, 2002). With parents and teachers being the adults that most children interact with on a daily basis, their

relationship with a child and understanding of that child's cognitive processes can set up either positive or negative interactions with the environment.

Stimulation

Adults are ultimately responsible for the design and resulting interactions that occur within a child's world through designing and managing most environments that children occupy such as classroom, playgrounds, public spaces, and domestic spaces (Chak, 2002). Children can be stimulated by an environmental experience in a number of ways. The level of stimulation a child experiences in an environment can be categorized through the framework of the Lewin Field Theory, which is used to evaluate momentary interactions between child and surroundings. The theory stresses the effect of context and continual temporal changes always surrounding an individual and the ability to evaluate a child's behavior based on their present attitude in comparison to the surrounding situation.

Instinctively children will look at an object and ask themselves what they can do with it (Chak, 2002). Three situation types are identified in the Lewin's Field Theory to evaluate a child's response to the environment and surrounding objects including 1) a positive stimulus situation in which the child finds the object stimulating and is able to grasp a product's ability through their own process of understanding, 2) a negative stimulus situation in which the child finds the object stimulating, although, after exploration the object appears to be beyond a child's understanding and anxiety sets in, or 3) a non-stimulus situation in which the child is not stimulated and bored by the object. The objective is to render spaces and products that challenge a child-user in an

appropriate manner as to not over complicate the interaction yet provide a higher level of risk and interest that keeps a child's focus. In order to accomplish this, children's abilities must be carefully understood to avoid a negative stimulus in avoidance of anxiety, which is a "known psychological force which hinders exploration" (Chak 2002, p. 78). In an effort to "arouse curiosity" the use of novel, yet complex objects are important elements in the process and planning of a classroom environment (p. 78). In accordance with Lewin's Field Theory, Day (2007) has proposed a process in which children engage with their environment through a progression of "trust, wonder, curiosity, control, and determination to change the world" (p. 18). A careful understanding of children's abilities will assist with appropriately providing positive stimulus environments and objects.

Affordances

An understanding of children's abilities can be attained through a familiarization with affordances. These are visual perceptions that a user makes based on "the different characteristics of the individual, such as his or her physical dimensions and abilities, social needs, and personal intentions" (Kytta 2006, p. 145). Once perceived, the practice of "actualized affordance" is put into play when a user engages in perceived activities with their surroundings successfully (p.145).

The way in which a child perceives a specific environment can be hypothesized through the theory of affordance (Gibson, 1979). An object does not have to be classified by type in order to perceive what a user could do with it. Instead a user can imagine what the object can allow them to do (Gibson, 1979). For example, a chair can be characterized as sit-on-able, stand-on-able, or jump-off-able. Other elements come into play when a

user begins to analyze, through visual perception, what they can do with the chair. If is it a small chair in comparison to the child, it may be deemed lift-able or move-able.

In describing how affordances can be classified in an environment, four types of child environments have been compared including 1) Bullerby, 2) wasteland, 3) cell, and 4) glasshouse (Kytta, 2006). Bullerby models are those most stimulating and physically accessible. These positive models are present when a multitude of affordances are perceived and *achieved* by a child occupant at a range of developmental levels. The other three models limit the relationship between visual perceptions and physical abilities. The cell type is a negative model in which a child occupant is unable to form a positive relationship with their surrounding environment due to restrictive elements. The wasteland model represents those environments which are perceived as dull while the glasshouse model is one in which give the appearance of an environment full of rich affordance; however, due to physical or supervised restrictions these affordances are unachievable by the child occupant. The question is raised as to the possibility of planning for a higher number of child-related affordances through the incorporation of children in the planning of these environments due to the various differences perceived in affordances between children and adults. Many of these differences are the result of differences in body sizes, particularly with furniture proportions.

The intentions of children are distinctly different than adults when using a space. Often children will use a space to explore and improve themselves (Day, 2007). In examining the differences between adult and child affordances, haptic and visual perceptions affect the differences in understandings and capabilities associated with

occupant's surroundings (Klevberg & Anderson, 2002). Haptic perception is that which relates to the sense of touch. With children still learning about their bodies and physical abilities, children often overestimate their physical skills. A comparison study enforced this overestimation, which favors the physical development of a child by constantly challenging themselves to achieve perceived affordances.

Playground as Precedence

Traditional playground environments and natural outdoor playscapes have been settings for interpretations and comparisons of possible affordances offered in both man-made and natural environments (Beate & Sandseter, 2009). A natural playscape was found to afford a greater amount of riskier play to the children than a traditional playground, although conclusively both environments offer a great deal of risky play. When considering affordance in designing for children, the designer must put themselves in the child's point to view and begin to acknowledge how they would interpret surfaces and forms.

Children themselves have defined the "[o]pportunities to move freely" as a mark of a high quality environment (Horne Martin 2006, p. 142). This desire to move freely is echoed in the child preference to "play everywhere but in the designated play ground spaces" (Frost as cited in Staempfi 2009, p. 269). With the initial function of the playground to act at the stepping stone to the "practice of self-restraint" and test for "educational success or failure", the playground now functions to provide a limited amount of physical activity and play produced with overly detailed safety precautions (Burke et al. 2008, p. 38). Society has placed such an emphasis on safety in playground

design that children are not being properly challenged in terms of their development (Staempfi, 2009). The absence in providing environments and objects that further a child's physical development is highlighted even further in interior environments, particularly the classroom.

In contrast to traditional adult-constructed playgrounds, a growing trend in Europe involves the incorporation of spaces called adventure playgrounds into urban spaces (Staempfi, 2009). These environments are constructed for children and, more notably, by children. With the use of self structured play, children are challenged by their own creativity. It is important give children the needed structure but it is just an important to allow for their own creations and development of personal spaces (Day, 2007). The playground is a perfect example of an area with possible numerous affordances and with it mainly occupied by children rather than adults, students are "most likely to feel confident and empowered" in these spaces and able to test their abilities (Prosser 2007, p. 19). The ability of the playground to adapt and change is necessary to constantly provide challenges but too often it is designed as a fixed passive structure, with the exception of elements such as swings or merry-go rounds. Through testing environmental limits, children learn about "the growing scale of their bodies and their emerging specialized skills" (Cosco 2007, p. 128). Playgrounds and other "[e]nvironments full of novel information and rich affordances should be considered as a developmental strength to accompany children's growth and the extension of physical capacities" (p. 129).

Designing for Development

Through recognizing the relationship that the environment can have with a student, we must also acknowledge the unique role children play in the classroom by understanding their specific developmental period. For example in middle childhood, specifically ages 6 to 8, there are a number of developmental dimensions that must be examined including physical, cognitive, affective, and social (Zembar & Blume, 2009). Through understanding the physical, constant growth of a child, designers can design furniture that reflect and accommodate this period of physical transition.

Similarly, providing furniture that is not merely a means of physical support but a challenge to their cognitive abilities should be reflected in the products that young students are surrounded with in their educational environments. Cognitive development in middle childhood focuses on "how children develop thought and problem-solving skills in direct interactions with the environment through the processes of assimilation and accommodation" (p. 188). Cognitive development for children age 6 to 8 is marked by a number of components including "increased short term capacity, faster processing speed, improved [attention and] focus, improved mnemonic strategies, increased knowledge base, greater automaticity, and greater metacognition" (p. 176). Piaget classified this period of development as a period of concrete operations, where a child begins to use tangible logic to understand the world through classifications and causalities (Zembar et al., 2009).

In addition, affective and social development can be supported through providing an environment that allows for individual expression, community building, and social

activities. Children develop their individual sense of self-worth and self competency during these years. Experiences designed to strengthen a child's self image are characterized by immersion "in an activity, merging actions and awareness, focusing attention, lacking self-consciousness, and feeling in control of the environment and actions" (p. 246). Children also establish self-awareness through social practices such as observation by watching those around them to determine acceptable and practical behavior. A child's understandings of social etiquette are consequently determined by patterns of "mutual, ongoing interactions between school-age children, their social environment, and their interpretations of their own and others' behaviors" (p. 305).

By the age of 5, children have the ability to control body movements and have the balance and agility to ascend and descend stairways without holding a railing (McGowan & Kruse, 2004). At age 7 and 8, it is regarded that most children gain control over challenging acts such as balancing and hopping. These periods represents the stage where children advance in motor, social, and cognitive development, which are often benefited by interaction with the environment. Children hone their physical abilities in activities such as balancing, running, jumping, and throwing while enhancing their fine motor skills (Zembar et al., 2009).

The idea of complimenting a child's developmental period in the design of educational facilities was pioneered by architect, Hans Scharoun, during the mid-century (Burke et al., 2008). His design philosophy for schools was based on developing a space using an informed design approach, highlighting an obvious and beneficial difference between classrooms as the child developed over the course of their education. His

designs, although purposeful in intent, were not particularly popular due to the "public demand for simpler and cheaper solutions, for rationalized and fixed types that would facilitate the series production for school building" meaning quantity over quality for educational design at the time (p. 127). Although lacking in immediate effect on educational design, Scharoun's designs and philosophy were the results of developmentally appropriate choices in their learning experiences.

Children's Furniture

In the child's designed world, the most intimate daily relationships occur with the furniture and everyday objects that children use, and as such, "[c]lassroom furniture and artefacts [are] shown to be potent carriers of meaning, communicating messages about notions and priorities with regard to the physical and psychological development of children" (Burke 2003, p. 136). Unfortunately, these intimate relationships between children and objects were "designed 'to fulfil the needs of adults, and even satisfy the fantasies, of adults' rather than addressing the notion of giving control to the child" (Burke 2003, p. 136).

Furniture Typologies

Furniture and objects in the traditional North American classroom fall into a limited number of categories, such as chairs and desks and tables. Designers have been criticized for relying too heavily on utilizing previous examples to solve problems and offer design solutions (Colguhoun, 1969). Objects are often designed and made through tradition, habit, and imitation based on the presumed needs of a society. Designers often assume that what worked before should work again and particularly in relation to the

classroom and its furniture, the nostalgic meaning and memories instilled in the traditional furniture are difficult to divert from. Although the creation of new meaning is what should be introduced at all time during design as the user needs and developmental changes occur. Colguhoun (1969) refuted the assumption that a fixed and immutable relationship exists between form and meaning, in that both the use and interpretations on the part of the individual user vary. This strict hold on traditional design has been responsible for the relatively small changes in classroom furniture over the years.

Through utilizing a user-centered design approach to create new meaning and forms, successful designers have focused much attention on the needs of the end-users (Cornell, 2002). However, a misinterpretation is seen in the practice of a user-based design approach, with designers often putting all the importance on the ease of functionality of the piece when in fact other elements call for consideration such as comfort, safety, health, usability, and psychological appeal (Cornell, 2002). The aim of adopting the user-based design process is not in the produced tangible product, but rather about the successful allowance of "creative positive, rich and meaningful user experiences" that result from the interactions with the products (McDonagh, Denton, & Chapman 2009, p. 433).

Despecialization

In order to test the affordance and ultimately the usability of an object, it is ideal to return the object to a generic and simple state through a process known as despecialization (Carreau & Pelletier, 2004). Many objects today are designed for one specific action or function while others present an ideal of multi-functionality with the

blending of products that satisfy a mixture of uses. Although even in multi-functional pieces it is the merger of specific recognizable forms. Instead of designing with recognizable forms, Carreau & Pelletier (2004) investigated the benefits of designing for actions rather than designing known things, alleviating the traditional design approach of designing an easily associated type of furniture. A chair presents an immediate image in a person's mind that is likely shared with others while an object for 'sitting-on' can present a number of different images such as a swing, a bench, a curb, a stair, etc. This can be characterized by its most simple of elements such as a plane for support depending on the height and user. The process of designing despecialized objects (See Figure 2.7) requires that they be looked at from all directions and manipulated to discover hidden affordances and design opportunities. These relationships that children have with affordances can be explored in a greater variety by utilizing this despecialized approach in designing objects for actions. The ideal for the application of this theory and design style is that is accepts that "the user's curiosity, creativity, and participation in the end, that will reveal (or not) the potential of these objects" (p. 17). This may be an especially beneficial approach to designing for children in that children are often robbed of their creative input when furniture and toys are pre-made with very specific in function and theme (Day, 2007). To children a toy shaped like a car is always a car while a simple cardboard box can become a whole realm of items that engage a child's creative thinking and imaginative abilities. This concept also aids in the development of a child's resourcefulness and allows for exercises in improvisation. The inclusion of less hard rectangular forms can "elude definition and increase imaginative opportunities" (p. 37).

Figure 2.7. Despecialized Objects. Adapted from "The Despecialization of Objects," by P. Carreau & H. Pelletier, 2004, Platform, p. 16. Copyright 2008.

Designing for Change

In combining this concept of evolving forms and changeable actions with educational needs, the school environment is then never complete (Burke at al., 2008). Designers have been guilty of over-designing schools and attempting to provide for all current functions when future actions and occupant input should be considered. The intention when designing interiors of schools and school objects is to provide incompletion "in order to stimulate a continuous design response among the users of these spaces over time" (Burke et al. 2008, p. 166). Several schools have begun to adopt and approve this approach through providing teachers with environments to demonstrate and "teach students to use space in their learning" (p. 178). This transformation of a schools appearance over time to reflect the new generations entering the environments call for designs that are flexible and ephemeral. However, this idea is often realized only through customized spaces and furniture and is difficult for schools due to budget

restrictions and easy access to inexpensive mass-produced school furniture, which provides for little to be changed other than simple furniture location (Burke et al., 2008).

Ergonomics

In addition to the concerns created with mass-production, "cost, supply, traditional ideas, and failure to listen to children's views" have added to not only limitations in educational product choices but have allowed for the neglect of basic ergonomics in the design of school furniture (Burke et al. 2008, p. 23). Ergonomics is an area which has been of concern in both building structure and furniture, yet has failed to be continually updated to project current standards (e.g., Legg, 2007; Woodcock, 2007). Teaching children about ergonomics can help in building an understanding of their environment and "gear them towards being more empathetic" (Woodcock 2007, p. 1551). Children are exposed to the value of design when the material is presented to them in challenging assignments requiring a divergent solution and providing an outlet for creativity. Because design for, with, and by children is an important idea, sharing this information about ergonomics with children is not simply about delivering information but applying that information to their surrounding environments, such as the school and home settings.

The discussion of ergonomics can be applied more specifically to the chair, which children perceive as an indicator of social status and a seating option greatly preferred by adults (Cranz, 1998). In examining the relationship between elementary students and chairs in the school environment, the chair has been argued to play the role of "a sedative causing passivity in the learning environment" (p. 64). This passivity in the classroom is

a result of an educator's attempt to establish classroom control and instill discipline. The stress consumed through the act of staying in a seat may create just as much of a disturbance as being able to move freely in a classroom (Cranz, 1998). Furniture and the environment should give young students the freedom to move about the classroom.

Most students are provided with a chair that is either too high or too low with adjustments and comfort coming from shifts prompted by the sitter (Molenbroek, Kroon-Ramaekers & Snijders, 2003). A basic chair is described as "an extension of a user, with no two users being exactly alike. No two users sit, squat, or move about in the same manner" yet classroom chairs continue to remain as a fixed design and allow little variation and unique postures (Postell 2007, p.106). The chairs and desks used in education often lack the capability to fully adjust from the formal upright positions to accommodate an informal position for tasks such as reading or drawing. In effect the users are the ones who alter their positions to adapt to the forms of the chairs. Based on their unique learning styles and size differences, children will not all sit the same way or sit in one position throughout the entire day. They will be constantly shifting and fighting the fixed form of the chair.

When given a choice, children often chose not to sit in a chair, possibly due to a child's constant interest in playing, but more importantly because of the proportions and scale of furniture in relation to their unique and changing body sizes (Cranz, 1998). The slope of the classroom chair has been highly criticized and has been the subject of much experimentation to find a more appropriate relation between the varying sizes of the students. A conflicting relationship exists between chair height and writing surface

height. These discrepancies are often due to visual distances and the actual distances often cause a student to slouch or arch their back to perform writing or reading activities (Cranz, 1998).

Chair ‘2000’ was the result of a design study aimed at testing a new ergonomic method in the classroom (see Figure 2.8, Knight & Noyes, 1999). Study results from the classrooms using the chair indicate not only should furniture be matched more fittingly to a student’s size but that the furniture should provide for constant position changes and that “the value of rocking forwards or backwards should be recognized and as a coping strategy tolerated” (p. 758).

Figure 2.8. Chair '2000' Redesigned for Improved Ergonomics. Adapted from SolSeatChair2000 by ESA McIntosh. Retrieved from http://www.esamcintosh.co.uk/solutionscentre/seatclass2000.aspx

The relationship between the child and classroom furniture, the proportions and anthropometric data used in the creation of standards is geared toward accommodation of students who are closest to average sizes leaving many students having to adapt to those standards (Molenbroek et al., 2003). The activities that occur within the classroom dictate the positions and postures of a student (Panagiotopoulou et al., 2004). Yet these activities are not often understood or even known by the designer and mismatching occurs. Children are more sensitive to the benefits of ergonomically correct furniture than adults because not only are their sitting habits still being developed but their overall bodies are constantly developing (Panagiotopoulou et al., 2004). Despite the obvious need for adjustable and ergonomically-correct furniture in the classroom, the furniture industry focuses more on providing ergonomically conscious furniture in offices rather than the school environment.

Figure 2.9. Mismatch of Furniture

Measurements collected of children and school furniture indicated an obvious mismatch in sizes, which is typical not only in the relationship between student and chair but also between objects in the same classroom (See Figure 2.9, Panagiotopoulou et al., 2004). In examining the mismatch between furniture and second graders, none exhibited a compatible seat depth, only 5% were compatible in height, 11.7% were compatible with the new desk over 3.3% compatible with the old desks (Panagiotopoulou et al., 2004). These findings indicate a mismatch in the school furniture and this mismatch is most noticeable in the furniture paired with smaller children, as their rates of growth vary most pointing to the benefits and needs to design for movement and change rather than a fixed position

Participatory Design

It is not always simple size and scale that can be examined to design furnishings but also listening to the users of the space. With the classroom and its design acting as a teaching tool that educates future consumers and aids in the understanding of how the learning environment shapes ideas and learning practices, the process of consulting children about their environment improves designers understanding (Grosvenor, 2005). Through incorporating students into the design process, students become involved in the ownership of their environments. This practice can further support the effort to create life-long learners that exhibit autonomy in learning both in the classroom and outside the classroom environment.

This process of including children in design brings into question the idea of childhood. Childhood is argued to be defined by the cultural relationships created

between adults and children (Rossi & Baraldi, 2009). Hindered by this relationship, "children's voices have been traditionally 'muted' within the social sciences" (Christensen & James 2000, p. 1). However, through conducting research with children they become recognized as "social actors" (p.1). This inclusion of end-users has been exercised by architects, designers, and social researchers who understand the benefits involved with engaging participants and has resulted in further insight into how teachers use their classrooms for teaching methods and how children feel the classroom could be more conducive to learning (See: Burke & Grosvenor, 2008).

Participation with children has often been criticized in its approach due to the attempt to lead a child using convergent thinking practices rather than adopting a divergent thinking method to obtain new understandings and new solutions (Rossi & Baraldi, 2009). Three main typologies are exhibited through participatory methods: 1) planning phase participation, 2) giving advice, 3) freely expressing. These typologies allow for a mix of qualitative methods to be used to establish a base for collecting and understanding the child's viewpoint. Just as children learn in different ways, children express themselves through a means of different manners and by utilizing a variety of approaches the resulting information can be more cohesive and represent the interpretations in a more accurate manner.

The Student's Perspective

The importance in engaging children is to strike a delicate balance between how information is collected and conveyed. The need for this delicate balance is evident in the simple fact that "users often say one thing, do another and feel something else"

(McDonagh et al. 2009, p. 433). In writings on education, Holt "encouraged those interested or engaged in education to look at the school through the eyes of the young child, picking out the spaces, places, textures and smells that held meaning for them, but which were forgotten or lost to the adult" (Burke et al. 2008, p. 130). However, the value is not just in understanding their viewpoints or even simply listening to children but rather constructing and adopting demonstrated methods that provide the means to recognize the opinions of the child (Burke, 2007). Research on middle childhood can benefit from participation with children because they best understand their views and perspectives.

Visual Culture of School

Through exploring the meaning of the visual culture of school and how students perceive the messages, these meanings change over time displaying the constant need to look to children for new meanings and relationships based on the generation at hand (Burke, 2007). The practice of listening to children's considerations and experiences is in "keeping with a constructivist approach to learning in which children and adults are engaged in a task of co-constructing and meaning making" (p. 361). This practice will allow both adults and children to understand the relationship of design, learning, and well-being. In previous studies, children made it clear that they wanted classrooms free from the restrictions of traditional desks, freedom to work with messy materials, the ability to walk around freely, areas for thinking other than the desks provided, and freedom to experience the tactile nature of the environment (Burke, 2007).

Participatory Precedents

Children's ideas have begun to be incorporated into the design of school environments and design projects (see: Burke, 2007; Appleby & Cox, 2003). Many positive factors arise from their collaborative design relationships specifically regarding the benefit that through the process children may begin to build an individual understanding of preferred and successful design practices (Burke, 2007). Through already having an understanding of the elements of value, children can express this information so that is can be utilized by a designer with a clearer understanding of its impact on the built environment and student-occupants.

In examining several studies that have successfully incorporated this practice of research *with* children, it is understood that in doing so designers are better informed on how children view the school environment (Penrose et al., 2001). Through the use of semi-structured interviews, drawing activities, identifying good and bad design, smell sampling, sound sampling, and experience recounting, investigators have been able to better understand the whole experience of the child (Penrose et al., 2001).

Summary

In acknowledging the benefits of a shift from passive to active learning environments and distinguishing the differences in intelligence and learning styles, the need for variation and flexibility in the classroom is validated. The presentation of the learning environment to students affects their individual learning preferences and can either aid in helping them develop life-long learning practices or hinder their autonomy for learning. Through not only supporting a child physically, the furniture in the early

elementary classroom can challenge and assist in the development of social, cognitive, and affective skills when designed with special attention to child affordances and a detachment from typical typologies. Using a participatory approach involving students, a series of products may be developed that provide a student-responsive environment and better support a child's development, imagination, and independence.

CHAPTER III

METHODOLOGY

Purpose of the Study

The determination of this study was to document the process of designing a new type of furniture for use in the first and second grades, using a participatory design approach. The aims of the study were to a) develop a relationship with elementary school stakeholders to conduct a participatory design approach, b) conduct a series of observations of classroom case studies, c) analyze and synthesize the information collected, d) develop a series of products for the early elementary classroom based on the collected information, and e) analyze and reflect on the process. The researcher sought to document the participatory design approach to understand children's interactions and insights involving the furnishings used in the classroom environment in order to design new types of furniture for the first and second grade classroom. These new forms allow for an increase in divergent forms of student/object interactions within those classrooms.

Research Questions

The primary research question for the study was: *What new types of furniture can be developed for the early elementary classroom to support active learning?* In order to address this question, the researcher first examined the following sub questions:

6. What are the physical relationships between the students and the existing classroom furniture?
7. How does a user-based design approach affect the process and outcome of designing classroom furniture?
8. What does participation from the user group offer the design process?
9. What elements of the design of classroom furniture are viewed as most important by stakeholders?
10. What aesthetic and functional elements can be adopted to create a new type of furniture that allows for active interactions?

Research Procedures as Objectives for the Study

The procedures of the study as objectives were to:

10. Conduct a critical review of literature on the educational environment and its effects on learning and behavior, child development and child needs, and the process of designing *with* children as an appropriate framework for the study.
11. Conduct a critical review of methodologies as part of the development of an appropriate research strategy for this study.
12. Work with participants to implement the research using case studies, semi-participant observation, validation discussions, and behavioral mapping.
13. Document the case study classrooms using photo ethnography, written observations, sketches, and inventory studies.
14. Analyze the information collected from the case studies.

15. Conduct a drawing activity with student participants. Work with participants to examine and interpret the drawings created in the drawing activities in relation to the purpose of this study.
16. Conduct a design process synthesizing the collected information and design a series of products in response. Incorporate the assistance of undergraduate student, Laura Snoderly.
17. Critique furniture produced during the design process and revise final prototypes.
18. Conduct final analysis of results. Write final documentation.

Theoretical Foundation of the Methodology

Design as Epistemology

This study engaged a 'design as epistemology' approach that progressed with the idea that the process of design is a practice used to obtain knowledge through experience (Mahdjoubi, 2003). As with any design project or qualitative process, no absolute answer exists but rather a concern for finding appropriate solutions. The distinction between a design approach and a scientific approach is that scientific research is intended for analysis and identification of truth, while design is a form of synthesis used to explore change (Mahdjoubi, 2003). In utilizing design as epistemology, this methodology involved a dominant visual element, along with an overall intention of expanding and contributing the field of interior product design and education.

Design knowledge for research has too often been overlooked and under-documented due to the visual presentation of design rather than the standard written format associated with the conclusion of research (Mahdjoubi, 2003). In examining the

reason for limited documentation the "plausible cause of poverty of written materials on the design methodology is that drawing rather than writing has been the preferred medium of thought and expression for a designer and in that respect for many professionals" (Mahdjoubi 2003, p. 4). In this study, the methodology was documented through a combination of written and visual form.

Reflexive Approach

In utilizing a design approach, researchers and designers have argued that the designer's experiences, tools, and technologies are the making of a reflexive process (Mahdjoubi, 2003). This attention to the experience of the designer/researcher is best recognized through the ability to accept the importance of the researcher's subjectivity in the study (Christensen & James, 2000). This recognition is crucial in research as the data is interpreted through the researcher and thus a dependent relationship exists between the researcher, methods, and results. The researcher's impact on the methods and results must be highlighted as an overlying element that determines the nature of the study (Greene & Hogane, 2005). Throughout this study, the researcher continually reflected on their individual experience and interpretations associated with all methods and as such the data collection, analysis, and design process are subjective to the researcher.

Challenges in Reflexive Approach

This practice of reflectivity can ultimately be defined as the researcher becoming designer and gaining an awareness of their responsibility for decision making in the task at hand (Mohammad, 2001). In this study the designer became the mediator between student and the built environment. In an effort to merge the reflexive approach with the

concept of user-based design, combinations of user-input and designer-input were exercised and documented throughout this thesis investigation. Information may be misinterpreted during a reflexive approach and often the researcher's childhood background and experiences can create a bias, which is why the participatory methods were appropriate to eliminate the likelihood of preconceived notions associated with the researcher's elementary experiences (Dwyer & Limb, 2001). Informal validation discussions were conducted with teachers following observations and with students following drawing activities in order to minimize misinterpreted data based on the researcher's biases.

Constructivist Approach

With the subjective nature of the researcher and design process, a constructivist approach was appropriate with the final design solutions being a product from the researcher's thoughts, based on their collection and interpretation of experiences used for the study (Hayes & Oppenheim, 1997). An objective solution cannot be discovered because all that exists is taken from a subjective standpoint and nothing can be viewed with a completely unbiased point of view, particularly within the design world with varying affordances. The relationships between researcher and participants are connected so that the researcher takes on the role as "the primary data-gathering instrument" (p. 33). Through the strong influence of experience during observations, drawing activities, and the design process, the outcomes are a result of the experience rather than a discovered truth.

Participatory Design Approach

This design study commenced with a Participatory Design approach, focusing on the participants acting as subjects in the study rather than as objects of the study (Christensen & James, 2000). Design is the practice of identifying a problem and then solving the problem through a creative process. By using a participatory approach in product design, the solution involved participation from the end-users during the process. Through this approach, the researcher incorporated working with the users through the use of multiple methods to gain an understanding of their needs and values.

A better insight into children's experiences and understandings of their educational environments, particularly in the school setting, was gained through participatory methods. A three stage process was implemented for involving participants including curiosity, action, and reflection (Burke et al., 2008). The drawing activities conducted allowed for students to exhibit all three stages and the compilations of all methods required that the researcher engaged in all three stages as well.

Recruitment

With incorporating students and teachers into the study, recruitment was an important process. The process for recruitment followed as such: 1) identified local school district, 2) submitted research proposal to conduct research, 3) contacted individual school for approval, 4) presented participating teachers with consent and assent forms, 5) sent home consent forms, and 6) scheduled observations and activities with teachers.

Institutional Review Board

As with any research study that incorporates human participants, approval was required from the Institutional Review Board to work within the school with the teacher and student participants. A protocol for this study was submitted, outlining the data collection methods. Consent forms were written for parents or guardians of the students (see Appendix A). In addition to the consent forms, students were presented with assent forms for the drawing activities to make it known that participation was optional. The consent and assent were given through the signing of approved IRB consent and assent forms. In addition to parental and student participation, the teacher was also required to consent to participation and allowance of classroom time.

Challenges in Participatory Design Approach

As this participatory approach included children, a number of obstacles and challenges existed such as power imbalances, parental approval, and scheduling issues (Thomson, 2008). Power imbalances often exist between adult researchers and child participants due to physical size and cultural aspects. In addressing this imbalance, avoidance of infantilizing children may be accomplished through conversing with children in an appropriate manner and establishing that they are assisting with the project can lessen perceived power imbalances (Christensen et al., 2000). On the other hand, the material must be easily understood by the participating students. Care was needed in deciding the most appropriate wording to use in working with the students to avoid feelings of inferiority and superiority. Language use and question formation were given to the participating classroom teacher to review to avoid any misunderstandings.

Brief Overview of the Study Design

The researcher addressed the research questions outlined above by conducting this research in partnership with school stakeholders in Greensboro, North Carolina using a variety of qualitative and quantitative methods such as classroom inventories, photo ethnography, behavioral mapping, semi-participant observations, validation discussions, drawing activities to gain access to the interpretations and activities afforded by classroom products with respect to school stakeholders. In conjunction with these methods, creative methods such as visualization, documentation, and product design were used to develop the products. The research was conducted using a Participatory Design Approach and a Reflexive Approach in concurrence with a User-based Design Approach. As the incorporation of children, and generally the users, becomes more visible in the field of interior product design, so too does the need for research become necessary in the field of design.

Methodologies

Qualitative methodologies are those that center on experiences and interpretations that permit “a means of understanding people’s elusive sense of place” and focus on the “importance of meanings and values held by both researcher and researched” (Dwyer et al. 2001, p. 3). Qualitative methods have been chosen for this study because the assumption cannot be made that the experiences occurring within the classroom environment are constant and quantitative. This study has used quantitative methods to support the qualitative experiences and creative methods to carry out the design investigation.

Methods

This research utilized a variety of methods, which are "specific techniques and tools [used] in exploring, gathering, and analyzing information", in order to study different aspects of the interaction between the classroom environment and the stakeholders who interact within the confines of that classroom, along with the values and insights held by the users (Gray & Malins 2004, p. 16). The four classroom case studies were examined through classroom inventories, photo ethnography, behavioral mapping, semi-participant observations, validation discussions, and drawing activities. A number of creative methods were used during the design investigation conducted as part of this study. These methods included process documentation, design visualization, and product design, which comprised of design phases beginning with programming and schematics, followed by design development and prototyping. Group Critiques were conducted throughout the design process.

Case Study

A collection of four classrooms were studied in order to produce "credible and accurate accounts" of the classroom setting (Gray et al. 2004, p. 117). These case studies were used to understand the everyday activities of the classroom, patterns of behavior, and patterns of interaction with furniture that materialize in the classroom environment. With a purpose of the case studies to note patterns and relationships in the classroom, no conclusions were drawn to infer causal relationships associated with teaching methods and the sole focus was on furniture to student relationships (Greene et al., 2005).

Four classroom case studies were selected for recognition based on grade levels, location, and approval of the school district and school. The case studies included two first grade classrooms and two second grade classrooms located within the Guildford County School District in Greensboro, North Carolina. The classrooms observed comprised of an estimated 24 students each with one teacher directing each classroom. The observations and supporting methods transpired in June at the conclusion of the 2010 school year while the drawing activities occurred in the same classrooms the following September and October. The classroom environments observed represented a combination of lower elementary grade levels and diversity between the types of furniture presently occupying the classrooms, making these four locations appropriate for examination. The information was collected in an organized manner to allow for an organized analysis. The data analysis followed the steps presented by Leedy & Ormrod (2010): 1) organized of details, 2) categorized data, 3) interpreted single experiences, 4) identified of patterns and themes, and 5) synthesized.

Classroom Inventories

The inventories created during this study were a quantitative method, documenting quantity and descriptions of products present in each classroom. This inventory resulted in the collection of data describing the types of furniture presently used in the case study classrooms, the placement of furniture, and the number of each piece. This data was collected to aid in formation of floor plans along with understanding what items were presently used in a classroom environment.

Recording and Analyzing Data in Classroom Inventories

Data was recorded in excel spread sheets as inventory lists noting color, style, quantity, and placement of each object. This data enabled comparison between classrooms to see if any differences existed and to identify the current items used in the classrooms.

Photo Ethnography

Photo Ethnography is "a method of capturing a static image of an object in its environment, providing evidence of particular significant features related to the research project issues" (Gray et al. 2004, p. 108). Photographs were used to document the classroom furniture in its surrounding environment while unoccupied. The photographs required reflectance on the researchers own experiences and observation within the classrooms to create meaning for the photographs (Grosvenor, Lawn, Novoa, Rousmaniere, & Smaller, 2004). These photographs, deemed appropriate for use by educational historians in past studies, were appropriate for analysis of the existing furniture by the designer (Burke et al., 2007). The photographs captured and analyzed are classified as Landscapes with the collection of objects capturing the social and cultural processes at work in the classroom.

The purpose of the photographs was to capture the environment and products in the case studies to construct an inventory and examine the classroom arrangement and functions. The information captured through photographs are open to interpretations therefore these photographs will be used to support information from other methods and will be interpreted and examined by the researcher ((Burke et al. 2007, p. 157).

Recording and Analyzing Data in Photo Ethnography

Data was recorded using a digital camera (see Figure 3.1). Images were taken of a vacant case study classroom either at the end of the school day or during the lunch or recess period for each classroom. The images were shot to include a well rounded understanding of the space and products included in the space. On average, 41 photographs were taken of each classroom, although not all pictures were used in examination due to photo quality. Furniture was not moved during the photo session. The images were taken from both the adult height and the child height. Images were imported on the researcher's computer and descriptions were applied to each photograph to explain what was captured created a reference tool that could be revisited after leaving the classrooms. The dominant furniture types seen in the photographs were included in the programming document and used to support the observation notes, floor plans, and the classroom inventories.

Figure 3.1. Sample Photograph of a Case Study Classroom.

Behavioral Mapping

Behavioral mapping is a form of observation and documentation used to record "the location of subjects and [measure] their activity levels simultaneously" in relation to the built environment (Cosco, Moore, & Islam, 2010). This method has been used in the study of school environments to "illustrate the method's sensitivity for coding built environment characteristics" and therefore, behavioral mapping is a valid method in obtaining information regarding student behavior and activities (p. 1).

Recording and Analyzing Data in Behavioral Mapping

The student locations were documented using a standard pen and paper method on sketched floor plans or printed floor plans depending on the classroom. A time-sampling approach was adopted and student behaviors were documented once an hour when available or during large movements of the classroom members. With this data being collected through time-sampling, certain activities and behaviors occurring throughout the day were not captured during the behavioral mapping sessions. On average, six maps were documented during each classroom observation. A floor plan of each classroom was constructed on the computer and the locations were transfer to the computer documents at the conclusion of the classroom examinations. A series of student positions were coded and represented by a color and letter (see Figure 3.2). The color related to the time and classroom activity of the sample while the letter related to the students position including sitting in a chair, kneeling, standing, or laying. The maps were then tagged with detailed descriptions of the events occurring at that time in relation to the observation notes. With the events noted matching those in the observation notes, the maps were intended for

visual studies to examine the use of the room and to support the observed actions within the classroom.

Figure 3.2. Example of Behavioral Maps

Semi- Participant Observations

An observation is when the "surroundings and interactions of people are viewed as a way to gain an understanding of the study setting" (Salkind, 2005). Due to the physical size of an adult and the difficulty of being "an outsider studying a different culture" it is not possible that these observation can be considered 'direct' or 'full' participant observations (Punch 2001, p. 166). The researcher was present in the room where the observations occurred, however was not participating in the activities. This type of observation method is termed semi-participant as the researcher's presence may affect the behaviors and activities occurring in the classrooms. As a part of the case studies a series of semi-participant observations were conducted using a method of event sampling (Greene & Hogane, 2005). Each observation occurred in the natural setting of the classroom environment (Leedy et al., 2010).

It has been contended that observations occurring over the course of 20 hours are considered adequate to establish a relatively "reasonable sense of the types of activities and interactions that are important to children's lives" (Greene et al. 2005, p. 115). With four case studies each taking a period of one day, the case studies took a total of four days or 24 hours to complete, which did not include organization time.

Recording and Analyzing Data in Semi-Participant Observations

The observations were recorded through note taking while the researcher sat at a table in the back of each classroom located by the classroom door. The question arises as to who is creating the meaning of the participants experiences in an observation and it is verified that the researcher has assumed that role (Dwyer et al., 2001).This location allowed for the least amount of disturbance to the classroom being observed, along with the minimal distractions with the use of note-taking. These observations were noted by the researcher through written words and supported by quick sketches when information was better documented in pictorial images (see Figure 3.3). The observations at times described the entire class activity and at other times simply noted the events occurring around the classroom. Immediately following an observation, the information was transcribed and the later placed into QRS NVIVO, an analysis software program, to code themes and patterns among other observations. The data was used to identify classroom activities and observed student positions and actions. The observation notes for each classroom were entered into the program and then coded to identify classroom activities and observed student positions and actions. The lists developed under these headings

grew during the coding process and resulted in a long list of activities and student positions and actions (see Appendix C).

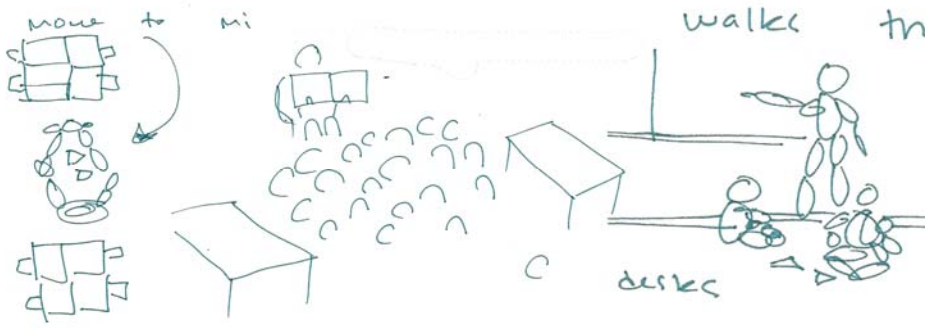

Figure 3.3. Sketches from Observations

Validation Discussions

A validation discussion, reflecting the questioning patterns used in an interview, is a tool wherein a dialogue is undertaken to confirm a researcher's observations and interpretations (Salkind, 2005). The validation discussions were semi-structured and contained both open-ended questions and mirror questions. A series of validation discussions were conducted with each of the school teachers in the participating classrooms. The validation discussion lasted a maximum of 20 minutes.

Recording and Analyzing Data in Validation Discussions

Validation discussions were recorded through written documentation if the information differed from the researcher's interpretations during the observations. The discussions occurred during times when the students were out of the classroom and at the end of the day. The recorded notes from the discussions were transcribed and then placed

into QRS NVIVO, where they were used to support observations and note possible design characteristic used during the design process.

Drawing Activities

Drawing activities allowed for the students to participate in the role of co-designer (Christensen et al., 2000). These activities were intended to "give reign to the child's imagination" and value their ideas and understandings of their classroom environment through pictorial methods (p. 14). This method in comparison to formal interviews allowed for the participant to thoughtfully consider a response rather than giving an instantaneous answer thus demonstrating the process stages of curiosity, action, and reflectance (Gauntlett & Holzwarth, 2006). The information collected through this method was not meant to stem from an unconscious reaction, therefore this method was appropriate.

This method took advantage of the child's ability to communicate experiences and thoughts through "the symbolic meaning of drawing" that acts as a form of language, taking the place of spoken or written words (Greene et al. 2005, p. 262). Through this drawing activity, after a brief introduction and discussion (see Appendix E); the students were asked to take a critical look at the classroom environment and draw two pictures. The students were given two sheets of paper. The first of which was to show their favorite spot in their classroom and the second was to show how they would make the furniture better. The activity concluded with an informal, individual discussion between researcher and student about their drawings, giving them the opportunity to explain and briefly analyze their own drawings. These discussions lasted less than two minutes each.

In examining precedents, there is a growing interest in giving children a voice through drawings but there are limited studies "where children are invited to be co-interpreters of their own images" (Thomson 2008, p. 37). Through this method children were given a 'voice' in the research process and the opportunity to share their understandings of the meanings and functions in the classroom. The benefits of these drawing activities were that they resulted in a tangible product that may be revisited by the designer and the student to analyze visual data and provide for reflection. The drawing activity followed the below format:

- Introduced drawing activity through a brief discussion with students
- Presented students with numbered sheets of paper and crayons (see Appendix E)
- Gave adequate drawing time where students socialized with other students, the teacher, and the researcher
- Talked to students individually during the drawing session noting child number and any interpretations and comments from child

The drawings produced were discussed in a respectful manner. With the divergent nature of the task, children were freely able to express their experiences and meanings behind their drawings. A feeling of genuine interest was displayed by the researcher during the discussion times and students were given the option to not discuss their drawings.

Recording and Analyzing Data in Drawing Activities

A total of 42 students participated in the drawing activity. Their drawings were analyzed using visual ethnography. The interpretations of these drawings were taken

seriously. Themes and elements that emerged from these drawings were discussed with the students, the undergraduate assistant and the committee chair. The favorite spaces and improvements were coded and places into categories to indentify dominant preferences and common improvement ideas. Elements coded for each drawing included location, function, form, scale, focus, design elements, and surroundings. The drawings were digitally scanned into the computer and assigned a corresponding number to enable confidentiality. The presented ideas were recorded through written notes and corresponded to the appropriate drawings.

The objects in the drawings were used in the schematic phase as well as to generate ideas through a 3-D modeling exercise conducted by the researcher to capture shapes and explore the design features and functions. During this modeling activity, the forms and spaces drawn by the students were modeled in SketchUp with color. This generation of models allowed the researcher to view the forms in three-dimensions to further view and experience the proposed furniture and connect more with the thoughts of the students.

Critique Groups

A critique is a common exercise during any design process. A critique group is similar to a focus group in that it is a meeting between a group of individuals "to discuss a particular topic chosen by the researcher(s) who moderate or structure the discussion" through presentation and following discussion (Dwyer et al. 2001, p. 121). The critique group method is often used as a way to allow others to "share their knowledge, experiences and prejudices; and argue their point of view" (Dwyer et al., 2001, p. 121).

Recording and Analyzing Data in Focus Groups

Major critique groups were conducted in October of 2010 and December 2010, as a requirement for a graduate studio course. Data was recorded through simple listening during comment and questions sessions. The major points made by the group members were later discussed with the undergraduate assistant and committee members during the design process. These discussions included developing a dialog about the benefits or issues with major points noted during the critique groups and the execution involved for major ideas.

Creative Methodology

With the intention for this study to result in the development of new classroom products, a combination of creative methods was appropriate. Through creative methodologies ideas are presents through visuals and supported by written documentation (Dwyer 2001). A creative methodology was adopted to synthesize those interpreted classroom experiences and meanings through product design while continuing to use a participatory approach and reflexivity.

Creative Methods

In defining creative methods as opposed to qualitative or quantitative methods, they are those that involve the researcher/designer in creative or inventive actions such as designing, drawing, and building (Greene at al., 2005). These creative methods included a combination of visual process documentation, product visualization, and product design.

Process Documentation

Process documentation refers to the capturing of aspects of the design process, data synthesis, sketching, schematic design, design development, modeling, prototype construction, photography, and design visualization. To document the process visually, a blog was utilized to capture the chronological order of the progress and to share the research process with those who may be interested, including the school participants. Along with the blog documentation, digital copies were stored for all materials pertaining to this study.

Recording and Analyzing Data in Process Documentation

All information obtained throughout this study was stored as digital copies in appropriate folders on the researcher's computer and external hard drive. These process images were created using a range of media from pen and paper to photography to computer renderings. The blog used to document several phases of the study can be visited at www.primaryobjectsprocess.blogspot.com.

Design Visualization

Design visualization may be referred to as visual thinking, where ideas are presented through a visual or pictorial means (Gray et al., 2004). With the intent of this research to document the process through visuals, visualization was used as a method to communicate information, serve as a focal point during critiques, and further develop ideas (Gray et al., 2004). The tools included a combination of drawings, digital representations, computer-aided design, prototypes, and photographs. The design

visualization in this study, as it has been used in previous studies, allowed for triggers of short-term memory, imaginative thinking and creativity to further evolve the design (Mulet & Vidal, 2008).

Recording and Analyzing Data in Visualization

The data produced during this study for visualization captured the product design process and continued throughout the study, capturing the sub-methods under the product design process for this study. Most visualization was recorded through sketches, digital models and renderings, photographs, and physical models. To visualize the uses and demonstrate the possibilities of the final prototypes in both foam and later in wood, photo shoots took place with a child-model. This photo shoot required a photo release.

Product Design

Design, and more specifically product design, "is seen to be an action process centered round the synthesis stage" (Swann 2002, p. 8). The design process demonstrated the action part of the participatory approach. In examining product design, the creative process behind it is understood "as that which incorporates new unknown variables or knowledge that are not previously available" (Mulet et al. 2008, p. 101). In the product design stage of this design thesis, a design process was followed and contained the following stages: programming, schematic design, design development, prototyping, and final documentation (see Figure 3.4). The approach to the product design process, although it may seem linear, is cyclical in nature with the act of revisiting previous stages throughout the process (Swann, 2002).

Figure 3.4. Design Process Diagram

Programming

Under this stage is the idea of documenting and identifying the requirements of the project and needs of the user (Priest & Sanchez, 2001). The program was created using the information collected from the case studies and theories from the literature review. This information was organized in a programming document created in excel to illustrate, through both text and graphics, the parameters of the project.

To illustrate an understanding of the needs of the user, a program highlighted anticipated user needs, user anthropometrics, user actions and positions, developmental dimensions, environmental conditions, third teacher principles, photographs of existing furniture, existing spatial dimensions, spatial distributions, design concerns, existing classroom products, and concepts (see Appendix F). This program evolved throughout the process as new information, new materials, and new functions entered into the design. The program provided an organized document that highlighted the major issues and functions as a growing reference throughout this study. The process for the development

of the program followed as such: (1) created program template in Excel, (2) identified major components, (3) input information, and (4) continued to add information throughout the process.

Schematic Phase

The schematic phase involved the development of abstract, preliminary forms and idea generation. This phase involved thinking through sketches, digital models, and written form. The forms produced by the students in the drawing activities were modeled in SketchUp to aid in the definition of design elements present in their drawings.

The schematic design phase, driven by the data collected from the case studies, began as a sketch exploration and a form study taking shape through sketches and digital models. A series of initial sketches were produced using trace paper and sketchbook pages with pen to develop basic forms that could work in multiple positions. The process for the schematic design phase followed as such: (1) produced sketches during observations, (2) generated ideas through sketching session, (3) developed a pair of blocks combining appropriate heights related to standard children heights (see Figure 3.5), (4) constructed a small scale classroom and collection of foam blocks to visualize block configurations (see Figure 3.6), (4) manipulated blocks digitally in SketchUp to produce a series of potential furniture forms, and (5) presented and critiqued resulting furniture forms.

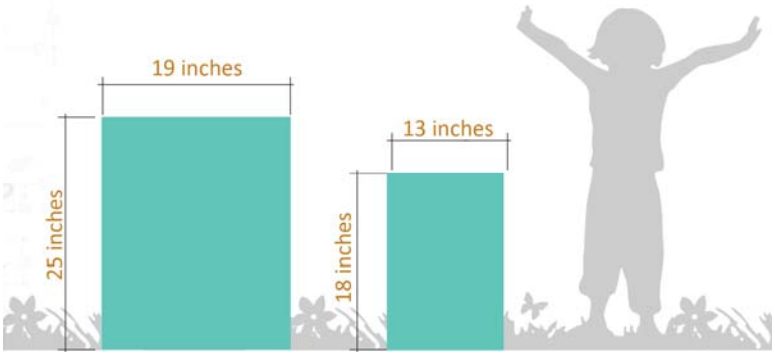

Figure 3.5. Schematic Design Phase Blocks. Silhouette adapted from Happy Child by Chelgrrl69 (2010). Retrieved from http://www.mylot.com/w/image/2282906.aspx

Figure 3.6. Small Scale Classroom Model

Design Development and Prototyping

The design development phase is where a product is further refined to meet the expectations and objectives outlined in the programming phase (Priest et al., 2001). The design development phase was continually revised in the second half of this design investigation followed by full scale prototyping explorations. As the forms developed, each design development phase was unique and was discussed individually below. During each design development phase a collection of sketches, digital models, small scale models, and finalized renderings were produced.

The prototyping phases for this study are defined as the creation of full scale models used to study the concepts of function and examine areas of concern relating to

the structure and aesthetics of the design (Priest et al., 2001). This method included the construction of physical prototypes in both foam and wood. This phase relied on the ability to make things and generate ideas and concepts through physical form (Baxter, Ortega Lopez, Serig, & Sullivan, 2008).

Design Development Phase One

The effective characteristics from the four preliminary models were integrated into a single form that was digitally developed, taking key elements from the evolving program and student drawings, in SketchUp. Instead of one form being selected and evolved, the strongest points in all forms were combined, examined, and evolved.

Prototype Construction Phase One

The initial full scale prototypes of the new forms were constructed with the assistance of an undergraduate research assistant, Laura Snoderly. These forms were constructed using 2” thick Extruded Polystyrene Insulation, EPI. This material was chosen due to its lightweight nature, ease of shaping, and low cost per sheet. The process for the initial foam prototype construction followed as such: (1) produced paper templates, (2) cut profiles from foam, (3) glued forms, (4) examined forms, (5) disassembled and reassembled if needed, (6) cut and sculpted contours if needed, and (7) sanded.

Design Development Phase Two

Following the initial full-scale prototype construction, the resulting forms were further developed. The process for the design development phase two followed as such: (1) examined form and usability, (2) presented and critiqued form, (3) discussed concerns

with undergraduate assistant, (4) discussed solution, (5) sketched and digitally modeled solutions in SketchUp, and (6) tested proposed changes on existing prototypes.

Prototype Construction Phase Two

The second collection of full scale prototypes were constructed using 2" thick Extruded Polystyrene Insulation, EPI. These prototypes were constructed to aid in the visualization of a finalized form to present for critique to committee members, fellow students, faculty members, and eventually the participating classrooms. The process for the final foam prototype construction followed as such: (1) produced hardboard template for small object profiles, (2) determined measurements for large object using initial prototype (3) cut foam, (4) glued form and wooden supports, (5) cut contours where appropriate, and (6) sanded, patched, and painted.

Design Critique

Although design discussions and critiques occurred throughout the design process, a final studio critique was used as a major critique and turning point for the design direction. The critique followed a fifteen minutes presentation by the researcher of the progress of the study. The final foam prototypes were presented. Following the presentation, the audience members, consisting of committee members, faculty, and fellow students, were given the opportunity to ask questions and make comments about the process or forms.

It can be challenging in a critique group to predict whether a design or idea will be received with enthusiasm or little interest (Dwyer, 2001). The reactions depend on how the visuals are presented and how the concluding question and comment session

evolves. The views and comments received through the critique groups are noted as such in the results to ensure contextual understanding.

Design Development Phase Three

Following the design critique, the resulting forms were further developed. The process for the design development phase three followed as such: (1) considered alternative materials for prototype construction, (2) discussed plastic fabrication methods with faculty, mentor, committee chair, and undergraduate assistant, (3) considered use of wood, (4) explored wood through design development, (5) discussed materials, form, and construction concepts with committee members, (6) developed concept for wood construction, (7) digitally developed ribbed structure for honeycomb concept in SketchUp, (8) produced a series of small models for study, and (9) discussed direction with committee members regarding materials, transparency, and usability.

The development of the design continued during the production of the prototype with the development of digital forms. The process for the design development during the construction of the cardboard prototypes followed as such: (1) revisions to grid spacing, (2) discussed structure, (3) varied material thickness in digital model, (4) removed of all right angles on digital models, and (5) digital modeled removable surface and removable bin.

Prototype Construction Phase Three

The third collection of full scale prototypes were constructed from cardboard and then wood using a combination of 1/8” and 1/4” Baltic birch plywood. These forms were constructed using a laser cutter and the machines available in the woodshop, CAMstudio,

and TechShop. The process for the cardboard prototype construction followed as such: (1) created digital cutting templates in Rhino, (2) cut panels of cardboard for laser cutter, (3) cut ribs for small object with laser, (4) made adjustments to digital templates, (5) re-cut ribs for small object with laser, (6) assembled prototype, (7) revised templates to include an addition rib, (8) cut panels of cardboard for laser cutter, (9) cut ribs for large object with laser, and (10) assembled prototype.

A collection of final full scale prototypes were then constructed using a combination of 1/8" and 1/4" Baltic birch plywood. These forms were constructed using a laser cutter and the machines available in the woodshop, CAMstudio and Techshop. The process for the wooden prototype construction followed as such: (1) cut wood to appropriate sizes, (2) cut ribs on laser cutter, (3) sanded burnt surfaces and edges, (4) assembled forms, (5) examined structures, (6) re-cut several revised ribs, and (7) glued and clamped forms. The process for the removable surface construction followed as such: (1) cut plywood sheet to size, (2) cut and sand waffle components, (3) glued and clamped waffle formation, and (4) sanded and painted top surface with dry erase paint. The process for the removable bin construction followed as such: (1) cut MDF sheets to size, (2) glued, nailed, and sanded form, (3) tested form using styrene and vacuum former, (4) adjusted form and needed, (5) vacuumed form 1/16" styrene over final form, and (6) sanded and painted final bin.

Recording and Analyzing Data in Product Design

All phases of the product design were captured through sketches, writings, digital images, physical models, and photography. Several aspects of the process of design were

documented on the project blog through images and written descriptions. Digital copies were collected and stored on an external hard drive. Challenges involved in the design phase included time and financial constraints. These products were designed during a Graduate Studio beginning in August 2010 continue beyond the endpoint of studio. Within the prototyping stage, financial requirements for the purchase of materials presented a challenge and funding was sought through submission of a community-based research grant. As with any design challenge, a concern was presented with the continual evolution of the design problem as the process progresses (Mulet et al., 2008). Continual reflection and evaluation of the problems and proposed solutions were incorporated during all phases of the product designing.

Ethical Obligations

Sharing Information

The researcher had an ethical obligation to share the results of the research. Information was made available to all participants and Guildford County Schools via the blog, classroom presentations, and this thesis paper.

Timeline

Spring 2010

- Setup research study. Make initial contact with school gatekeepers and stakeholders.
- Develop case study assessment tool
- Develop drawing activity

Summer 2010

- Examine case studies, including behavioral mapping, validation discussions, inventories, and observations
- Analyze collected information using qualitative analysis software and models

Fall 2010

- Analyze information from case studies and construct programming document
- Conduct drawing activities
- Analyze drawings and information collected during drawing activities
- Design Product(s) in Fall Graduate Studio
- Conduct Critique groups of visuals and prototypes

Winter 2010-2011

- Analyze prototypes

Spring 2011

- Develop the design further and construct revised prototypes
- Write Thesis and defend

CHAPTER IV

RESULTS

This chapter is divided into three parts: case studies, design process, and future explorations. The data compiled from the case study classrooms was analyzed to identify and define classroom activities and student behavior noted during the observations, behavioral mapping studies, and student drawings. The design process, commencing during the examination of the case studies, proceeded through a progression of sketches, digital models, prototypes, photographs, critique notes, and renderings. The phases and products comprising the design process were documented and analyzed in chronological order. Additionally, future explorations are proposed based on the analysis of the design process and resulting product.

Case Studies

Observed Actions

During the classroom observations, examinations included notation of student activities occurring within the classroom and observed student positions and actions (see Appendix C). This data supported the identification of student interactions with the existing furniture, limitations and benefits presented with existing furniture, and description of relationships between student positions to potential classroom activities.

Student Interactions with Existing Furniture

Through examination of these case studies, a collection of conclusive student interactions were observed with the existing furniture that included sitting in chair, leaning on furniture, carrying bins and supplies, moving the furniture, rocking in a chair, jumping on furniture, using supplies, kneeling on chairs, and using the table and desk surfaces. These interactions were witnessed between students and chairs, tables, desks, bins, and other items throughout the classroom.

The observed accounts of these actions showed that the majority of student interactions took place in their chairs, although the posture, leg placement, and direction differed depending on the activity and individual student preferences. Students rarely sat using the back rest as a back rest and often were found to use the back rest more as an armrest while turning in a chair or as an area to easily grab onto from a standing position. When sitting in a chair, students were observed sitting on the edge, hanging half of a side, sitting on knees, in a crouched position, one leg up and one leg down, legs tucked under or around legs, crossed-legged, standing with one knee on the chair, straddling chair, tipping forward, stretching, tilting chair forward, sitting in chair backwards, balancing on two legs, stack chairs at end of day, slide on chair, and standing on chair. An overall analysis of these observed positions showed that it was impossible to predict precisely how a student would position themselves during an activity, but rather that they constantly moved and explored the range of capable positions, even those that required great balance to achieve.

The intimate interactions with the desks and tables included leaning over to write, stretching, placing elbows on desk, erasing desk tops, placing arms, leaning down to look inside, leaning from a standing positions, sitting on desktop, place head down, hanging off side, leaning onto neighboring desks, leaning across to see other's work, assembling art projects, building with blocks and crayons, and cleaning desk surface with paper towel. The table and desk surfaces were used for a variety of activities including eating, writing, drawing, leaning, and resting heads. The students continually interacted with the desk and table surfaces throughout the day mostly using the closest surface. A trust between student and desk existed due to the stability of the desk. Ensuring that students develop a level of trust and security with using the furniture, the stability was carried through into the new products.

The movement of furniture by students was most seen with small chair movements, pulling chairs out, and pushing chairs in. Larger movements made by students with chairs were as a test of strength during classroom clean-ups and, at other times, the result of students wanting to discretely shift to a closer position to view a visiting lizard. When students did venture across the classroom with a chair, they lifted it over their head or were subjected to struggling with trying to maneuver the chair legs around existing furniture. For shorter chair movements from one table or desk cluster to another, students slid chairs across the carpet. When pulling a chair in to sit, students wrapped their feet around the legs and slide it across carpet in small distances. In even smaller movements of furniture, desks were shifted and aligned by teachers and also by students. Minor disagreements and conversation erupted between students over the

position of their desks, with some slightly pushing their desks back and forth. Throughout the day, students moved bins containing books, blocks, and math games. In classrooms providing bean bags and light weight soft seating, students easily moved items for movie watching and free center time. These movements allowed students to take some control in the classroom while also communicating to others through their actions.

In those classrooms with softer seating areas and sofas in the reading areas, students selected those areas first for group and individual activities when given the chance. These areas included bean bags and loose pillows that generally remained in these special areas. The attraction to these areas was comfort but also may have to do with the less rigid form of the furniture.

With these observations occurring at the end of the school year, the classrooms were cleaned-up in two of the case study classrooms. The students appeared eager to assist with clean-up and movement of furniture. Students participated in wiping down shelves, cleaning up books, cleaning off boards, emptying out desks, cleaning desktops with shaving cream, sliding desks, and stacking desks and chairs (see Figure 4.1). Eagerly taking to the physical challenge, several students lifted a desk or carried chairs to stack at the front of the classroom. This occasion for physical activity in the classroom excited the students and all took the advantage of moving around the room freely.

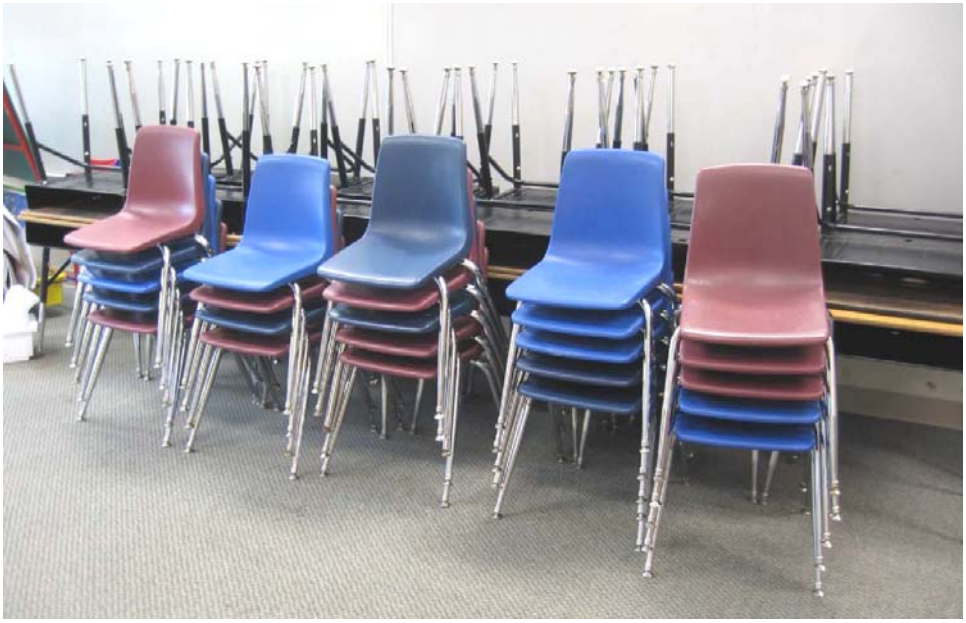

Figure 4.1. Photograph of Classroom Furniture After Clean-up

Although the chairs and desks dominated the classrooms, students utilized smaller products frequently throughout the day. Containers filled with blocks were an attractive play items in the classrooms during free times. Students moved book bins around the rooms and took them out of the rooms filled with library books. Pencil boxes were compact and were easily transported around surfaces, carried across the room, and taken outside. In the classrooms most materials came from bins and students took responsibility for returning contents to bins. Pencil and crayons were kept in bins around rooms, along with other supplies such as glue (see Figure 4.2). This storage and access to bins gave students a level independence in the classroom.

Figure 4.2. Bins Holding Supplies in the Classrooms

The actions observed in the classroom were recorded in the anticipation that the new furniture types would be designed to support those interactions. These design features includes flexibility with seating, intimacy with furniture forms, ease of movement, challenges of physical activity, comfort, and independence.

Student Interactions without Furniture

In addition to these direct interactions with the furniture, several actions seen in the classroom were indirectly affected by the furniture in the classroom including walking about the room through traffic paths created by the furniture arrangements, gathering on the floor as a whole class, lining up towards the back of the classroom, standing around the furniture looking at other's work on a table top or a computer screen, conversing around a grouping of furniture, sitting and kneeling on floor, and laying on floor. All these activities, although they did not require that the students touch the

furniture, required that the student acknowledge and demonstrate an awareness of the arrangement of their environment.

During the observations, students walked around and left their seats throughout the day to accomplish such activities as walking to the teachers desk, conversing with other students, lining up to leave classroom, throwing scraps away, getting a drink from the water fountain, accessing lockers, sharpening pencils, skipping, retrieving and returning supplies, twirling or dancing across room, helping with handing papers out, and watering flower or performing assigned tasks. With items being located away from the static tables and desks, it gave students the opportunity to walk around the room, socialize with others, and exert energy.

Students engaged with the floor often throughout the day to sit with the class, work in small groups, or play in pairs or alone. When in small groups or pairs, students formed intimate spaces between desks when reading centers were occupied. Larger groups of students shifted their positions around desks. Those selecting to work on the floor knelt to use the floor as the work surface. When kneeling on the floor, students looked down at the work space most of the time and then looked up to visually engage with work partners. The floor, although kept clear most of the time, functioned to dry projects due to lack to tabletop surface. This utilization of the floor, which accommodated a range of positions from laying down to jumping in the air, was a great value to the students.

Limitations with Existing Furniture

In observing the students throughout the day, limitations presented by the existing furniture included such obstacles as hindering of positions, incompatible dimensions, safety, and non-personalized furniture. Student's positions were hindered with the solid backs of the chairs. Students constantly fidgeted and sought to sit comfortably on the chairs, obviously designed for a legs forward seated position. The design of the chair also worked against the idea of easily turning to view a teacher or other students. The configurations of the rooms required that students turned to view the teacher, leaving several students with their backs to the teacher at all times (see Figure 4.3).

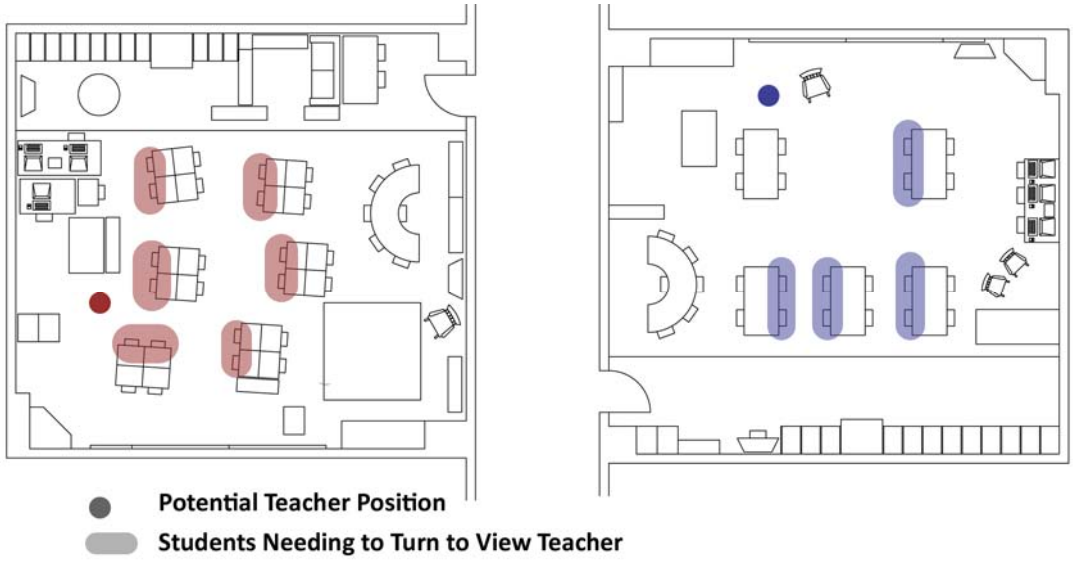

Figure 4.3. Example Diagrams of Inhibited Views

It is the interpretation of the researcher that students enjoyed working together and being social rather than working alone. The students enjoyed working close. Often times to get close, students sat at the side of a desk, shifting their position to avoid or accommodate the metal bar and legs of the desk.

Limitations presented by the furniture during drawing and writing activities included height of desks, leaving the students to either prop themselves up on their legs in a chair or stand and hunch over the table top. When working on computers, the height of the table and size of the computer caused students to constantly look up, as did the placement of the television on a wheeling cart or above the corner storage unit. Students could lessen the angle of viewing by lying down but with the number of students and the amount of floor space this was often not an option.

Students rarely engaged with furniture surfaces from the floor. This engagement occurred only when students were stretching. The height of the furniture, with only the metal legs reachable from a seated position, resulted in a disconnection between the floor and furniture use.

Safety was not issue with the students and existing furniture except for the occasionally accident of falling out of a chair or falling back in a chair. It is quite possible that this occurred as a call for attention on the student's part but students are prone to embarrassment when loss of balance happens. Along with the loss of balance, several students demonstrated an inattention to surface area, often resulting in supplies and pencil boxes falling off the desk surfaces causing disturbances and making a mess.

The generic finishes for the desks and chairs limited the amount of personalization exhibited on the part of the student, with the exception of a laminated name tag. Students were given opportunities for creativity on paper, words, and building with toys, but they were given no creative outputs in their desks and chairs. That is not to say that the students do not make attempts to change the furniture. Several chairs contained crayon marks on the back and students often marked the desk surface and then returned to erase the markings.

Benefits with Existing Furniture

In examining the relationships between students and furniture it is obvious that, just as there are limitations, there are positive elements recognized. Solid table surfaces proved adequate for writing when a student is just learning cursive. Stable structures continually supported the weight of a child during simple actions and when they decide to stretch or jump on furniture placing greater weight and stress on the form. The storage of items within the desk allowed for easy access and a sense of personal space for the students, along with a name tag for marking territory. These beneficial elements, including stability in the desks and tables, solid surfaces, and basic storage, were carried through into the new forms designed during this study.

Relationships of Students and Activities

Although student's individual positions are unpredictable and prone to constant movement, there were particular positions currently associated with classrooms activities. These combinations included such relationships as writing on a solid writing surface with their head held close to the paper. When reading, students preferred a comfortable spot

and rest their book against either their lap or the furniture. When interacting with blocks or toys, students knelt or stood to allow for greater opportunities of movement not afforded in a cross-legged position or seated. Although some positions seemed common among students during activities, it was concluded that the relationships are difficult to define due to their dependence on the individual student's preference, their scale, the permitted classroom behavior, and the positions of those around them. Accordingly, this relationship was a product of the affective, physical, cognitive and social development of a student.

Validation Discussions

During certain times of the observation, questions arose that related to preference and activities. In validating the observed data, teachers expressed that their furniture preference was compatible with the type they had, whether it was individual desks or group tables. One teacher preferred desks because they offered the students more independence than tables. The teacher with tables preferred the tables because of the mess within desks. Positive and negative aspects were associated with both furniture types. When questioned about configurations, teachers confirmed that they kept them in the same position, although in one classroom the arrangement was put into row configurations to control student's behavior and limit disruptions.

Suggestions from the teachers included dry erase surfaces on desks so that they could write on student's desks rather than simply conveying information through verbal means. During the discussions, one teacher suggested edge contours to mimic the cutouts

in the rainbow-shaped tables in the classrooms. Most other questions asked to teachers confirmed the interpretations of the researcher.

Arrangements and Inventories

The furniture arrangements seen in the classrooms were similar with slight changes in placement of rug space for class gatherings (see Appendix D). The inventories produced allowed for a better understanding of all that it stored within the classroom with most classrooms having the same items. While taking inventory, there were extra desks used as storage pieces when not needed for a student. These desks are often set against the wall and the top is cluttered with files and boxes. Designing the objects to function as alternative storage was included as an objective for this study.

Behavioral Patterns

The behavioral maps and the observations aided in the understanding of the classrooms. The classrooms were arranged into a system of zones dominated by a class gathering area that occupied a large space with desks and tables taking up a large portion of the classroom and with learning centers lining the perimeter of the space. These areas remained fixed throughout the day. In examining the behavioral maps taken throughout the day, students utilized a great deal of the classroom space throughout the day (see Figure 4.4). When engaging in tasks away from their desks or table spots, students engaged the floor or soft surfaces demonstrating the preference for different seating surfaces. The clear floor space was a popular area for class gatherings and individual group work, supporting the interpretation that students value the floor.

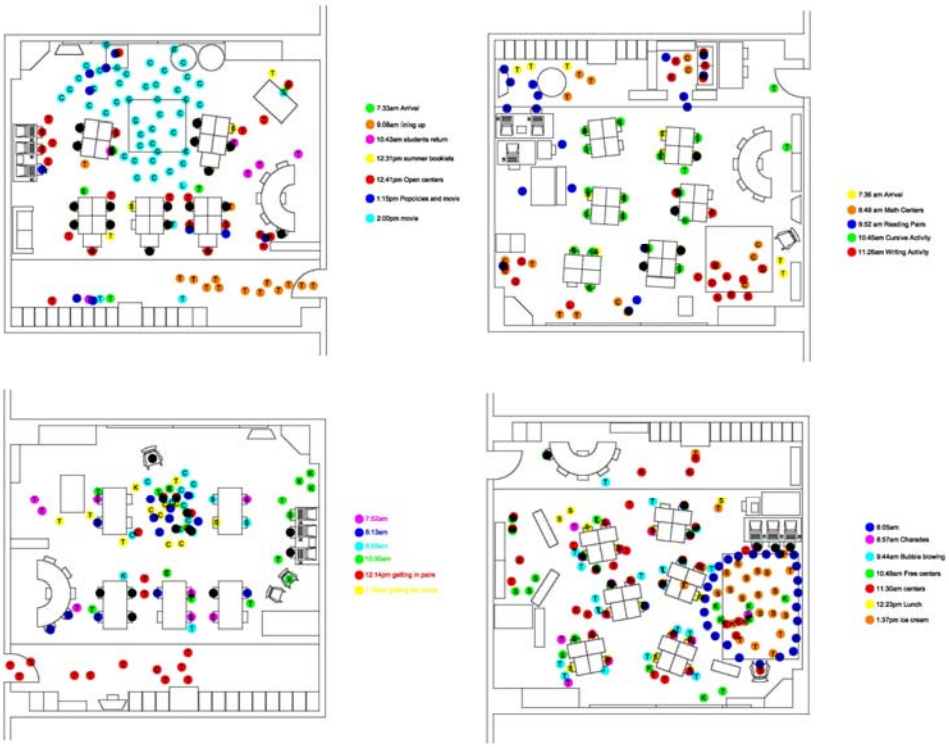

Figure 4.4. Behavioral Maps of All Case Study Classrooms

Drawing Activities

With the research and design process guided by a participatory approach, the inclusion of student's insights into the design process was paramount. Students demonstrated an overall thoughtful consideration about their classroom environment with their drawings and their discussions of their drawings during discussions with the researcher. This activity instilled a sense of curiosity in the participating students to complete the drawings and allowed for reflection when discussing the outcome with the researcher.

Students began the drawing activity by thinking about and drawing their favorite spot in the classroom (see Figure 4.5 & Appendix E). This prompt gave students the

opportunity to depict what spots they deemed as valuable in the classroom. There was a large amount of overlap in preference with the most students drawing the reading centers, followed by chairs, rocking chairs, the computer stations, tables, with fewer students preferring the drawing centers, desks, rug areas, and places outside the classroom. It may be shown that through these drawings and discussions, students chose certain areas based on comfort, creative and stimulating actions, surrounding people, and current location. From there drawings, students were shown to value comfort, stimulation, and a place of their own.

Figure 4.5. Student Drawings

The second drawing required that students think about how they could improve the classroom furniture. Many of the students proposed ideas that demonstrated their ability to improve the classrooms with such additions as more table space for drawing in drawing centers, smaller seats, multiple spaces, soft seating, more seating, and greater storage for art supplies (see Figure 4.6). The drawings showed many variations in color with red and blue being dominate colors in the drawings next to no color. Few students developed a change in furniture purpose other than a moving television.

Figure 4.6. Student Drawings Showing Improvements

A major theme that emerged during the analysis of the drawings was movement. The addition of rockers and wheels on furniture demonstrated that students wanted to move in dynamic ways (see Figure 4.7). Several students drew furniture that could go up and down while others included swings and slides in the classroom.

In addition to movement, many improvements consisted of changing the forms and scale of the furniture. Accordingly, tables were drawn as circular or very long rectangles contrasting from the small rectangular shapes of the existing furniture. In one image, the furniture was drawn to fit together like a puzzle while in others the corners were all rounded.

The second grade students depicted a separation of classroom spaces. A number of students added a second level or cut the room up into smaller spaces that accommodated different activities. This demonstrated an interest in contributing to the layout of the classroom to improve it. Along with new spaces, students introduced new

products into the classroom through these drawings including more chairs in popular areas, more bean bags for lounging, and recycling cans in the drawing center.

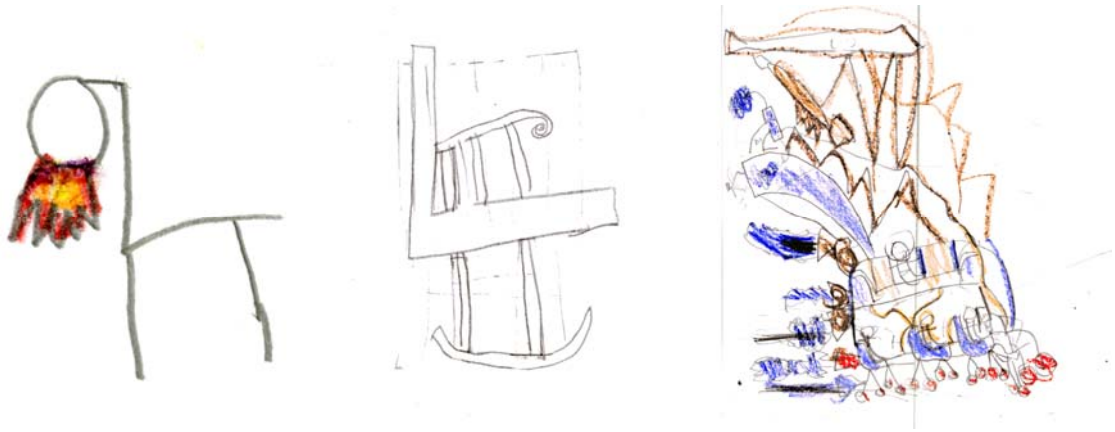

Figure 4.7. Student Drawings Showing Movement

The drawings themselves were analyzed for any emerging design elements. Most were two-dimensional with a horizontal emphasis, often including the floor. Lines used included mostly thin lines, either straight or curvy, that went in a variety of directions. The shape of the furniture exhibited a mix of rectangular and organic forms. Most textures read as smooth. The resulting themes from the analysis included movement, creativity, changes in scale, and introduction of more furniture in learning centers. These identified themes influenced the design beginning in the earliest stages of programming and schematic phases and continued throughout the process.

Design Process

The design process continued to demonstrate the action part of this participatory approach. Beginning with quick sketches during the classroom observations, the

evolution of the form flowed in a cyclical nature with a repetition of revisions throughout the design development and prototyping phases.

Observations and Sketches

A collection of responsive sketches were generated during the classroom observations. In response to several observed functional issues, these sketches provided possible solutions such as adjustable table top heights, a built-in privacy fence for testing, and movable wall surfaces (see Figure 4.8). The solutions behind these sketches were considered during the programming phase and noted several problems observed in the classroom such as fixed table heights that required the students to make adjustments during use.

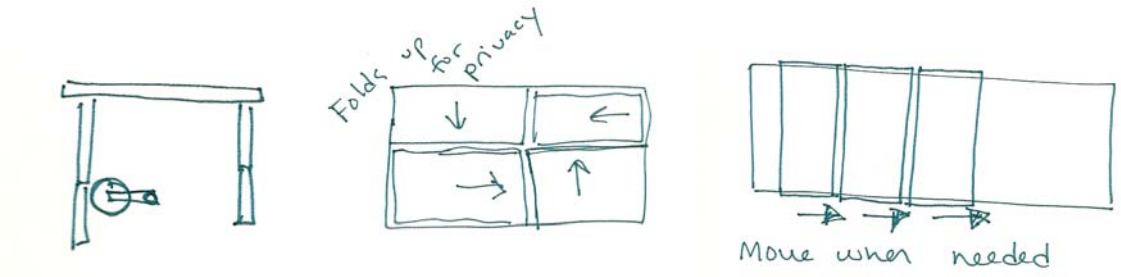

Figure 4.8. Sketches from Observations

Schematic Design

In response to the themes identified in the classrooms paired with those discussed in the literature review, a list of objectives was confirmed that characterized the design of the new furniture. The proposed furniture was intended to support the developmental needs of a child age 6 to 8, engage active relationships, promote flexibility, allow for

movement, provide multiple positions, encourage creative use, and enable building. Upon establishing these intentions, initial sketches were created that featured an array of generic forms shaped to provide a range of surfaces and act as a preliminary visual study of how the forms could work together (see Figure 4.9). These sketches lead to the use of digital models to create potential forms that could easily be examined from all sides. The creation of two objects would provide for a wide range of interactions without creating too complex of an environment.

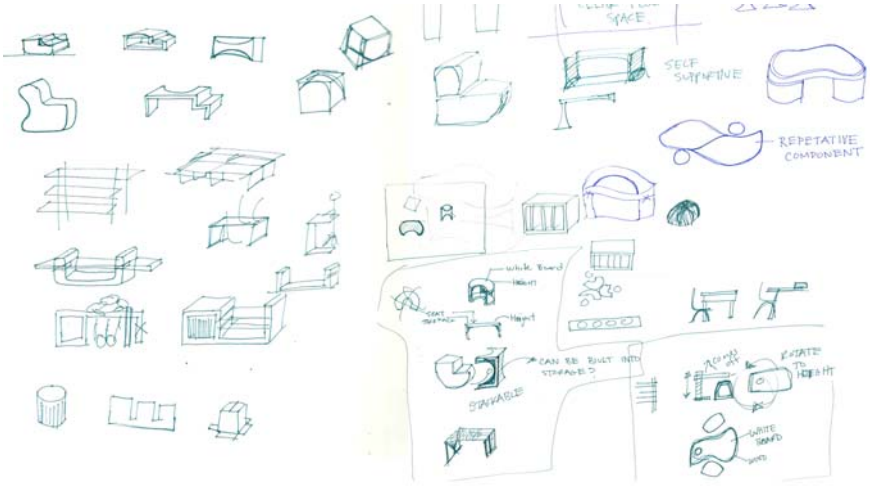

Figure 4.9. Schematic Sketches

Through employing digital media, two distinctly sized blocks were established to act as starting templates for the objects. These blocks represented unique surface heights that when rotated provide a child-user with a multitude of combinations for different purposes that can work in a number of positions (see figure 4.10). Instead of leaving the products to a literal block shape, the forms were sculpted and shaped to afford a diversity of positions for interactions that compliment the positions observed in the classrooms.

The larger of the two blocks measured 25 inches high, by 19 inches wide, by 24 inches deep. The smaller block measured 18 inches high, by 13 inches wide, by 10 inches deep. These particular sizes related to standard seat and table heights along with standard heights of children between ages 6 to 8. To visualize potential configurations with the forms generated from the block, a small scale model of the classroom environment was created from poplar wood and a collection of the small foam blocks were produced to demonstrate the potential arrangements with the generic forms (see Figure 4.11). When cut-away through exploration of positive and negative space, these simple shapes presented voids and recesses that permit a child-user to rotate the forms and place the objects in positions that enable an infinite number of reciprocal actions.

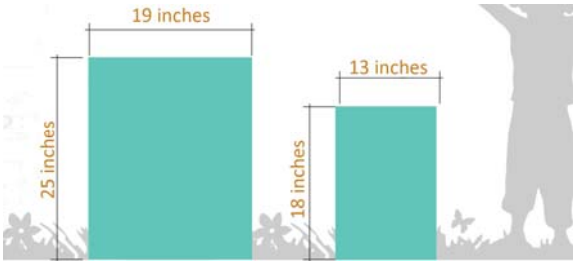

Figure 4.10. Silhouettes of Initial Blocks. Silhouette adapted from Happy Child by Chelgrrl69 (2010). Retrieved from http://www.mylot.com/w/image/2282906.aspx

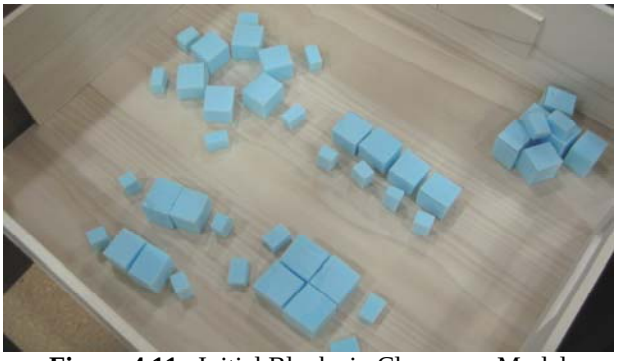

Figure 4.11. Initial Blocks in Classroom Model

During the digital form studies commencing with the simple block shapes, several features were included in the form studies. A storage bin was conceived for flexible storage so teachers and students had the option to store items within the products or around the classroom, exhibiting a level of independence afforded by the use of removable bins. The products in each model contained at least one surface finished with a dry erase surface paint. In order to provide the students with opportunities to actively develop their classroom environments, while also establishing uses for extra pieces, the products were designed to stack. The resulting set of preliminary digital models presented a number of concern including safety, usability, stability, comfort, and proportions. All the models consisted of a large object, a small object, and the option of a removable bin (see Figure 4.12).

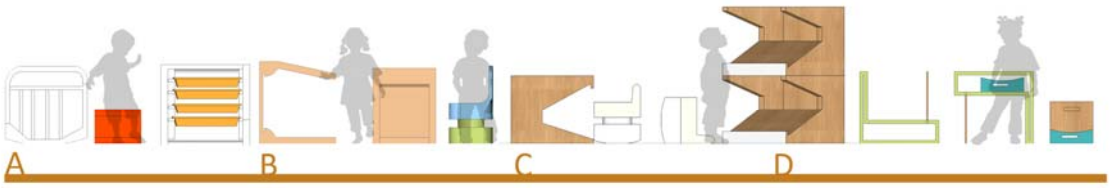

Figure 4.12. Preliminary Digital Models. Child silhouettes adapted from Kids Silhouettes Vector. Retrieved from http://www.allfreelogo.com/rf-vector/696847-kids-silhouettes-vector.html

Model A featured a large object that could tilt in a certain direction due to angled supports and rotate in multiple directions (see Figure 4.13). The small object in Model A functioned as a seating surface, work surface, storage, and partition when rotated. The shape of the small object allowed it to rock when placed in a specific position. For storage, small removable bins spanned the length of the large object and fit in a collection

of location provided in the large object depending on use. The large object held up to four bins at varying levels. Areas of concern for the Model A included the stability of the large object with the removable bin due to items shifting and the comfort of the seat due to the flat hard surfaces.

Figure 4.13. Model A Digital Renderings

Model B provided a slanted writing surface and a flat dry erase surface that allowed for a horizontal or vertical application (see Figure 4.14). The height of the small object can be adjusted through twisting a threaded seat column, moving the object up or down depending on the direction of the rotation. This adaptation would enable a student to determine the height most appropriate to the activity and their physical size. Concerns with Model B included limited storage and stacking abilities, along with wear and tear associated with the threaded column that could fail over time with extended use.

Figure 4.14 Model B Digital Renderings

Model C was the most stable of all four models due to its thickness and form (see Figure 4.15). The large object provided a dry erase surface and can stack to store books and papers. The large objects can rotate to provide two distinct surface heights and a slanted work surface provides for engagement while on the floor. The small object, similar to the one in Model B, was designed for movement up and down so the user can adjust the height through a threaded column support. The concerns with this model related to ease of rotation due to the rigid shape of the large object. This large object would require handles in order to move. The small object, with a curved bottom for rocking, was prone to tipping over and the proportions needed to be adjusted.

Figure 4.15. Model C Digital Renderings

Model D exhibited linear forms (see Figure 4.16). Through rotation and the opening and closing of a hinged panel, the large object provided for interaction from a kneeling position, seating position, and standing position. The removable bin functions to raise the height of the small object, which can rock in certain positions. The small object also exhibited a hinged top which can lift to provide a back support when used as seating. The concerns with Model D included comfort with the dominance of right angles and the durability with the hinged panels which lead to safety concerns.

Figure 4.16 Model D Digital Renderings

Design Development Phase One

The digital models were critiqued by fellow students and committee members to identify positive and negative elements. Accordingly, the positive elements were then combined into a single pair of objects for further development. The resulting forms continued to embody a small, removable bin that would rest within a collection of voids scattered around the large object (see Figure 4.17). Taking shape from a combination of the preliminary models, the large object blended the storage from Model D with the stable form of Model C. Complementing curved leg forms were added to the large object to create edges that would contour a child's body and visually soften the form, while also supporting the objects when rotated.

Figure 4.17. Revised Classroom Products

Through rocking in one position and remaining stable in others, the resulting small object resembled the small object in Model. The simple form enabled the object to stack creating storage systems and partition walls constructed by the teachers and students. The movable parts, such as the threaded support columns and hinged panels, envisioned on several of the models were eliminated due to safety and lessened durability with extended wear and tear. In reflecting on the observations, the idea of a seat back was eliminated due to students rarely using the back of the seat to lean against during activities.

Prototype Construction Phase One

The creation of full scale prototypes allowed for further analysis of the design in its current state. The prototypes aided in identifying potential problems with the forms and making necessary improvements to advance the design. These forms were created from Extruded Polystyrene Insulation, a dense foam material, for cost and ease of construction. The foam acted as a substitute for the proposed material of hollow plastic.

Beginning with a paper template of the profile, the smaller of the two objects was constructed by ripping basic dimensions on the table saw and the radial arm saw, then using the band saw to cut out the profile of each layer (see Figure 4.18). The foam profiles were then glued together using hot glue. The hot glue allowed for quick drying and made it easy to disassemble the prototypes when revisions were needed, providing for a fluid and flexible construction process.

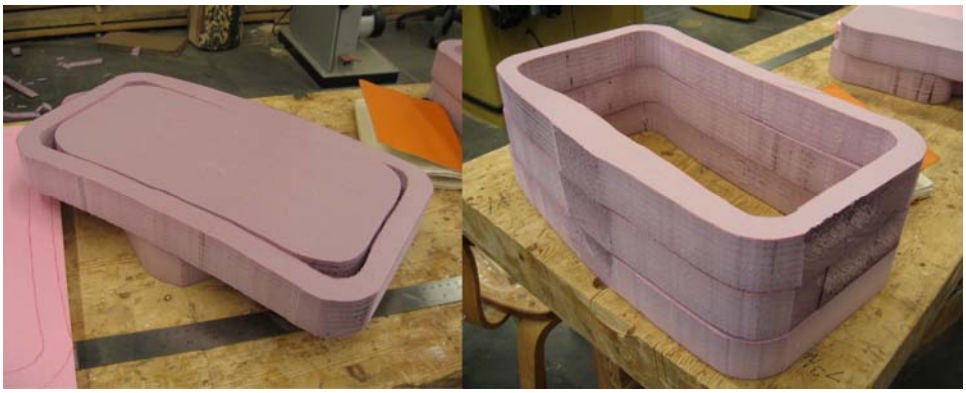

Figure 4.18. Small Object Foam Prototypes Phase One

Using 2” thick foam, the large object was constructed by working with a digital model to determine the dimensions of the layers. Each layer was ripped and cut using a combination of the table saw and radial arm saw. Once cut, these layers of foam were stacked and angles were cut where appropriate using the table saw. Throughout the cutting process, each layer of foam was assigned a letter to assist with the assemble process. The leg pieces began with the use of templates and were cut using the band saw. The pieces of foam were then glued together and sanded to finalize the full scale form for critique (see Figure 4.19).

Figure 4.19. Large Object Foam Prototype Phase One

After this initial assembly of the basic form, a discussion occurred between the researcher and undergraduate assistant. The discussions of the forms included where to place cut-outs and curved edges. With this being a sketch model, locations were simply drawn on the form with marker for the cutting session. Other areas of discussion included the inclusion of a storage cubby within the angled center of the form, placement of dry erase surfaces for optimal use, a name tag, magnetic strips and possible removal of one of the legs.

Following the discussion, the layers of foam were taken apart and the recess for storage within the form was created by cutting down the layers and then gluing them together again. During this deconstruction, the edges of the flat surfaces were curved. These curves edges encouraged a more intimate experience with the furniture, wherein the user could become close in their engagement with the products. As this was intended to be a study model, the precise location of the curves was still explored. Using a knife, the form was carved to contour the rigid shape of the rectangular surfaces so the form

would embrace a student user and provide for a more ergonomic and comfortable relationship between user and form (see Figure 4.20).

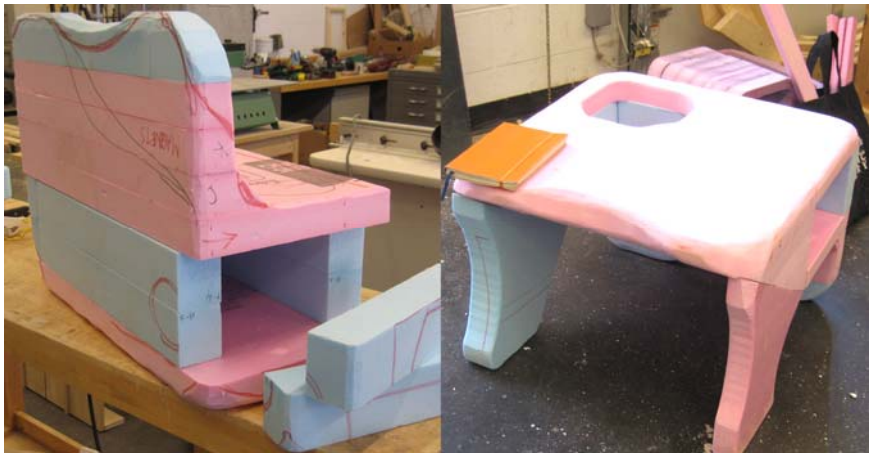

Figure 4.20. Process Images of Large Object in Foam

Design Development Phase Two

These prototypes were judged with the concepts of form and usability. With the objective of the products to foster creative and imaginative uses, a more asymmetrical form was envisioned to permit varied opportunities for diverse synergy between student and form.

After further discussions with the undergraduate assistant and discussions prompted by a graduate studio critique, the leg forms evolved from two simple curved forms to a leg and a solid panel, providing two unique surfaces for imaginative use and different activities. Appearing too bulky in certain positions, the leg form was changed to a more asymmetrical form. This prompted the anticipated use of rounded corners, numerous voids, and color to break-up the form visually.

The design attribute of stacking the objects brought up concerns in both the large and small objects. In the large object's process, the concern for a secure stacking feature prompted a short deviation from the current form to explore different shapes that would enable secure stacking by teachers and students. A series of models were explored and resulted in the return to a form similar to the initial object, with one leg replaced by an additional panel (see Figure 4.21).

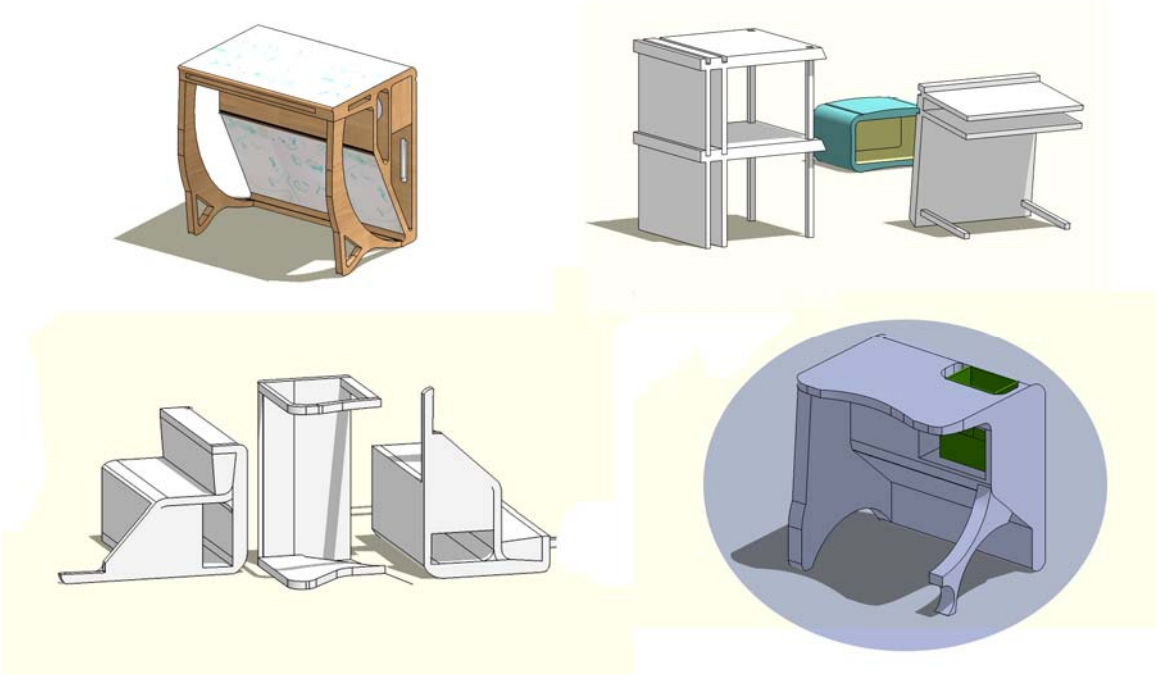

Figure 4.21. Sketch Models

The issue of stability was questioned in the small object as well. With these objects stacking to produce flexible storage and vertical partitions in the classroom, the risk of an object slipping on a single-axis, curved surface was a concern due to storage items shifting or irregular placement associated with child-users. Additional stabilization

was designed into the form of the small object through the introduction of small grooves and protruding dowels that would fit together in a tongue and groove manner when the objects were stacked, similar to a puzzle connection. A mock-up was done on an initial prototype to test the construction method using wooden dowels (see Figure 4.22). The initial test proved successful and, for the future prototypes, a template would assure accuracy with dowel and groove placement. The introduction of the support system altered the profile of the form, which presented both positive and negative issues. The placement of the grooves could be used for impromptu storage when using the small object in a rotated position. However, the inclusion of the dowel provided opportunities for some discomfort in specific positions.

In anticipation of the wear and tear placed on the prototypes by potential users and the weight of a child interacting with the prototypes, an inner support system was essential within the foam prototypes. The latest support system incorporated wooden dowels positioned throughout the objects in weak areas and in areas where the glue would not provide the necessary strength and support for minor but experimental use.

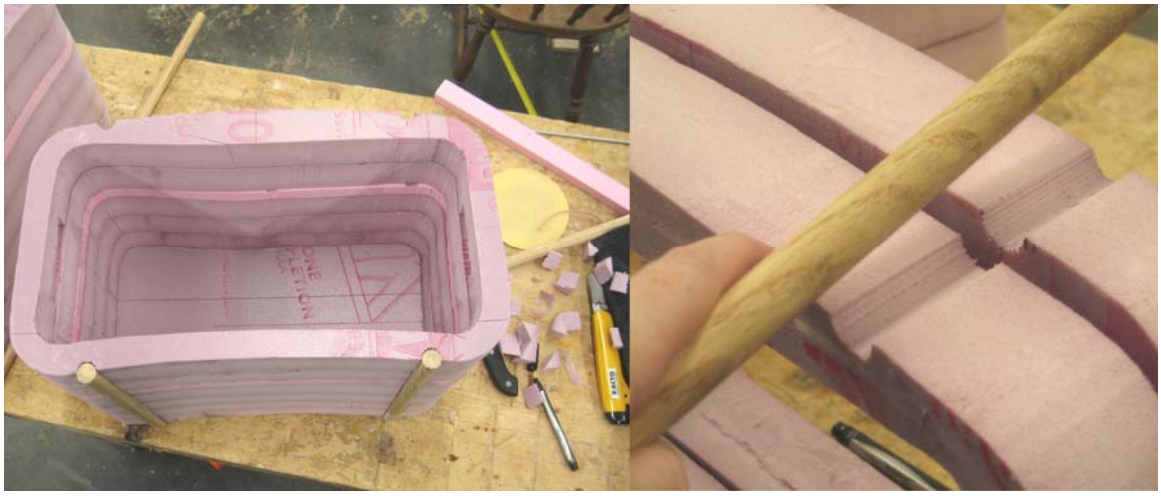

Figure 4.22. Testing of Dowels on Small Foam Object

Prototype Construction Phase Two

In carrying out these revisions, a new collection of prototypes was constructed at full-scale. These new prototypes aided in the design development phase as revisions occurred throughout the construction process. Four of the small objects and two of the large objects were produced to demonstrate the many uses of the objects both alone and together. This collection of foam prototypes was constructed in part to study the form further but also to present the forms for a studio critique.

The construction of the small objects began with the fabrication of a cutting template made from hard board, rather than a simple paper template used before (see Figure 4.23). With constructing four of the small objects and each object needing six layers, a total of 24 layers were created. In order to control the placement of grooves, recesses, and openings, a template was used. The consistency between each layer permitted an ease in assembly and less surface variation. Drill holes marked the location of dowels on the template, allowing for consistency in location so inserting the wooded

supports would be consistent. The cut profile layers of the small objects and corresponding wooden dowels were cut, glued, sanded, patched, and painted. Generic handles were cut out on each of the objects for further contouring and shaping. During the painting stage, experimentation was exhibited though color and finish. Dry erase surface paint was applied to the flat side of the small objects and blue paint was applied to the interior of two of the objects. The color was introduced to highlight the handles and to add an accent to the object.

Figure 4.23. Construction Process of Final Small Foam Prototypes

The large objects were constructed through the same process, although instead of layering the foam, solid panels were cut and glued together (see Figure 4.24). The initial large prototype acted as a reference for the sizes of the panels. The use of solid panels gave the objects an overall consistent width in material. Voids were added to the three main surface areas that opened to the center storage cubby. These voids were cut to a size that would accommodate the small bins in width and an extended size in length to limit the risk of finger-pinching when used by a child during the placement of a bin. The voids also functioned as handles when rotating the objects. The dowel supports added strength to the weak areas of the inner cubby and the leg. Dry erase paint was then applied to the three large surfaces areas, followed by an introduction of blue paint to highlight the voids (see Figure 4.25).

Figure 4.24. Construction of Final Large Foam Prototypes

Figure 4.25. Final Foam Prototypes

The small removable bins were basic in design. They exhibited a rectangular form with tapered sides that allowed for stacking. To construct the bin, mat board was cut on a laser cutter into a series of parts that were folded and assembled using glue (see Figure 4.26). These forms were placeholders and would be further developed for fabrication using a more durable material and construction method such as vacuum forming or heat forming plastic.

Figure 4.26. Removable Bins

To further display the abilities of the products in combination with one another, and with the limitations in constructing the quantity of prototypes needed to fill an entire classroom, a collection of small scale models were contrived using the laser cutter. The small models filled the small scale classroom model produced using poplar. These small models enabled the manipulation of the furniture and experimentation with arrangements in an entire classroom setting. These models were created on a laser cutter by making a series of profiles for the small objects that were glued together and a template for the large object that is scored and then folded into form (see Figure 4.27). The construction

process for the small object mimicked the full scale foam process, while the construction process for the large object at the small scale presented new possibilities for construction of full scale prototypes. This method of construction presented the idea that the large objects could be produced from a single sheet that would fold to form the structure of the object, creating a different aesthetic with thinner proportions.

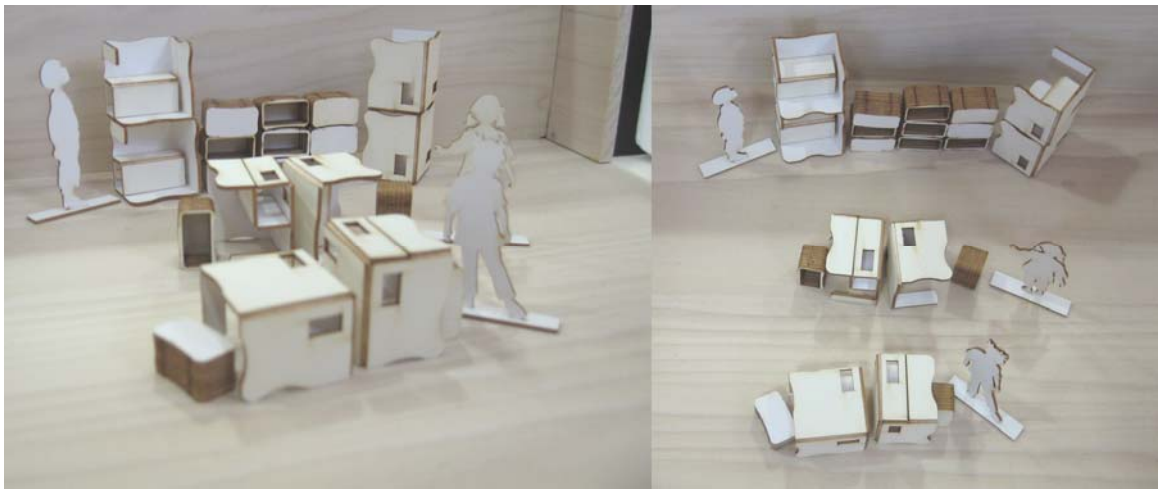

Figure 4.27. Small Scale Models of Prototypes

Photographs and Visualization Phase Two

With classroom furniture, these products are designed for repetition of more than 20 times in a classroom. The objects can be individually positioned by the students or set-up by the teachers in a number of different configurations that reflect classroom activities and learning styles (see Figure 4.28). With the high cost and time required to produce 20 pairs of the objects, a collection of digital model renderings, within a typical classroom, allowed for visualization of the products in their intended environment (see Figure 4.29).

Figure 4.28. Samples of Furniture Arrangements

Figure 4.29. Digital Renderings of Foam Prototypes

To visualize the uses and demonstrate the possibilities of the final foam prototypes, a photo shoot took place with a child (see Figure 4.30). The photo session began with a number of positions exhibiting the large object as a work surface providing for a number of postures based on the combination of objects or the solo use of the large object from a kneeling position (see Appendix H). The child was given dry erase crayons and asked to model the ability to write or draw on the furniture surface on both the large object and small object. All the while, his materials and supplies were held in the removable bin that easily transferred from voids to floor. With the use of the lightweight foam, the child modeled the ability to lift the large and small objects and move them into the appropriate positions. As the small object was created to function on its own, the child modeled its versatility, beginning with its rocking ability both front to back and side to side in different orientations, then utilizing the piece as a reading desk from a floor position. Returning to the large object, the child modeled flipping the object to use it as a different seating surface, a lounge, and another work surface.

Figure 4.30. Child Modeling Products

Design Critique

During a design critique with committee members, faculty, and fellow students, several concerns were brought into question including intended materials, production methods, material thickness, curves and beauty of the design, and shaping of voids and handles. On the contrary, minimal functional issues were raised. The intended material at the time was plastic, which lead to questions of production and material thickness. The intention was that the products may be either rotationally-molded or injection-molded creating a hollow, lightweight form. Although plastic was a valid choice, there were

critiques about the material choice and whether a more child-friendly, sustainable option was possible. In addition to the materiality concerns, a disconnection was observed between the profiles of the small and large forms, which could be identified as an issue with the fluctuation of material thickness between the small object and large object. This difference in material thickness was the result of the different construction methods, with the small object constructed of layers and the large object constructed of panels. Along with variations in thickness, more refinement was called for in the shaping of the voids and handles. Further revision was required for the rigid form to incorporate more meaningful curves and an overall beauty into the objects. The challenge of exploring materials and infusing more meaningful curves and connections into the forms were the goals of the next revisions and design developments.

Design Development Phase Three

In an effort to address the concerns, the forms were further revised and examined. The revisions led to different material considerations in anticipation of constructing the material from a more durable material such as wood or plastic, rather than the foam. After deliberations with developing a plastic mold and the scale conceivable with those construction methods, a wood construction was deemed more suitable for the final prototypes and would provide students with a warm, easily identifiable, and natural product (Day, 2007).

With the weight of wood compared to the foam, a solid sheet construction at the needed material thickness would be too heavy to be a functioning prototype; therefore, experimentation began with a thin wooden frame to lessen the weight. A lighter, rigid

material such as an eco-plastic could rest within these wooden frames. The large object was proposed to have panels of wood with shaped edges that would be fastened together to form the shape, mimicking the thinner proportions seen in the small scale folded models (see Figure 4.31). The small object was constructed from the layering of sheets of wood. These construction methods resembled those used in the foam prototypes and continued to present a visual disconnection between the two forms, one with varying thicknesses and one with a static thickness.

Figure 4.31. Small Wooden Frame Models

To better connect the forms and infuse meaning into the curves, a new concept for construction was explored prompted by discussions with the committee members. In taking inspiration from a honeycomb or waffled structure with meaningful voids and surfaces, a more dynamic form emerged. A wooden, ribbed structure offered the strong structural elements needed while at the same time keeping it lightweight for easy movements and lifting by young children (see Figure 4.32). The overall shape and dimensions of the forms remained the same with the storage cubby still included. It was anticipated that the objects could be veneered with wood on the surface to provide solid, yet thin, surfaces for writing. However, there were concerns with veneering such a fluid form and hesitations about enclosing the form, resembling the original solid form.

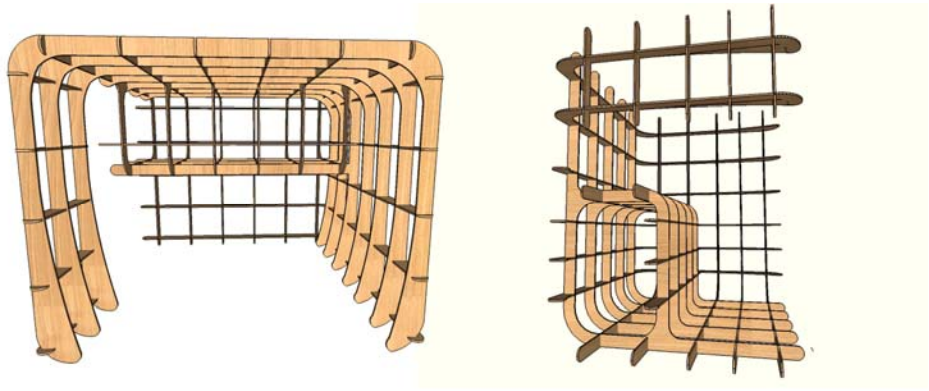

Figure 4.32. Digital Models of Ribbed Structure

The revised ribbed form was created and studied first as a digital model to explore potential profiles, leading to a more clear connection between the two pieces (see Figure 4.33). The digital models were then broken down to produce a series of templates for cutting on a laser cutter, allowing the profiles and ribs could be produced with precision.

Figure 4.33. Digital Models of Ribbed Products

A collection of small sketch models were produced using the laser cutter (see Figure 4.34). Through the production of these models, studies were done on the assembly process. Some changes were made to the slot positions based on the difficulty for insertion in some areas during the assembly process.

Figure 4.34. Small Study Models

In addition to the changes in slot locations, several form changes resulted from these initial laser cut models. The first change was to the small object in the slope of the profiles. The profiles were adjusted to allow for rocking in two directions, rather than just a side to side motion. This change resulted in a uniquely curved surface on both sides appropriate for comfort, multi-directional rocking, and stacking. With the new contouring, the tongue and groove detail present on the previous foam models was eliminated and no longer disrupted the profile on the small object. On the large object several ribs were cut to accommodate voids for the removable bins still present in the design. Once these changes were completed on the digital models, another set of small study models were cut, along with solid surface options to represent the veneered outside shell (see Figure 4.35).

At the time the plan was to veneer the exterior of these forms and possibly leave some areas open to expose the frame and provide voids for the bins. After discussions with the undergraduate assistant and the committee chair, an option was presented for having the objects fully-veneered, semi-veneered, or completely open. The attraction to the open gridded construction method was that it added a level of transparency absent in the solid structure and presented students with the opportunity to add to the form. Although there existed concerns about surface use, it was anticipated that the ribs could lead to more imaginative uses when left open, with students being able to use the inner spaces to personalize the products. This concept of offering the product three ways was reconsidered after a discussion with a committee member about the benefits of the ribs

allowing the object to ship flat. The introduction of the veneer would require the form to be shipped fully assembled, so it was decided that the product would remain uncovered.

Figure 4.35 Small Model Process for Assembly

In the absence of a veneered exterior, removable surfaces were developed that incorporated a waffle back to fit into the ribbed frame securely (see Figure 4.36). This provided the users with a flat, solid surface suitable for writing on. The removable surface also performed on its own as a lap desk or placed on the floor. This addition of a removable surface with waffle back lead to a redistribution of the ribs to form a consistent grid on the large object and a compatible grid on one surface of the small object. For the waffle back to work on both objects, the waffles were placed in a distinct pattern. With the relationships in size between the grid and waffle back, the removable

surfaces can be moved around the large objects in both horizontal and vertical applications.

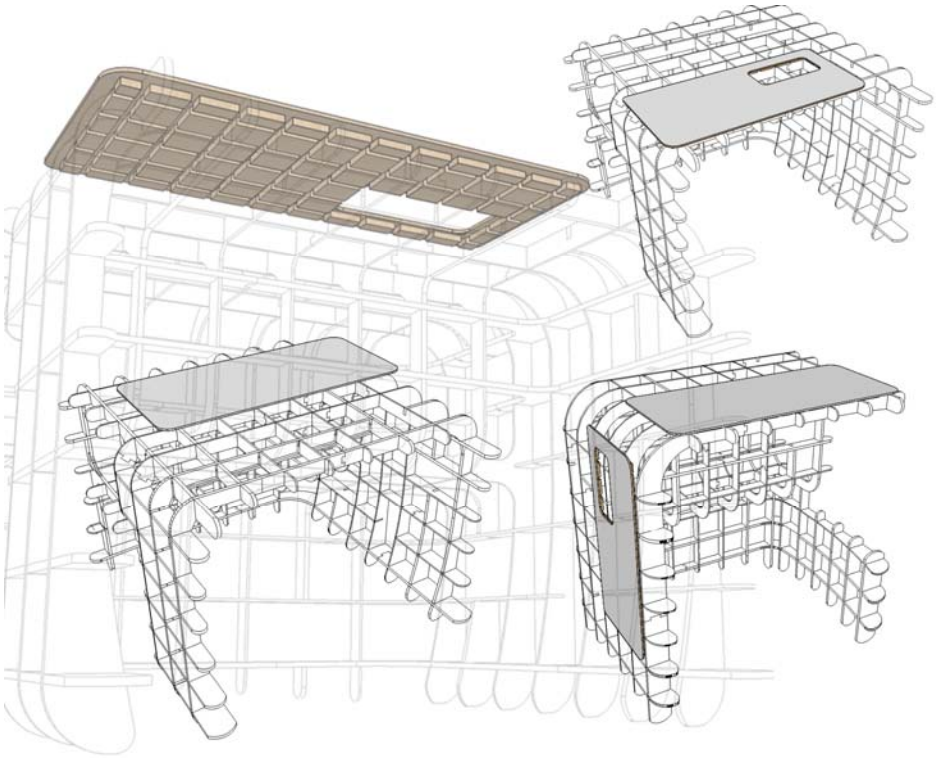

Figure 4.36. Removable Surface Renderings

Along with the removable surface, a removable bin was designed to accompany the objects to allow for independence and organization in the classroom. These bins are designed to fit within the ribbed structure with two handles on the sides that allow for a student to pickup and place the bin without pinching their fingers (see Figure 4.37). With fitting into the structure of the large object, there is a limited possibility for students to inadvertently knock the bins and supplies onto the floor of the classroom. The placement of the bin engages the users in cognitive activities with determining placement and

physical activities associated with placement of bins within the voids. The bins are small and can easily more from the floor to the voids. The bins are also usable within the small object to provide for additional storage when the small objects are stacked.

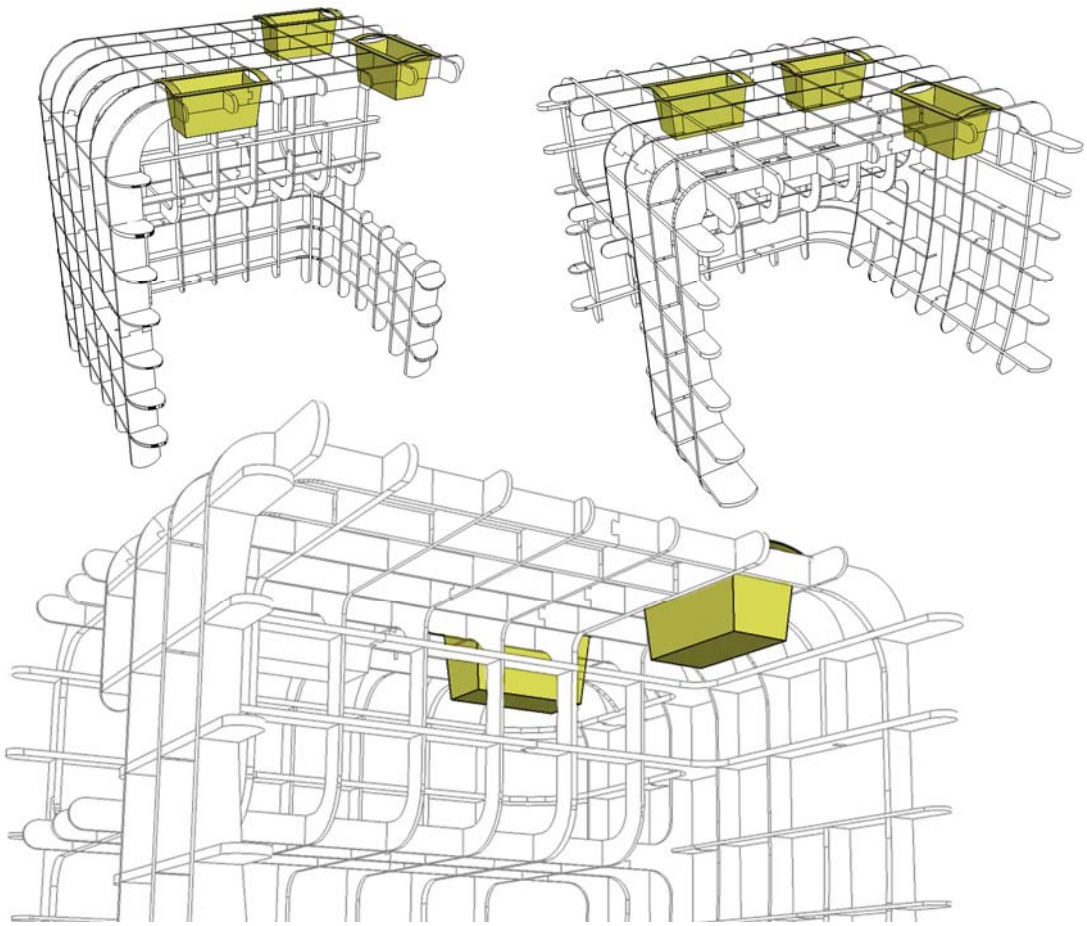

Figure 4.37. Removable Bin Renderings

In discussions with committee members, structural concerns were raised about the weakness of the leg structure in the large object. Instead of doubling the thickness of the material at these weak points, the ribs were extended and connected to other ribs at the

points of weakness. Along with extending ribs to provide a stronger frame, it was decided that the Baltic birch plywood would include a combination of a 1/8” thickness on several interior ribs and a 1/4” thickness on the exterior ribs, framing the object (see Figure 4.38). This combination allowed for a more stable form but kept the products lightweight. This combination provides visual interest and also gives students the opportunity to classify and categorize thicknesses first hand.

Figure 4.38. Photograph of Varying Material Thickness

Prototype Construction Phase Three

Before cutting the ribs out of wood, full scale cardboard prototypes were produced. The small object was cut first (see Figure 4.39). In experimenting during the construction of the pieces, several ribs were divided to allow for assembly around tight areas. The ribs were also divided in several areas due to the size of the laser cutter beds, the ribs on the large object were cut into two or three parts to fit within the 18 x 24 bed.

The divisions were made through the use of a custom dovetail connection between each piece (see Figure 4.40). The small and large objects were assembled using a labeling system that had been designed and cut into the ribs (see Figure 4.40). The labels placed on the ribs were unique to the direction of the ribs and the location in the progression. The cardboard prototypes were used to visualize and examine the scale of the object and detect any issues with the templates before cutting the wood pieces. In examining the small object, there was concern about the size of the grid in relation to the shoe size of a user who may sit cross-legged or in a kneeling position on the object and the possibility of a shoe being caught and presenting a safety risk. The grid was therefore tightened to limit the risk of an incident occurring.

Figure 4.39. Small Object Cardboard Prototype

Figure 4.40. Joints and Labeling for Assembly

Upon cutting the large object out of cardboard, the object was assembled (see Figure 4.41). Several changes were made to the lengths of several rib profiles, including shortening some of the profiles to give the illusion of a curved edge rather than a straight edge (see Figure 4.42). To make the form truly fluid and limit the probability of their being a designated up or down orientation, all right angles were eliminated throughout both objects before the final digital templates were created for the full scale plywood prototypes.

Figure 4.41. Large Object Cardboard Prototype

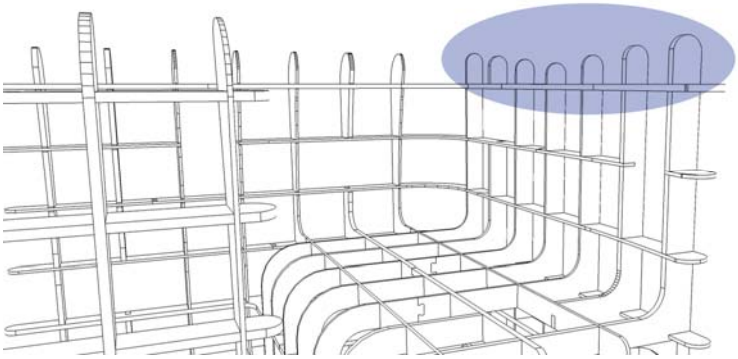

Figure 4.42 Revisions to Edges

Following several changes made to the cardboard prototypes, the final wood templates were cut from a combination of 1/8” and 1/4” Baltic birch plywood. Following the sanding of the ribs, the small and large objects were assembled using the labeling system that had been designed and cut into the ribs (Figure 4.43, & Figure 4.44). Due to a tight radius and thickness of material at several locations on the large object, three ribs were unable to be placed within the grid during assembly. After discussing the possible solutions for including the ribs with the undergraduate assistant, the ribs were each

divided into two pieces using the custom joint and cut again. In addition to revising several ribs for fit, the single leg structure on the large product proved weak and prone to swaying. To strengthen the leg, an existing rib was extended to make the leg three ribs wide instead of two ribs wide (see Figure 4.45). This change added more stability and did not detract from the aesthetics of the form.

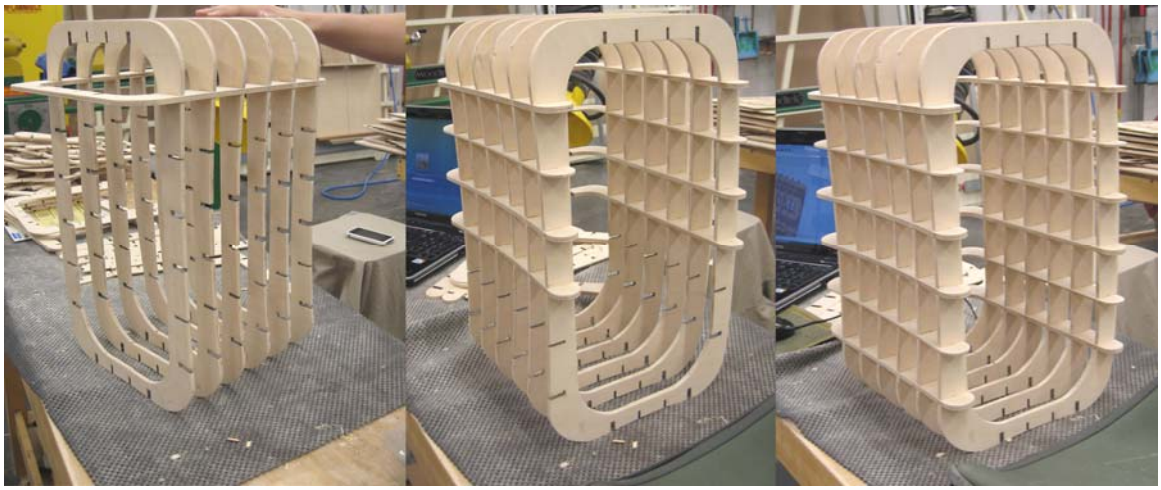

Figure 4.43. Small Object Prototype Assembly

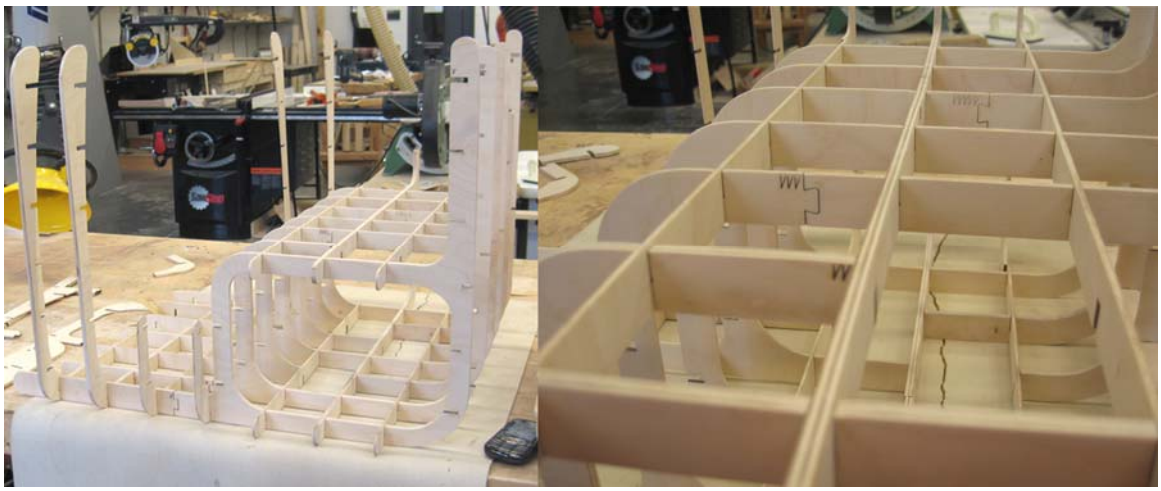

Figure 4.44. Large Object Prototype Assembly

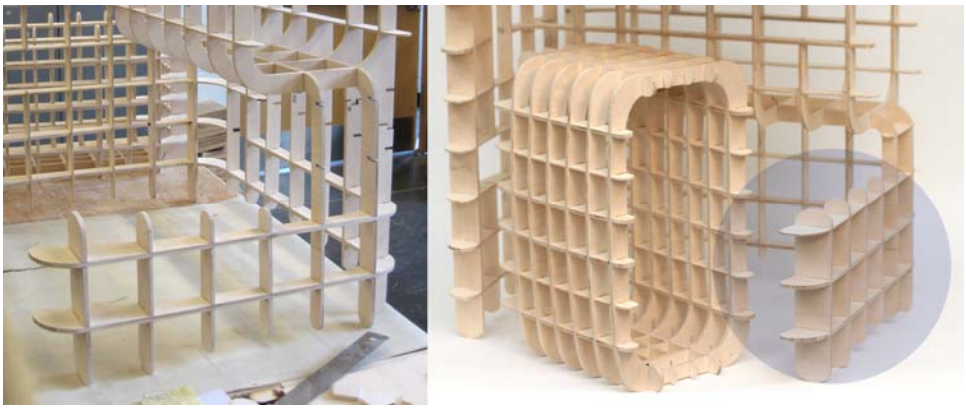

Figure 4.45. Revisions to Final Prototype

While the forms of the ribbed objects progressed, the removable surfaces were constructed with a waffle back. With the interest of having the waffle back fit snuggly on the frame, the use and fit was tested continually during construction (see Figure 4.46). The initial digital model had the waffles covering the entire back of the removable surfaces but, upon testing, only three rows were needed on the back of each surface leading to a shortened assembly time and lower weight. Through testing it was discovered that placing the surfaces within the grid took time with having to match up the grid. This task would beneficially engage the user's cognitive and physical abilities. With the pieces fitting together like a puzzle, the user would have to establish an understanding between the two forms and physically work to combine the two. This activity would develop skills in cognitive thinking and physical manipulation.

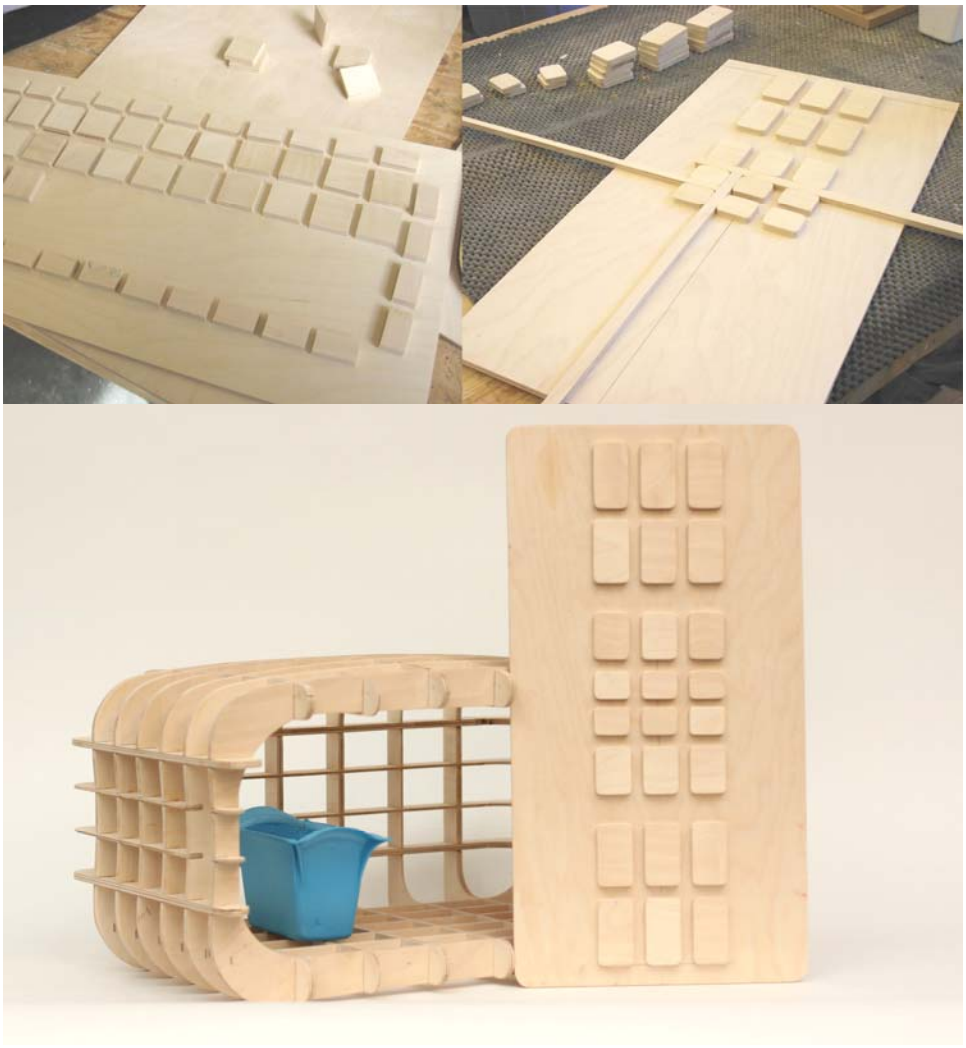

Figure 4.46. Removable Surface

The removable bin, accompanying the objects, was created through vacuum forming plastic over an form constructed from medium density fiberboard (see Figure 4.47). During this process, both styrene and soft foam were used. Ultimately, the styrene provided a more durable piece. Although, the soft foam afforded the possibility of interesting actions and uses with the ability to squish and fold the bins that then spring back to shape. The concern with the foam bin was the risk of falling through when the

weight of items stored within the bin was too great. The shape of the final bin easily fit into the frame of the large object at certain areas in both a horizontal and vertical application, allowing the user to engage and move the bin to a number of positions that may be reached from the floor and a standing position.

Figure 4.47. Removable Bin

Photographs and Visualization Phase Three

To illustrate the products and the uses, a series of visualization exercises were conducted. Due to the production of only one pair of wooden prototypes, a rendering was created to illustrate how multiples of the products would appear in a classroom (see Figure 4.48). The ability to make a combination of minor and major changes with the products creates an ever-changing environment that is full of surprises and new experiences daily. Ultimately, the options for configuration are limitless (see Figure 4.49).

The products were individually modeled by children to show a selection of intended uses for the products (see Figure 4.50 & Appendix J). During the photo shoot,

the children modeled the range of positions available with the forms including combinations of the small object and large objects, along with using the forms separately. Physical activities were modeled with a child lifting the products over their head and rotating the products into new positions. Cognitive activities were exhibited with a child counting the number of cells in a row and weaving fabric through the frame to create and learn.

Figure 4.48 Final Products in Classroom

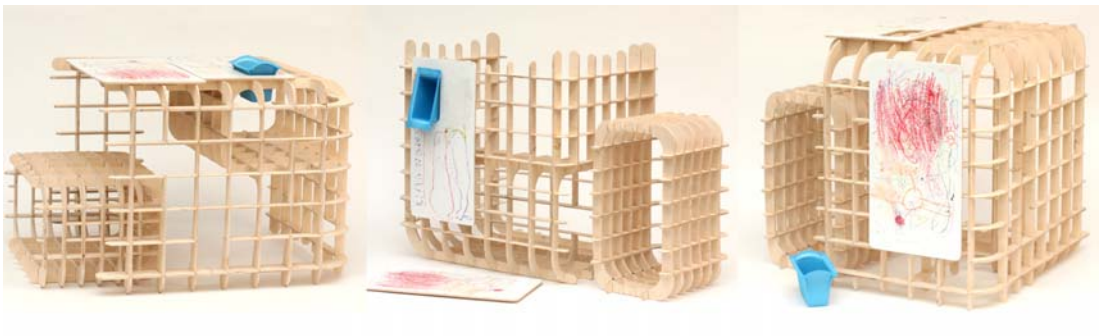

Figure 4.49. Sample of Possible Configurations

Figure 4.50. Product Use Photographs

Future Explorations

Just as the classroom environment should be ever-changing, these products too can continue to evolve. These products may be examined more through testing sessions, above and beyond the light testing exhibited during the photo shoots. A more extensive test of the products could include outfitting a classroom with these forms and allowing the students to experiment over an extended period of time. It is anticipated that changes

resulting from future product tests could include improved structural stability and inclusion of a thicker material or addition of a stronger internal material such as aluminum hidden within the ribs. Other evolutions resulting from testing sessions could include exaggerating or revising the curves in the ribs based on observed student interactions.

Along with examining its durability and longevity, the material itself can still be explored. The use of the ribs can lead to potential applications of other materials such as a bio-plastic, bamboo, or cork for sustainable and aesthetic purposes. The inclusion of new material could impact the entire form or could border the wooden ribs to protect the product during bumps and handling. Accordingly, color may also be experimented with further. Color could reflect the material's natural finish, a stain, or a paint surface (see Figure 4.51). With the natural wood it is possible that the students, teachers, or school staff could opt to paint the entire object or a selection of ribs. Paint could be applied to match school colors, which are prominent throughout the school environment.

Figure 4.51. Color Studies

As students and teachers have the opportunity to bring additional elements to these objects, it is fair to predict that different accessories could be produced to further strengthen the realm of possibilities with these objects. Accessories, in addition to the removable bin and removable surface, could include such items as a lighting element, a soft surface, additional storage, and a name tag. During the photo shoot, additional items

were modeled with the products to show the possibilities including a pillow, games relating to the structure, and weaving or craft exercises (see Figure 4.52). There is also a grand opportunity for accessories that could complement subject matter being introduced at the time that a school could purchase such as a measuring tool for learning to measure and mathematical games. The accessories currently provided with the objects are intended as a starting point and anticipated to grow through designed add-ons and those imagined by the users.

Figure 4.52 Examples of Additional Accessories Used with Products

With the products intended for classroom use, mass production would be necessary. The final wooden prototype was constructed on a laser cutter, but with the time and energy consumed during the production of a single pair of objects this fabrication method would not be the most economical and practical production method at a large scale. Suggestions for exploration would include CNC production, water jet production, plastic molding, and dye cutting. All methods, of course, have their pros and cons and many would require a mock-up prototype to test the form in that method.

These future explorations are driven by the themes of movement and engagement, creativity, scale, comfort, and multiple positions observed in the classrooms and conveyed in the student's drawings. The despecialized nature of the design, even through evolution, can continue to be examined with relation to a child's perceived affordances and to test their developmental abilities.

CHAPTER V

CONCLUSIONS

The framework and justification provided by the theories of affordance, middle childhood, and third teacher supported the synthesis of a design process that engaged students and teachers in a participatory approach. The input of student-identified needs and classroom improvements fortified better-informed design decisions. The student drawings communicated various issues described by students accompanied by thoughtful solutions to those issues through visual and verbal means. During the design process, the use of both digital and physical process models of proposed furniture forms prompted valuable discussions with committee members, faculty, and fellow students. The insights collected during those discussions and critiques, along with the information collected from the participating classroom teachers and participating classroom students, ameliorated the classroom furniture designs produced as a result of this investigation.

Designing Relationships

The series of products created during this investigation successfully exhibited the despecialized nature intended in these imagination-evoking and responsive classroom furnishings. The concept of a generic form for unanticipated use is visible in the asymmetrical, rotatable forms. The light-weight construction of the products allows students to easily move and manipulate the products to form customized learning spaces

and modify their environment. The products also work with other accessories that may accompany the furniture in the classroom including pillows and books.

The principles of the third teacher philosophy were used during the design process through the maturation of an intriguing form and transparent structure that relates to the scale of the products, in addition to promoting active learning through opportunities for exploration and hands-on movements. With the responsive nature of the products, collaboration, reciprocity, and relationships may develop during the interactions of students with the products.

Through the consideration of developmental appropriate design elements, the products are intended to promote physical, cognitive, social, and effective development. With the ability to rock, stack, and rotate, the products themselves encourage the students to become physically active while using the products and challenge them with balancing, lifting, and manipulation activities. Cognitive challenges are present through the consideration of product placement, product exploration, and product creativity. Through the act of doing things with these products, students engage in shared activities that may strengthen social skills and social awareness with other students in the class. Through the customization and creative outlets designed into the object, students can display their personality and character in a more imaginative way.

Participatory Design

The inclusion of users in the design process added value to the decision making process and provided a number of themes, such as movement, variation in scale, and more variety, used to inform the researcher of elements that students found valuable in

the classroom. The ability to observe the classroom environment provided the designer with many answers and a valid reference to use throughout the design process. The activities observed in the classroom and the positions of the students throughout the day support the idea that children are constantly moving. The observations provided a collection of both positive and negative aspects of the furniture that provided direction for the design decisions.

Challenges

Throughout the participatory process, the main challenge was the use of an intensive study for the observations and drawing activities and lack of extensive approach. The longevity of the study and interactions with the participants where designed to fit within the time line of the program and related to IRB lead times and school approval lead times. More opportunities for engagement with the participants could further benefit from a more extensive participatory study, including participants more throughout the design phase.

Future Studies

The nature of this study encourages new studies involving end-users in the design process. Extending the drawing activity over a more prolonged period would give participating students even more opportunities to think about their classroom products and their interactions with the products, enriching the experience for both the researcher and students involved. A testing session would be the next step in the investigation of these products to test uses over time and in the proposed environment. This, of course, would require multiple productions of the forms involving financial means to produce the

models, time for construction and studies, and further IRB approval for student participation. As with many designs studies, further explorations arise as the design progresses. Further material explorations would benefit the form with the possible inclusion more sustainable and durable materials, accompanied by color or different finishes. With the anticipation of the products shipping flat and being assembled on site, a testing session of assembly would benefit the product prior to marketing and large scale production.

Designing for and with Children

Through this study, a new collection of products were designed that accommodate a range of different learning postures and support active learning. These products were designed with the intention of creating positive relationships between the student and the classroom furnishings during varying activities. Engaging the users in the process affected the design outcome in that the program incorporated more user specific needs observed first hand and represented in student drawings. Aesthetic and functional elements adopted to create these new types of furnishings were influenced by both the existing literature through the discussion of developmentally appropriate design and despecialization, while pulling further from the student drawings collected from the participating classrooms.`

The importance of this study is that it demonstrates the advantage of involving the child in the design process. Through this inclusive process, the classroom furnishings developed in this study were designed for change. As the learning process itself is a progression of change and growth, so too should the environment and furniture

supporting those in that environment. In conclusion, it was revealed during this study that the inclusion of participants in a design process provided valuable information, working from basic forms can enable the production of despecialized objects beneficial for imaginative use, and that a design is never complete when the user continually, through use and adaptation, has the ability to change the function and meanings. The design process is continuous, even after it leaves the designers hands, when a product is designed for creativity, flexibility, change, and independence.

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APPENDIX A

CONSENT FORMS

UNIVERSITY OF NORTH CAROLINA AT GREENSBORO

CONSENT TO ACT AS A HUMAN PARTICIPANT: LONG FORM

Project Title: Primary Objects: Developing a New Typology for Early Elementary Classroom Furniture

Project Director: Dr. Anna Marshall-Baker

Participant's Name:

What is the study about?
This is a research project. This study involves research of classroom products and furniture. The purpose of this research is to develop a new type of furniture for use in the early elementary classroom that allow for different ways for children to interact with furniture. The information obtained through this study will be used to design a new type of furniture for early elementary classrooms.

This research is also being conducted to fulfill requirements for a Thesis in Interior Product Design in the Department of Interior Architecture in the School of Human Environmental Sciences at The University of North Carolina at Greensboro. The process will be documented using an online blog that will document both the data collection process and design process. The identity of all participants will be kept confidential and will not appear the blog. You are invited to visit the blog at http://primaryobjectsprocess.blogspot.com/.

Why are you asking me?
With this study focusing on first and second grade classroom environments, you and your classroom have been selected as a typical example and will be used as the environment where the data will be collected. You have been asked to participate in this study because you are a teacher in the Guilford County School District.

What will you ask me to do if I agree to be in the study?
Your classroom will participate in a two-day long observation. Prior to the observation an inventory study will be conducted in your classroom where the student researcher will take measurements to create a floor plan and photographs of the existing furniture used. During this observation session, you will be asked to participate in a validation discussion to verify the researcher's observations and interpretations. These discussions may take place at your convenience and will occur once per day. On the second day of the observations, a drawing activity will be presented to the student in the classroom. During this drawing activity the students will be asked to think about the classroom furniture, their experiences with classroom furniture, and how furniture can be improved. They will present their ideas through drawings and will be given the opportunity to present their ideas and drawings to their classmates, teacher, and researcher.

What are the dangers to me?
Risks involved in this study may include any anxiety and embarrassment associated with answering questions.

If you have any concerns about your rights, how you are being treated or if you have questions, want more information or have suggestions, please contact Eric Allen in the Office of Research Compliance at UNCG at (336) 256-1482. Questions, concerns or complaints about this project or benefits or risks associated with being in this study can be answered by Dr. Anna Marshall-Baker who may be contacted at (336) 256-

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0307or by email at a_marsha@uncg.edu and Ms. Stephanie Brooker who may be contacted at (215) 896-0678 or by email at slbrooke@uncg.edu.

Are there any benefits to me for taking part in this research study?
There are no benefits to taking part in this research study.

Are there any benefits to society as a result of me taking part in this research?
The research study may benefit society in further demonstrating the opportunities to gain insight into the student's perspective of the classroom environment.

Will I get paid for being in the study? Will it cost me anything?
There are no costs to you or payments made for participating in this study. Materials for the drawing activity will be provided by the researcher.

How will you keep my information confidential?
Information collected during this study will be kept confidential. Procedures will be taken to assure confidentiality; as such signed consent forms will be stored in a locked file cabinet in the primary researcher's office on the campus of the University of North Carolina at Greensboro. Teacher participants will not be identified by name due to a confidential data collection procedure in which all validations and explanations will be assigned an individual letter. All information obtained in this study is strictly confidential unless disclosure is required by law. Inventory photographs and observations taken of your classroom during this study may be used on the student researcher's blog and thesis presentations, however all participant identities will be kept confidential.

In addition, there are certain instances where the researcher is legally required to give information to the appropriate authorities. These would include mandatory reporting of information about behavior that is immediately dangerous to you or to others, such as child abuse, etc.

What if I want to leave the study?
You have the right to refuse to participate or to withdraw at any time, without penalty. If you do withdraw, it will not affect you in any way. If you choose to withdraw, you may request that any of your data which has been collected be destroyed unless it is in a de-identifiable state. Your decision to participate will not affect your relationship with the school.

What about new information/changes in the study?
If significant new information relating to the study becomes available which may relate to your willingness to continue to participate, this information will be provided to you.

Voluntary Consent by Participant:
By signing this consent form you are agreeing that you read, or it has been read to you, and you fully understand the contents of this document and are openly willing consent to take part in this study. All of your questions concerning this study have been answered. By signing this form, you are agreeing that you are 18 years of age or older and are agreeing to participate, or have the individual specified above as a participant participate, in this study described to you by Dr. Anna Marshall-Baker and Ms. Stephanie Brooker.

Signature: _____ Date: _____

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Valid 5/25/10 to 5/24/11

UNIVERSITY OF NORTH CAROLINA AT GREENSBORO

CONSENT FOR A MINOR TO ACT AS A HUMAN PARTICIPANT: LONG FORM

Project Title: Primary Objects: Developing a New Typology for Early Elementary Classroom Furniture

Project Director: Dr. Anna Marshall-Baker

Participant's Name:

What is the study about?
This study involves research of classroom products and furniture. The purpose of this research is to develop a new type of furniture for use in the early elementary classroom that allow for different ways for children to interact with furniture. The information obtained through this study will be used to design a new type of furniture for early elementary classrooms. Your child will be participate in a drawing activity in which they will be asked to think about the classroom furniture, their experiences with classroom furniture, and how furniture can be improved. They will present their ideas through drawing and be given the opportunity to present their ideas and drawings to their classmates, teacher, and researcher. The information obtained through this study will be used to design a new type of furniture for early elementary classrooms.

This research is also being conducted to fulfill requirements for a Thesis in Interior Product Design in the Department of Interior Architecture in the School of Human Environmental Sciences at The University of North Carolina at Greensboro. The process will be documented using an online blog that will document both the data collection process and design process. The identity of all participants will be kept confidential and will not appear in the blog. You are invited to visit the blog at http://primaryobjectsprocess.blogspot.com/.

Why are you asking my child?
Your child has been selected for this activity because they are a student in a classroom that is being observed for this study.

What will you ask my child to do if I agree to let him or her be in the study?
Your child will be asked to participate in a classroom drawing activity. Your child will be asked to consider how they feel the classroom furniture and arrangement of furniture could be improved. Your child will be provided with paper and crayons to draw their ideas. Upon completion of the drawing activity, the participating students will be given the opportunity to share their ideas and talk about their drawings to their classmates, the teacher, and researcher.

What are the dangers to my child?
Risks to your child may include any anxiety and embarrassment associated with drawing, presenting in front of a class, and answering questions.

If you have any concerns about your child's rights, how they are being treated or if you have questions, want more information or have suggestions, please contact Eric Allen in the Office of Research Compliance at UNCG at (336) 256-1482. Questions about this project or benefits or risks associated with being in this study can be answered by Dr. Anna Marshall-Baker who may be contacted at (336) 256-0307or by email at a_marsha@uncg.edu and Ms. Stephanie Brooker at 215-896-0678 or slbrooke@uncg.edu.

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Are there any benefits to my child as a result of participation in this research study?
There are no direct benefits to participants in this study.

Are there any benefits to society as a result of my child taking part in this research?
The research study may benefit society in further demonstrating the opportunities to gain insight into the student's perspective of the classroom environment.

Will my child get paid for being in the study? Will it cost me anything for my kid to be in this study? There are no costs to you or payments to you or your child as a result of participation in this study. All materials will be provided.

How will my child's information be kept confidential?
Information collected during this study will be kept confidential. Procedures will be taken to assure confidentiality; as such signed consent and assent forms will be stored in a locked file cabinet in the primary researcher's office on the campus of the University of North Carolina at Greensboro. Student participants will not be identified by name due to a confidential data collection procedure in which all student participant drawings and explanations will be assigned an individual number. All information obtained in this study is strictly confidential unless disclosure is required by law. The drawings collected and insights presented by your child during this study may be used on the student researcher's blog and thesis presentations, however all identities of the participants will be kept confidential. Your child's identity will not appear on the blog.

In addition, there are certain instances where the researcher is legally required to give information to the appropriate authorities. These would include mandatory reporting of information about behavior that is immediately dangerous to you or to others, such as suicide, child abuse, etc.

What if my child wants to leave the study or I want him/her to leave the study?
You have the right to refuse to allow your child to participate or to withdraw him or her at any time, without penalty. If your child does withdraw, it will not affect you or your child in any way. If you or your child chooses to withdraw, you may request that any data which has been collected be destroyed unless it is in a de-identifiable state. Your decision to have your child participate in this study will not affect your relationship or your child's relationship with the school or their grades.

What about new information/changes in the study?
If significant new information relating to the study becomes available which may relate to your willingness allow your child to continue to participate, this information will be provided to you.

Voluntary Consent by Participant:
By signing this consent form, you are agreeing that you have read it or it has been read to you, you fully understand the contents of this document and consent to your child taking part in this study. All of your questions concerning this study have been answered. By signing this form, you are agreeing that you are the legal parent or guardian of the child who wishes to participate in this study described to you by Dr. Anna Marshall-Baker and Ms. Stephanie Brooker.

_____ Date: _____
Participant's Parent/Legal Guardian's Signature

_____ Date: _____
Participant's Parent/Legal Guardian's Signature

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Valid 5/25/11 to 5/24/11

UNIVERSITY OF NORTH CAROLINA AT GREENSBORO

CONSENT TO ACT AS A HUMAN PARTICIPANT: LONG FORM

Project Title: Primary Objects: Developing a New Typology for Early Elementary Classroom Furniture

Project Director: Dr. Anna Marshall-Baker

Participant's Name:

What is the study about?
This is a research project. This study involves research of classroom products and furniture. The purpose of this research is to develop a new type of furniture for use in the early elementary classroom that allow for different ways for children to interact with furniture. The information obtained through this study will be used to design a new type of furniture for early elementary classrooms.

This research is also being conducted to fulfill requirements for a Thesis in Interior Product Design in the Department of Interior Architecture in the School of Human Environmental Sciences at The University of North Carolina at Greensboro. The process will be documented using an online blog that will document both the data collection process and design process. The identity of all participants will be kept confidential and will not appear the blog. You are invited to visit the blog at http://primaryobjectsprocess.blogspot.com/.

Why are you asking me?
With this study focusing on first and second grade classroom environments, you and your classroom have been selected as a typical example and will be used as the environment where the data will be collected. You have been asked to participate in this study because you are a teacher in the Guilford County School District.

What will you ask me to do if I agree to be in the study?
Your classroom will participate in a day long observation. Prior to the observation an inventory study will be conducted in your classroom where the student researcher will take measurements to create a floor plan and photographs of the existing furniture used. During this observation session, you will be asked to participate in a validation discussion to verify the researcher's observations and interpretations. These discussions may take place at your convenience and will occur once per day. A drawing activity will be presented to the students in the classroom. During this drawing activity the students will be asked to think about the classroom furniture, their experiences with classroom furniture, and how furniture can be improved. They will present their ideas through drawings and will be given the opportunity to present their ideas and drawings to their classmates, teacher, and researcher.

What are the dangers to me?
Risks involved in this study may include any anxiety and embarrassment associated with answering questions.

If you have any concerns about your rights, how you are being treated or if you have questions, want more information or have suggestions, please contact Eric Allen in the Office of Research Compliance at UNCG at (336) 256-1482. Questions, concerns or complaints about this project or benefits or risks associated with being in this study can be answered by Dr. Anna Marshall-Baker who may be contacted at (336) 256-

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0307or by email at a_marsha@uncg.edu and Ms. Stephanie Brooker who may be contacted at (215) 896-0678 or by email at slbrooke@uncg.edu.

Are there any benefits to me for taking part in this research study?
There are no benefits to taking part in this research study.

Are there any benefits to society as a result of me taking part in this research?
The research study may benefit society in further demonstrating the opportunities to gain insight into the student's perspective of the classroom environment.

Will I get paid for being in the study? Will it cost me anything?
There are no costs to you or payments made for participating in this study. Materials for the drawing activity will be provided by the researcher.

How will you keep my information confidential?
Information collected during this study will be kept confidential. Procedures will be taken to assure confidentiality; as such signed consent forms will be stored in a locked file cabinet in the primary researcher's office on the campus of the University of North Carolina at Greensboro. Teacher participants will not be identified by name due to a confidential data collection procedure in which all validations and explanations will be assigned an individual letter. All information obtained in this study is strictly confidential unless disclosure is required by law. Inventory photographs and observations taken of your classroom during this study may be used on the student researcher's blog and thesis presentations, however all participant identities will be kept confidential.

In addition, there are certain instances where the researcher is legally required to give information to the appropriate authorities. These would include mandatory reporting of information about behavior that is immediately dangerous to you or to others, such as child abuse, etc.

What if I want to leave the study?
You have the right to refuse to participate or to withdraw at any time, without penalty. If you do withdraw, it will not affect you in any way. If you choose to withdraw, you may request that any of your data which has been collected be destroyed unless it is in a de-identifiable state. Your decision to participate will not affect your relationship with the school.

What about new information/changes in the study?
If significant new information relating to the study becomes available which may relate to your willingness to continue to participate, this information will be provided to you.

Voluntary Consent by Participant:
By signing this consent form you are agreeing that you read, or it has been read to you, and you fully understand the contents of this document and are openly willing consent to take part in this study. All of your questions concerning this study have been answered. By signing this form, you are agreeing that you are 18 years of age or older and are agreeing to participate, or have the individual specified above as a participant participate, in this study described to you by Dr. Anna Marshall-Baker and Ms. Stephanie Brooker.

Signature: _____ Date: _____

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UNIVERSITY OF NORTH CAROLINA AT GREENSBORO

CONSENT TO ACT AS A HUMAN PARTICIPANT: LONG FORM

Project Title: Primary Objects: Developing a New Typology for Early Elementary Classroom Furniture

Project Director: Dr. Anna Marshall-Baker

Participant's Name:

What is the study about?
This is a research project. This study involves research of classroom products and furniture. The purpose of this research is to develop a new type of furniture for use in the early elementary classroom that allow for different ways for children to interact with furniture. The information obtained through this study will be used to design a new type of furniture for early elementary classrooms.

This research is also being conducted to fulfill requirements for a Thesis in Interior Product Design in the Department of Interior Architecture in the School of Human Environmental Sciences at The University of North Carolina at Greensboro. The process will be documented using an online blog that will document both the data collection process and design process. The identity of all participants will be kept confidential and will not appear the blog. You are invited to visit the blog at http://primaryobjectsprocess.blogspot.com/.

Why are you asking me?
With this study focusing on first and second grade classroom environments, you and your classroom have been selected as a typical example and will be used as the environment where the data will be collected. You have been asked to participate in this study because you are a teacher in the Guilford County School District.

What will you ask me to do if I agree to be in the study?
A drawing activity will be presented to the students in your classroom that will take no longer than 45 minutes to conduct. During this drawing activity the students will be asked to think about the classroom furniture, their experiences with classroom furniture, and how furniture can be improved. They will present their ideas through drawings and will be given the opportunity to present their ideas and drawings to their classmates, teacher, and researcher. During this activity the students will be observed by the researcher.

There is a possibility that not all parental consent forms will be returned to the classroom, as the teacher you will be responsible for dictating a different drawing activity or classroom activity to those students who have not had a parent or guardian provide parental consent for their child to participate.

What are the dangers to me?
Risks involved in this study are minimal and may include any anxiety and stress associated with organization of the drawing activity.

If you have any concerns about your rights, how you are being treated or if you have questions, want more information or have suggestions, please contact Eric Allen in the Office of Research Compliance at UNCG at (336) 256-1482. Questions, concerns or complaints about this project or benefits or risks associated with

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being in this study can be answered by Dr. Anna Marshall-Baker who may be contacted at (336) 256-0307or by email at a_marsha@uncg.edu and Ms. Stephanie Brooker who may be contacted at (215) 896-0678 or by email at slbrooke@uncg.edu.

Are there any benefits to me for taking part in this research study?
There are no benefits to taking part in this research study.

Are there any benefits to society as a result of me taking part in this research?
The research study may benefit society in further demonstrating the opportunities to gain insight into the student's perspective of the classroom environment.

Will I get paid for being in the study? Will it cost me anything?
There are no costs to you or payments made for participating in this study. Materials for the drawing activity will be provided by the researcher.

How will you keep my information confidential?
Information collected during this study will be kept confidential. Procedures will be taken to assure confidentiality; as such signed consent forms will be stored in a lockable file cabinet in the primary researcher's office on the campus of the University of North Carolina at Greensboro. Teacher participants will not be identified by name due to a confidential data collection procedure in which all validations and explanations will be assigned an individual letter. All information obtained in this study is strictly confidential unless disclosure is required by law. Observations taken of your classroom during this study may be used on the student researcher's blog and thesis presentations, however all participant identities will be kept confidential.

In addition, there are certain instances where the researcher is legally required to give information to the appropriate authorities. These would include mandatory reporting of information about behavior that is immediately dangerous to you or to others, such as child abuse, etc.

What if I want to leave the study?
You have the right to refuse to participate or to withdraw at any time, without penalty. If you do withdraw, it will not affect you in any way. If you choose to withdraw, you may request that any of your data which has been collected be destroyed unless it is in a de-identifiable state. Your decision to participate will not affect your relationship with the school.

What about new information/changes in the study?
If significant new information relating to the study becomes available which may relate to your willingness to continue to participate, this information will be provided to you.

Voluntary Consent by Participant:
By signing this consent form you are agreeing that you read, or it has been read to you, and you fully understand the contents of this document and are openly willing consent to take part in this study. All of your questions concerning this study have been answered. By signing this form, you are agreeing that you are 18 years of age or older and are agreeing to participate, or have the individual specified above as a participant participate, in this study described to you by Dr. Anna Marshall-Baker and Ms. Stephanie Brooker.

Signature: _____ Date: _____

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El consentimiento de los participantes voluntarios:
Al firmar este formulario de consentimiento, usted está indicando que lo ha leído o se lo han leído, y que entiende perfectamente el contenido de este documento para que su hijo/a participe en este estudio y que también todas sus preguntas sobre este han sido contestadas. Al firmar este formulario, usted está indicando que es el padre legal o tutor del niño/a participante en este estudio que se le describe a usted por la Dra. Anna Baker Marshall y la Srta. Stephanie Brooker.

_____ Fecha: _____
Firma del padre legal o tutor del niño/a participante

_____ Fecha: _____
Firma del padre legal o tutor del niño/a participante

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UNIVERSITY OF NORTH CAROLINA AT GREENSBORO

Study Title: Primary Objects: developing a new typology for early elementary classroom furniture

My name is Stephanie Brooker.

What is this about?
I would like to talk to you about your classroom furniture. I want to learn about your favorite spots and furniture in your classroom and how you think the furniture in the classroom could be better. I will use your ideas to help with designing a new type of furniture that may be used in the classroom.

Did my parents say it was ok?
Your parent(s) said it was ok for you to be in this study and have signed a form like this one.

Why me?
We would like you to take part because you spend a lot of time in your classroom and can share your experiences and thoughts to help the researcher better understand how the classroom furniture could be better. Your thoughts and ideas about the classroom furniture and arrangement are respected by the researcher.

What if I want to stop?
You do not have to say "yes", if you do not want to take part. We will not punish you if you say "no". Even if you say "yes" now and change your mind after you start doing this study, you can stop and no one will be mad at you. Your decision to take part in this study will not affect your relationship with the school or your grades.

What will I have to do?
During this study you will be asked to draw pictures of your favorite spot in the classroom and how you would make the furniture in your classroom better. Once you draw your pictures you will be able to share your pictures with your classmates, the teacher and the researcher. You will share your drawings by talking about what you have drawn.

Will anything bad happen to me?
You may experience nervous feelings during the drawing activity, talking in front of your class, and answering questions.

Will anything good happen to me?
You will be able to share your ideas about the classroom and how the classroom furniture could be better. Your participation in this study will help with showing how student's ideas and drawings can be valued in research.

Do I get anything for being in this study?
Your drawings will be collected at the end of the drawing activity and will be returned to you after the researcher has copied the drawings.

What if I have questions?
You are free to ask questions at any time.

If you understand this study and want to be in it, please write your name below.

_____ _____
Signature of child Date

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Valid 8/31/10 to 5/24/11

LA UNIVERSIDAD DE CAROLINA DEL NORTE EN GREENSBORO

FORMA DE PERMISO PARA PARTICIPANTES HUMANOS MENORES DE EDAD: FORMA LARGA

Titulo del Proyecto: Objetos Primarios: Desarrollo de una nueva tipología de mobiliario de aulas de primaria

Directora de Proyecto: Dr. Anna Marshall-Baker

Nombre del/de la Participante: _____

¿De que trata esta investigación?

Esta actividad es un proyecto de investigación. Este estudio implica la investigación de productos de clase y los muebles. El propósito de esta investigación es desarrollar un nuevo tipo de mobiliario para uso en las aulas de primarias que permiten diferentes formas para que los niños interactúen con los muebles. La información obtenida a través de este estudio se utilizará para diseñar un nuevo tipo de mobiliario para las aulas de primarias. Su hijo/a participará en una actividad de dibujo en el que se les pedirá que piensen en el mobiliario escolar, sus experiencias con mobiliarios escolares, y cómo se pueden mejorar los mismos. Ellos presentarán sus ideas a través del dibujo y se le dará la oportunidad de presentar sus ideas y dibujos con sus compañeros de clase, maestros/as, y la investigadora.

Esta investigación también se está llevando a cabo para cumplir con los requisitos para una tesis de Diseño de Productos de Interiores en el Departamento de Arquitectura de Interiores en la Escuela de Ciencias del Ambiente Humano de la Universidad de Carolina del Norte en Greensboro. El proceso será documentado mediante un blog del Internet que documentará tanto el proceso de recopilación de datos como procesos de diseño. La identidad de todos los participantes será confidencial y no aparecerá en el blog. Usted está invitado a visitar el blog en http://primaryobjectsprocess.blogspot.com/.

¿Por qué le estás preguntando a mi hijo/a?
Su hijo/a ha sido seleccionado para esta actividad, porque es un estudiante de un aula que se ha observado en este estudio.

¿Qué vas a pedir de mi hijo/a para saber si estoy de acuerdo en que participe en el estudio?
Su hijo será invitado a participar en una actividad de dibujo en su clase y se le pedirá que piense en su lugar favorito del aula y cómo cree que el mobiliario y la disposición de los muebles puede ser mejor. A su hijo se le dará papel y crayones para dibujar sus ideas. Durante y al término de la actividad de dibujo, los estudiantes participantes tendrán la oportunidad de compartir sus ideas y de hablar de sus dibujos con sus compañeros de clase, el maestro/a y la investigadora.

¿Cuáles son los riesgos de mi hijo/a?

Los riesgos de su hijo/a es que pueden incluir la ansiedad y la vergüenza asociada con el

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dibujo, la presentación frente a una clase, y contestar preguntas.

Si usted tiene alguna preocupación acerca de los derechos de su hijo o cómo están siendo tratados, si desea más información, o tiene alguna sugerencia, por favor póngase en contacto con Eric Allen en la Oficina de Investigación de UNCG al (336) 256-1482. Preguntas sobre este proyecto o los beneficios o riesgos asociados con participar en este estudio pueden ser respondidas por la Dra. Anna Marshall-Baker, que puede ser contactada en (336) 256-0307 o por correo electrónico en a_marsha@uncg.edu o la Srta. Stephanie Brooker en (215) 896-0678 o por correo electrónico en slbrooke@uncg.edu.

¿Hay beneficios para mi hijo por su participación en este estudio de investigación?
No hay beneficios directos para los participantes en este estudio.

¿Hay beneficios para la sociedad que podrían resultar por la participación de mi hijo/a en esta investigación?
Este estudio de investigación puede beneficiar a la sociedad para seguir demostrando las oportunidades de profundizar en la perspectiva del estudiante en el ambiente de su aula.

¿A mi hijo se le pagará por participar en el estudio? ¿Me costará algo para que mi hijo participe en este estudio?
Ningún pago estará recibido y ningún costo se hará por participar en esta investigación.

¿De qué manera se mantendrá confidencial la información de mi hijo/a?
La información recopilada durante este estudio se mantendrá confidencial. Los procedimientos serán tomados para asegurar la confidencialidad. Formas tales como el consentimiento firmado o las formas de dictamen serán guardados en un archivador cerrado con llave en la oficina de la investigadora principal en la Universidad de Carolina del Norte en Greensboro. Los estudiantes participantes no serán identificados por sus nombres y a todos sus dibujos y explicaciones se le asignará un número individual. Toda la información obtenida en este estudio es estrictamente confidencial a menos que sea requerido por la ley. Los dibujos obtenidos y sus explicaciones, en su forma confidencial, pueden ser utilizados en el blog de la investigadora y durante la presentación de su tesis.

Además, hay ciertos casos en que la investigadora está obligada por la ley a dar información a las autoridades competentes. Estos incluirían la notificación obligatoria sobre algún comportamiento que constituye un peligro inmediato para usted o para otros, como el suicidio o el abuso infantil, etc.

¿Qué pasa si mi hijo/a o yo queremos abandonar el estudio?
Usted tiene el derecho de negarse a que su hijo participe y que se retire en cualquier momento sin ningún problema. Si su hijo se retira, no lo va a afectar a usted o a el mismo de ninguna manera. Si usted o su hijo/a deciden retirarse, usted puede solicitar que los datos recogidos sean destruidos a menos que estén sin identificar. Su decisión de que su hijo participe en este estudio no afectará su relación o la relación del niño con la escuela o con sus calificaciones.

¿Qué pasa si hay nueva información o cambios en el estudio?
Si hay nueva información significativa en relación con el estudio que afectará su voluntad de permitir que su hijo/a sigan participando, esta información será proporcionada a usted.

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UNIVERSITY OF NORTH CAROLINA AT GREENSBORO

CONSENT FOR A MINOR TO ACT AS A HUMAN PARTICIPANT: LONG FORM

Project Title: Primary Objects: Developing a New Typology for Early Elementary Classroom Furniture

Project Director: Dr. Anna Marshall-Baker

Participant's Name:_____

What is the study about?
This study involves research of classroom products and furniture. The purpose of this research is to develop a new type of furniture for use in the early elementary classroom that allow for different ways for children to interact with furniture. The information obtained through this study will be used to design a new type of furniture for early elementary classrooms. Your child will be participate in a drawing activity in which they will be asked to think about the classroom furniture, their experiences with classroom furniture, and how furniture can be improved. They will present their ideas through drawing and be given the opportunity to present their ideas and drawings to their classmates, teachers, and the researcher.

This research is also being conducted to fulfill requirements for a Thesis in Interior Product Design in the Department of Interior Architecture in the School of Human Environmental Sciences at The University of North Carolina at Greensboro. The process will be documented using an online blog that will document both the data collection process and design process. The identity of all participants will be kept confidential and will not appear in the blog. You are invited to visit the blog at http://primaryobjectsprocess.blogspot.com/.

Why are you asking my child?
Your child has been selected for this activity because they are a student in a classroom that has been observed for this study.

What will you ask my child to do if I agree to let him or her be in the study?
Your child will be asked to participate in a classroom drawing. Your child will be asked to think about their favorite spot in the classroom and how they think the classroom furniture and arrangement of furniture could be better. Your child will be provided with paper and crayons to draw their ideas. During and upon completion of the drawing activity, the participating students will be given the opportunity to share their ideas and talk about their drawings to their classmates, the teacher, and researcher.

What are the dangers to my child?
Risks to your child may include any anxiety and embarrassment associated with drawing, presenting in front of a class, and answering questions.

If you have any concerns about your child's rights, how they are being treated or if you have questions, want more information or have suggestions, please contact Eric Allen in the Office of Research Compliance at UNCG at (336) 256-1482. Questions about this project or benefits or risks associated with being in this study can be answered by Dr. Anna Marshall-Baker who may be contacted at (336) 256-0307or by email

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Valid 8/31/10 to 5/24/11

at a_marsha@uncg.edu and Ms. Stephanie Brooker at 215-896-0678 or slbrooke@uncg.edu.

Are there any benefits to my child as a result of participation in this research study?
There are no direct benefits to participants in this study.

Are there any benefits to society as a result of my child taking part in this research?
The research study may benefit society in further demonstrating the opportunities to gain insight into the student's perspective of the classroom environment.

Will my child get paid for being in the study? Will it cost me anything for my kid to be in this study? There are no costs to you or payments to you or your child as a result of participation in this study. All materials will be provided.

How will my child's information be kept confidential?
Information collected during this study will be kept confidential. Procedures will be taken to assure confidentiality; as such signed consent and assent forms will be stored in a lockable file cabinet in the primary researcher's office on the campus of the University of North Carolina at Greensboro. Student participants will not be identified by name due to a confidential data collection procedure in which all student participant drawings and explanations will be assigned an individual number. All information obtained in this study is strictly confidential unless disclosure is required by law. The drawings collected and insights presented by your child during this study may be used on the student researcher's blog and thesis presentations, however all identities of the participants will be kept confidential. Your child's identity will not appear on the blog.

In addition, there are certain instances where the researcher is legally required to give information to the appropriate authorities. These would include mandatory reporting of information about behavior that is immediately dangerous to you or to others, such as suicide, child abuse, etc.

What if my child wants to leave the study or I want him/her to leave the study?
You have the right to refuse to allow your child to participate or to withdraw him or her at any time, without penalty. If your child does withdraw, it will not affect you or your child in any way. If you or your child chooses to withdraw, you may request that any data which has been collected be destroyed unless it is in a de-identifiable state. Your decision to have your child participate in this study will not affect your relationship or your child's relationship with the school or their grades.

What about new information/changes in the study?
If significant new information relating to the study becomes available which may relate to your willingness allow your child to continue to participate, this information will be provided to you.

Voluntary Consent by Participant:
By signing this consent form, you are agreeing that you have read it or it has been read to you, you fully understand the contents of this document and consent to your child taking part in this study. All of your questions concerning this study have been answered. By signing this form, you are agreeing that you are the legal parent or guardian of the child who wishes to participate in this study described to you by Dr. Anna Marshall-Baker and Ms. Stephanie Brooker.

_____ Date: _____
Participant's Parent/Legal Guardian's Signature

_____ Date: _____
Participant's Parent/Legal Guardian's Signature

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Approved Consent Form
Valid 8/31/10 to 5/24/11

TRƯỜNG ĐẠI HỌC BẮC CAROLINA Ở GREENSBORO

ĐƠN XIN PHÉP CHO HỌC SINH DƯỚI VỊ THÀNH NIÊN: MẪU ĐƠN DÀI

Tên Dự Án: Mục Tiêu Chính: Phát Triển Hình Học Mới Về Bàn Ghế Cho Nội Thất Phòng Học Mẫu Giáo

Dự Án Trưởng: Tiến Sĩ Anna Marshall-Baker

Tên Học Sinh: _____

Mục Tiêu Của Cuộc Nghiên Cứu Này Là Gì?
Dự án này bao gồm việc nghiên cứu các sản phẩm về đồ nội thất của các lớp mẫu giáo. Mục đích của nghiên cứu này là phát triển một loại đồ nội thất mới dùng trong các lớp học mẫu giáo để thúc đẩy khả năng phát triển của trẻ em trong sự khám phá và học hỏi với chúng. Các thông tin thu được qua nghiên cứu này sẽ được sử dụng để thiết kế một loại đồ nội thất cho phòng học đầu mẫu giáo. Con của quí vị sẽ được tham gia vào một hoạt động vẽ và thiết kế. ả goài ra các em sẽ nhận được các câu hỏi để suy nghĩ về kinh nghiệm của họ với nội thất phòng học và làm thế nào đồ nội thất có thể được cải thiện. Các em sẽ trình bày ý tưởng của mình thông qua các bản vẽ. Ý tưởng và bản vẽ của các em sẽ được chia sẽ cùng các bạn cùng lớp, giáo viên của họ, và nhà nghiên cứu.

ả ghiên cứu này cũng đang được tiến hành để thực hiện các yêu cầu cho một luận án trong nội thất Thiết Kế Sản Phẩm tại Khoa Kiến Trúc ả ội Thất trong các trường học của Khoa Học Môi Trường ả hân Loại tại Đại học Bắc Carolina ở Greensboro. Quá trình thu thập dữ liệu và thiết kế này sẽ được ghi chép và công bố bằng cách sử dụng một blog trực tuyến. Danh tính của tất cả các học sinh sẽ được giữ bí mật và không xuất hiện trong blog. Quí vị sẽ được mời ghé thăm blog tại http://primaryobjectsprocess.blogspot.com/.

Tại Sao Con Em Quí Vị Được Yêu Cầu Tham Dự?
Con em quí vị đã được lựa chọn cho dự án này vì các em là học sinh trong một lớp học đã được quan sát và chọn lựa cho việc nghiên cứu.

Con Em Chúng Tôi Phải Làm Gì Nếu Tôi Đồng Ý Để Cho Họ Tham Gia Việc Nghiên Cứu Này?
Con quí vị sẽ được yêu cầu tham gia vào một hoạt động vẽ trong lớp học. Con quí vị sẽ được hỏi để suy nghĩ về địa điểm ưa thích của họ trong lớp học, cách họ nghĩ về những đồ nội thất lớp học, và làm sao sắp xếp đồ nội thất có thể được tốt hơn. Con quí vị sẽ được cung cấp với giấy và bút chì màu để vẽ ý tưởng của họ. Trong và sau khi hoàn thành các hoạt động vẽ, học sinh tham gia sẽ có cơ hội chia sẻ ý tưởng của mình và nói về bản vẽ của mình để các bạn cùng lớp của mình, các giáo viên, và nghiên cứu viên.

Những Nguy Hiểm Cho Con Của Tôi Là Gì?
Các rủi ro cho con của bạn có thể bao gồm bất kỳ sự lo lắng và bối rối liên quan đến bản vẽ, trình bày trước lớp một, và trả lời câu hỏi.

ả ếu quí vị có bất kỳ mối quan tâm về các quyền lợi của con quí vị, cách họ đang được sinh hoạt hoặc nếu quí vị có thắc mắc, muốn biết thêm thông tin hoặc có ý kiến, xin vui lòng liên hệ với Eric Allen tại Văn phòng ả ghiên Cứu Tuân Thủ ở Uả CG tại số (336) 256-1482. Các câu hỏi về dự án này, lợi ích hoặc rủi ro liên quan có thể được trả lời qua Tiến sĩ Anna Marshall-Baker. Quí vị có thể liên lạc tại (336) 256-0307 hoặc qua email tại a_marsha@uncg.edu và giáo viên Stephanie Brooker tại 215 -896-0678 hoặc slbrooke@uncg.edu.

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Có Bất Kỳ Lợi Ích Cho Con Tôi Như Là Kết Quả Của Sự Tham Gia Trong Nghiên Cứu Này Nghiên Cứu?
Không có lợi ích trực tiếp cho người tham gia trong nghiên cứu này.

Có Bất Kỳ Lợi Ích Cho Xã Hội Như Là Kết Quả Của Con Tôi Tham Gia Vào Nghiên Cứu Này?
Các nghiên cứu có thể mang lại lợi ích xã hội trong việc tiếp tục thể hiện những cơ hội để đạt được cái nhìn sâu sắc vào quan điểm của học sinh trong môi trường lớp học.

Liệu Con Tôi Có Được Trả Tiền Để Tham Gia Trong Việ cNghiên Cứu Này? Liệu Tôi Có Phải Chi Phí Cho Bất Cứ Điều Gì Cho Đứa Trẻ Của Tôi Được Trong Nghiên Cứu Này?
Không có chi phí cho quí vị hoặc con quí vị tham gia trong nghiên cứu này. Tất cả các chi phí sẽ được cung cấp.

Làm Thế Nào Thông Tin Của Con Tôi Sẽ Được Giữ Bí Mật?
Thông tin thu thập trong quá trình nghiên cứu này sẽ được giữ bí mật. Thủ tục sẽ được thực hiện để đảm bảo bí mật, như vậy sự đồng ý ký kết và các hình thức phê chuẩn sẽ được lưu trữ trong một tủ khóa sắt trong văn phòng của nhà nghiên cứu chính trong khuôn viên của trường Đại học Bắc Carolina ở Greensboro. Học sinh tham gia sẽ không được xác định theo tên do một quy trình thu bí mật dữ liệu. Trong đó tất cả học sinh tham gia sẽ được chỉ định một số cá nhân. Tất cả các thông tin thu được trong nghiên cứu này là nghiêm mật, trừ khi công bố thông tin là yêu cầu của pháp luật. Các bản vẽ thu thập và trình bày những hiểu biết của con quý vị trong nghiên cứu này có thể được sử dụng trên blog các nhà nghiên cứu của học sinh và trình bày luận án, tuy nhiên tất cả các bản sắc của những người tham gia sẽ được giữ bí mật. Bản sắc của con quý vị sẽ không xuất hiện trên blog.

ả goài ra, có những trường hợp nhất định mà các nhà nghiên cứu pháp lý cần thiết để cung cấp thông tin cho cơ quan thích hợp. Các báo cáo bắt buộc bao gồm thông tin về hành vi có thể gây nguy hiểm cho quý vị hoặc cho người khác, như tự tử, lạm dụng trẻ em, vv...

Nếu Con Tôi Hoặc Tôi Muốn Hủy Bỏ Tham Gia Việc Nghiên Cứu Này?
Quí vị có quyền từ chối cho phép con em quí vị tham gia hay rút họ ra ở bất kỳ thời gian nào và không bị ràng buộc. Khi quí vị chọn lựa để thu hồi, quí vị có quyền yêu cầu tiêu huỷ bất kỳ dữ liệu đã được thu thập, trừ khi nó đang ở trong qui định không xác định được cá nhân và không có cơ sở hợp lý để tin rằng các cá nhân có thể được xác định từ đó (De-Identifiable State). Quyết định của quí vị cho con em tham gia vào nghiên cứu này sẽ không ảnh hưởng đến mối quan hệ của quí vị hay mối quan hệ của trẻ đối với các trường học hoặc các lớp của họ.

Nếu Có Thông Tin Mới Hoặc Thay Đổi Trong Nghiên Cứu Này?
ả ếu có thông tin quan trọng mới liên quan đến sự phê duyệt của quí vị về việc cho phép con của quí vị tiếp tục tham gia, thông tin này sẽ được cung cấp cho quí vị.

Sự Chấp Thuận Tự Nguyện Của Người Tham Gia:
Khi ký giấy chấp thuận này, quí vị xác nhận rằng quí vị đã đọc nội dung của việc nghiên cứu này hoặc nó đã được đọc cho quí vị. Quí vị hoàn toàn thông hiểu nội dung của tài liệu này và đồng ý cho con em tham gia vào dự án. Tất cả các câu hỏi của bạn liên quan đến dự án này đã được trả lời. Bằng việc ký tên vào mẫu đơn này, quí vị xác nhận rằng quí vị là cha mẹ hoặc người giám hộ hợp pháp của học sinh muốn tham gia vào cuộc nghiên cứu mô tả cho quí vị từ Tiến sĩ Anna Marshall-Baker và giáo viên Stephanie Brooker.

Chữ Ký Cha Mẹ Hoặc ả gười Giám Hộ Hợp Pháp	Ký Vào Tháng ả gày, ả ăm
Chữ Ký Cha Mẹ Hoặc ả gười Giám Hộ Hợp Pháp	Ký Vào Tháng ả gày, ả ăm

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มหาวิทยาลัยนอร์ธ แคโรไลนา กรีนส์โบโร

คำยินยอมสำหรับให้ผู้เยาว์เข้าร่วมการศึกษาวิจัยในฐานะเป็นตัวบุคคล: ฉบับยาว

ชื่อโครงการ: วัตถุประสงค์หลัก: พัฒนาเฟอร์นิเจอร์ชนิดใหม่สำหรับใช้ในห้องเรียนระดับประถมศึกษาตอนต้น

ผู้อำนวยการโครงการ: **ดร. แอนนา มาร์แชลล์-เบเกอร์**

ชื่อผู้เข้าร่วม:_____

การศึกษานี้เกี่ยวข้องกับเรื่องใด?
การศึกษานี้เป็นการวิจัยผลิตภัณฑ์และเฟอร์นิเจอร์สำหรับใช้ในห้องเรียน
จุดประสงค์ของการวิจัยนี้คือ
เพื่อพัฒนาเฟอร์นิเจอร์ชนิดใหม่สำหรับใช้ในห้องเรียนระดับประถมศึกษาตอนต้นที่จะช่วยให้เด็กๆ สามารถมีปฏิสัมพันธ์กับเฟอร์นิเจอร์ได้หลากหลายแบบ
ข้อมูลที่ได้มาจากการศึกษานี้จะนำมาใช้เพื่อออกแบบเฟอร์นิเจอร์ชนิดใหม่สำหรับห้องเรียนระดับประถมศึกษาตอนต้น
บุตรหลานของท่านจะได้เข้าร่วมในกิจกรรมการวาดภาพโดยที่จะมีการขอให้เด็กๆ คิดถึงเฟอร์นิเจอร์ในห้องเรียน ประสบการณ์ที่มีต่อเฟอร์นิเจอร์ในห้องเรียน และวิธีการปรับปรุงเฟอร์นิเจอร์ เด็กๆ จะแสดงความคิดผ่านทางการวาดภาพและได้รับโอกาสให้นำเสนอความคิดและภาพวาดแก่เพื่อนๆ ร่วมชั้น คุณครู และผู้วิจัย

การวิจัยครั้งนี้ยังดำเนินการเพื่อตอบสนองข้อกำหนดสำหรับการทำวิทยานิพนธ์ในด้านการออกแบบตกแต่งภายในและผลิตภัณฑ์ของภาควิชาสถาปัตยกรรมภายใน คณะวิทยาการสิ่งแวดล้อมมนุษย์ ณ มหาวิทยาลัยนอร์ธ แคโรไลนา กรีนส์โบโร
กระบวนการนี้จะได้รับการจัดทำเป็นเอกสารโดยใช้บล็อกออนไลน์ที่บันทึกทั้งกระบวนการรวบรวมข้อมูลและกระบวนการออกแบบ
ข้อมูลการระบุตัวตนของผู้เข้าร่วมทั้งหมดจะเก็บรักษาไว้เป็นความลับและจะไม่นำมาแสดงในบล็อกดังกล่าว เราใคร่ขอเชิญท่านมาเยี่ยมชมบล็อกที่ http://primaryobjectsprocess.blogspot.com/

เหตุใดจึงต้องเป็นบุตรของฉัน?
บุตรหลานของท่านได้รับเลือกให้เข้าร่วมกิจกรรมนี้เนื่องจากเป็นนักเรียนอยู่ในห้องเรียนที่มีการเฝ้าสังเกตสำหรับการวิจัยครั้งนี้

คุณจะให้บุตรหลานของฉันทำอะไร หากฉันยินยอมให้เด็กเข้าร่วมในการศึกษาครั้งนี้?
บุตรหลานของท่านจะได้เข้าร่วมในกิจกรรมการวาดภาพของชั้นเรียน ทั้งนี้ จะมีการขอให้บุตรหลานของท่านนึกถึงพื้นที่โปรดในห้องเรียน
และแสดงความคิดว่าเฟอร์นิเจอร์ในห้องเรียนและการจัดเฟอร์นิเจอร์จะสามารถปรับปรุงให้ดีขึ้นได้อย่างไรบ้าง
บุตรหลานของท่านจะได้รับกระดาษและดินสอสีสำหรับใช้วาดแสดงความคิด ในระหว่างกิจกรรมการวาดภาพและหลังจากทำกิจกรรมดังกล่าวเสร็จแล้ว
นักเรียนที่เข้าร่วมกิจกรรมจะได้รับโอกาสให้แบ่งปันความคิดและพูดคุยเกี่ยวกับภาพวาดของตนให้เพื่อนร่วมชั้น คุณครู และผู้วิจัยฟัง

มีอันตรายใดๆ ที่จะเกิดขึ้นกับบุตรหลานของฉันได้บ้าง?
ความเสี่ยงที่จะเกิดกับบุตรหลานของท่าน ได้แก่ ความวิตกกังวลและความเขินอายที่เกี่ยวเนื่องกับการวาดภาพ การนำเสนอหน้าชั้นเรียน
และการตอบคำถามต่างๆ

หากท่านมีความกังวลในเรื่องสิทธิ์ของเด็ก วิธีการปฏิบัติต่อเด็ก หรือหากท่านมีข้อสงสัย ต้องการข้อมูลเพิ่มเติมหรือมีคำแนะนำใดก็ตาม โปรดติดต่อ คุณอิริค เอลเลน สำนักงานตรวจสอบการวิจัย (Office of Research Compliance) ณ มหาวิทยาลัยนอร์ธ แคโรไลนา กรีนส์โบโร โทร. (336) 256-1482

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หากมีคำถามเกี่ยวกับโครงการนี้หรือประโยชน์หรือความเสี่ยงที่เกี่ยวเนื่องกับการเข้าร่วมการศึกษาวิจัยนี้ สามารถติดต่อสอบถามได้ที่ ดร. แอนนา มาร์แชลล์-เบเกอร์ โทร. (336) 256-0307 หรือ อีเมล: a_marsha@uncg.edu และ คุณสเตฟานี บรู๊คเกอร์ โทร. 215-896-0678 หรือ slbrooke@uncg.edu

บุตรหลานของฉันจะได้รับประโยชน์ใดบ้างหรือไม่จากการเข้าร่วมในการศึกษาวิจัยครั้งนี้?
ไม่มีประโยชน์โดยตรงจากการเป็นผู้เข้าร่วมการศึกษาครั้งนี้

การที่บุตรหลานของฉันเข้าร่วมในการศึกษาวิจัยครั้งนี้มีประโยชน์ต่อสังคมหรือไม่?
การศึกษาวิจัยครั้งนี้อาจเป็นประโยชน์ต่อสังคมในลักษณะที่เอื้อให้เกิดความเข้าใจในมุมมองของเด็กนักเรียนที่มีต่อสภาพแวดล้อมของห้องเรียน

บุตรหลานของฉันจะได้รับค่าตอบแทนจากการเข้าร่วมในการศึกษาวิจัยครั้งนี้หรือไม่? ฉันจะต้องเสียค่าใช้จ่ายใด ๆ สำหรับบุตรหลานของฉันในการเข้าร่วมการศึกษาวิจัยครั้งนี้หรือไม่?
ท่านไม่จำเป็นต้องมีค่าใช้จ่ายใดๆ อีกทั้งไม่มีค่าตอบแทนใดๆ สำหรับท่านหรือบุตรหลานของท่านอันเนื่องมาจากการเข้าร่วมในการศึกษาวิจัยครั้งนี้
วัสดุอุปกรณ์ทั้งหมดจะจัดเตรียมไว้ให้พร้อม

ข้อมูลของบุตรหลานของฉันจะได้รับการเก็บรักษาไว้เป็นความลับได้อย่างไร?
ข้อมูลที่รวบรวมในระหว่างการศึกษาวิจัยครั้งนี้จะเก็บรักษาไว้เป็นความลับ เราจะมีการใช้กระบวนการต่างๆ เพื่อความมั่นใจในการรักษาความลับ
แบบฟอร์มการยินยอมและคำยินยอมที่มีการลงลายมือชื่อนี้จะถูกจัดเก็บไว้ในตู้เอกสารที่สามารถล็อกได้ในสำนักงานของผู้วิจัยหลักในวิทยาเขตของมหาวิทยาลัยนอร์ธ แคโรไลนา กรีนส์โบโร นักเรียนที่เข้าร่วมจะไม่ถูกระบุชื่อเนื่องจากเราใช้กระบวนการเก็บข้อมูลที่เป็นความลับ
ทั้งนี้ภาพวาดและคำอธิบายของนักเรียนที่เข้าร่วมทั้งหมดจะได้รับการมอบหมายหมายเลขไว้เฉพาะ
ข้อมูลทั้งหมดที่ได้มาจากการศึกษาวิจัยครั้งนี้จะเก็บไว้เป็นความลับอย่างเข้มงวดเว้นแต่กฎหมายจะกำหนดให้ต้องเปิดเผย
ภาพวาดที่รวบรวมและความรู้ความเข้าใจที่บุตรหลานของท่านนำเสนอในระหว่างการศึกษาวิจัยครั้งนี้อาจนำมาใช้ในบล็อกของผู้วิจัยที่เป็นนักศึกษาและการนำเสนองานวิทยานิพนธ์ อย่างไรก็ตาม ข้อมูลระบุตัวตนทั้งหมดของผู้เข้าร่วมการวิจัยจะเก็บรักษาไว้เป็นความลับ
ข้อมูลระบุตัวตนของบุตรหลานของท่านจะไม่ปรากฏอยู่บนบล็อกดังกล่าว

นอกจากนี้ ยังมีบางกรณีที่ผู้วิจัยจำเป็นต้องให้ข้อมูลแก่หน่วยงานที่เหมาะสมตามข้อกำหนดของกฎหมาย
กรณีเหล่านี้รวมถึงการที่กฎหมายบังคับให้ต้องรายงานข้อมูลเกี่ยวกับพฤติกรรมที่เป็นอันตรายต่อตัวท่านหรือบุคคลอื่นอย่างกะทันหัน เช่น การฆ่าตัวตาย การทารุณกรรมเด็ก ฯลฯ

จะเป็นอย่างไรหากเด็กต้องการออกจากการศึกษาวิจัยหรือเมื่อฉันต้องการให้เด็กออกจากการวิจัยดังกล่าว?
ท่านมีสิทธิ์ปฏิเสธไม่ให้บุตรหลานของท่านเข้าร่วมหรือถอนตัวได้ตลอดเวลาโดยจะไม่มีบทลงโทษใดๆ หากบุตรหลานของท่านถอนตัว
ก็จะไม่ส่งผลกระทบต่อตัวท่านหรือบุตรหลานของท่านไม่ว่าทางใดก็ตาม หากท่านหรือบุตรหลานของท่านเลือกที่จะถอนตัว
ท่านอาจขอให้ทำลายข้อมูลใดก็ตามที่เก็บรวบรวมไว้เว้นแต่ข้อมูลนั้นจะอยู่ในสถานะที่สามารถระบุถึงตัวบุคคลได้
การตัดสินใจของท่านในการให้บุตรหลานเข้าร่วมในการศึกษาวิจัยครั้งนี้จะไม่ส่งผลกระทบต่อความสัมพันธ์ระหว่างโรงเรียนกับตัวท่านหรือเด็ก
หรือจะไม่ส่งผลกระทบต่อระดับคะแนนของเด็กแต่อย่างใด

จะมีข้อมูล/ความเปลี่ยนแปลงใหม่ ๆ ในการศึกษาวิจัยอย่างไรบ้างหรือไม่?
หากมีข้อมูลสำคัญใหม่ๆ เกี่ยวกับการศึกษาวิจัยนี้ ซึ่งอาจส่งผลต่อความเต็มใจในการอนุญาตให้บุตรหลานของท่านเข้าร่วมการวิจัยต่อไป
จะมีการแจ้งข้อมูลเหล่านี้ให้ท่านทราบ

คำยินยอมโดยสมัครใจของผู้เข้าร่วม:
การลงลายมือชื่อในแบบฟอร์มการยินยอมนี้ แสดงว่าคุณยอมรับว่าได้อ่านแบบฟอร์มนี้หรือมีการอ่านแบบฟอร์มนี้ให้คุณฟังเรียบร้อยแล้ว
และคุณมีความเข้าใจอย่างครบถ้วนในเนื้อหาของเอกสารนี้และคำยินยอมในการให้บุตรหลานของท่านเข้าร่วมในการศึกษาวิจัยครั้งนี้
คำถามทุกข้อที่คุณมีเกี่ยวกับการศึกษาวิจัยนี้ได้รับคำตอบเรียบร้อยแล้ว การลงชื่อในแบบฟอร์มนี้ แสดงว่า

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คุณยอมรับว่าคุณเป็นผู้ปกครองผู้เยาว์ของเด็กผู้นี้ซึ่งมีความประสงค์จะเข้าร่วมในการศึกษาวิจัยที่ ดร. แอนนา มาร์แชลล์-เบเกอร์และคุณสเตฟานี ปรู๊คเกอร์ ได้อธิบายให้คุณทราบแล้ว

_____ วันที่: _____
ลายมือชื่อของผู้ปกครองของผู้เข้าร่วม/ผู้ปกครองผู้เยาว์

_____ วันที่: _____
ลายมือชื่อของผู้ปกครองของผู้เข้าร่วม/ผู้ปกครองผู้เยาว์

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APPENDIX B

EXISTING CLASSROOM FURNITURE

Fig. B.1. Classroom A utilizes tables and chairs

Fig. B.2. Classroom A provides child size rocking chairs in the reading center.

Fig. B.3. Classroom A storage in the reading and drawing center.

Fig. B.4. In classroom A, Books are stored in loose bins on the floor.

Fig. B.5. Classroom A, a loose student desk is used as a storage piece.

Fig. B.6. Classroom A, Inadequate storage with fixed shelving system.

Fig. B.7. Classroom A with group tables uses individual pencil boxes and a shared bin in the middle of each table.

Fig. B.8. Chairs in classroom A had crayon drawings on the backs hinting at the potential for students to use uncommon spaces to draw.

Fig. B.9. Classroom A using extra student desks as storage for overhead projector.

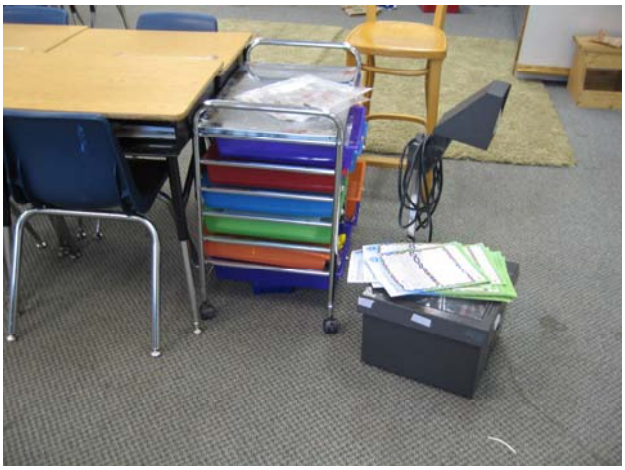


Fig. B.10. Classroom B overhead projector is stored on floor.

Fig. B.11. Classroom B books are stored in bins on shelves.

Fig. B.12. Classroom B utilizes individual desks with front access storage.

Fig. B.13. Classroom B provides an upholstered sofa in reading center and shelves positioned for a semi-private space.

Fig. B.14. Classroom B provides large chairs at rainbow table for teacher and visiting parents.

Fig. B.15. Classroom C stores extra desks off to the side.

Fig. B.16. Classroom C provides an area of soft seating at the front of the classroom.

Fig. B.17. Classroom C provides an upholstered sofa in the reading center.

Fig. B.18. Classroom C utilizes individual desks.

Fig. B.19. Classroom C uses cubbies for student mailboxes.

Fig. B.20. Classroom D provides an array of soft seating in the reading center.

Fig. B.21. Classroom D uses adjustable shelves in the art center. Students then have to draw at a table or on the floor.

Fig. B.22. Classroom D stacked chairs and desks.

Fig. B.23. Classroom D utilizes individual desks with open front storage.

APPENDIX C

SEMI-PARTICIPANT OBSERVATION ANALYSIS

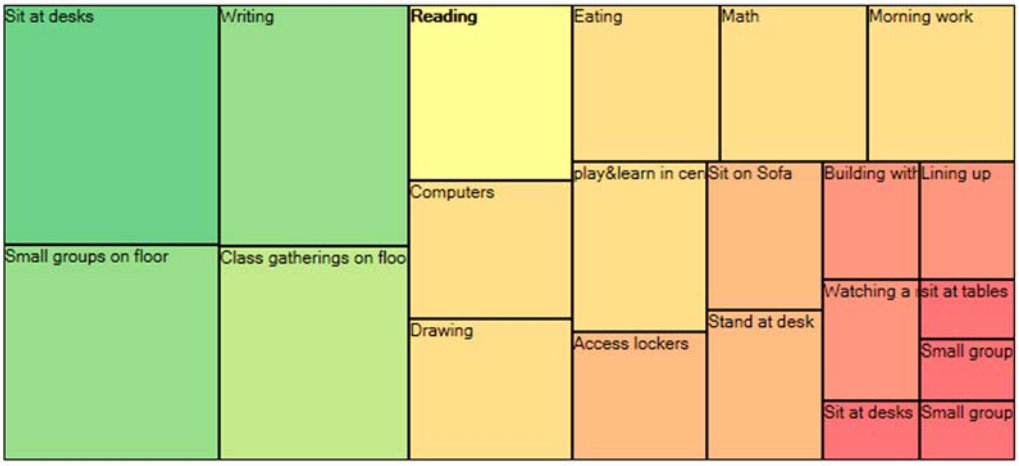


Figure C.1. Visualization of Observed Classroom Activities

List of Observed Classroom Activities:

Reading	Drawing	Math
Writing	Class gatherings on floor	Building with Blocks
Computers	Lining up	Access lockers
Eating	Morning work	Small groups on floor
Small group at table	Small group at desks	Sit on Sofa
Sit at desks to await instruction	Stand at desk	Play& Learn in centers
Sit at desks	Watching a movie	Sit at tables

Figure C.2. Visualization of Observed Student Positions and Actions

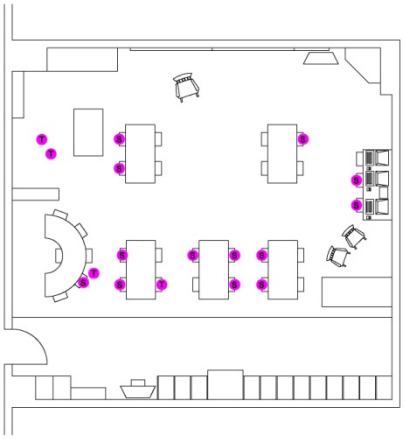
Observed Student Positions and Actions:

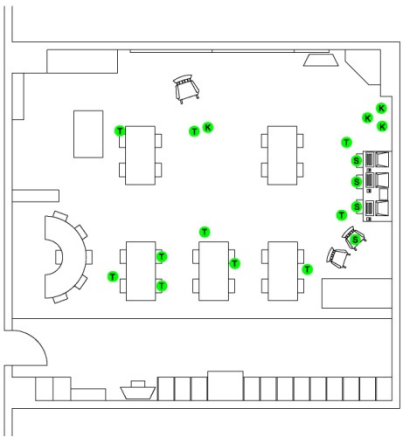
Jumping	On floor	Stretching
switch lights off or on	use table surface for work	Use supplies
Laying on floor	Cross-legged on floor	Rocking
moving furniture	Carry bins and supplies	Looking around
Talking	Leaning on furniture	Kneeling
Standing	Walking around room	Sitting in chair

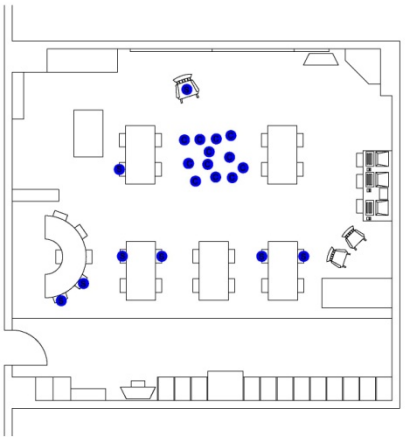
APPENDIX D

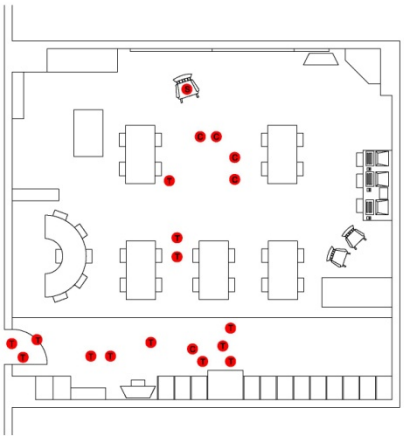
BEHAVIORAL MAPS

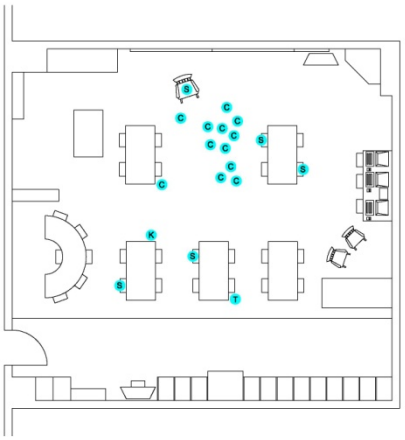
Classroom A

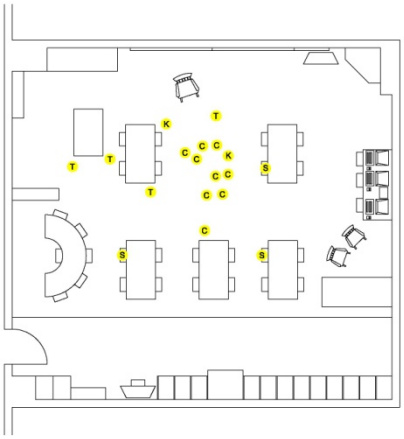

7:52am


10:30am

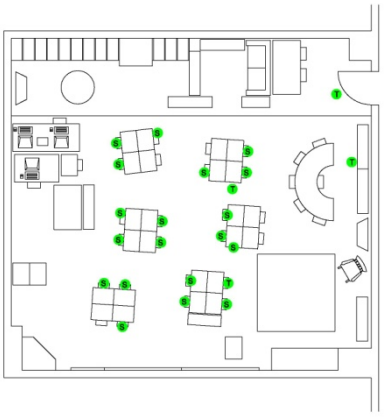

8:13am


12:14pm getting in pairs

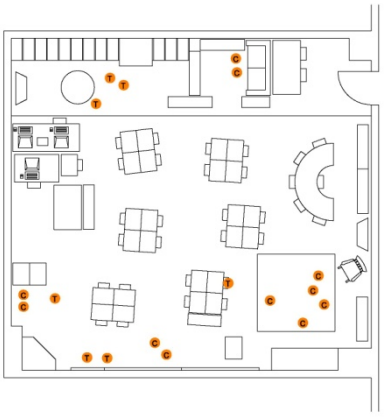

9:55am


1:19pm getting for movie

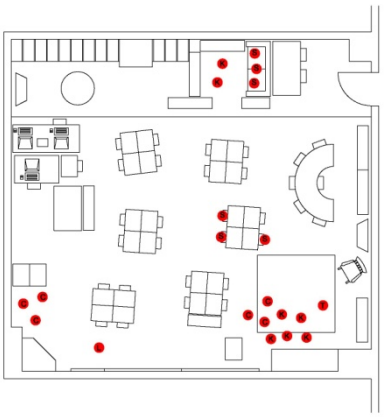
Classroom B



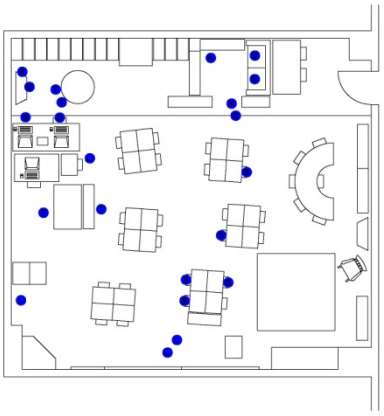
10:45am Cursive Activity



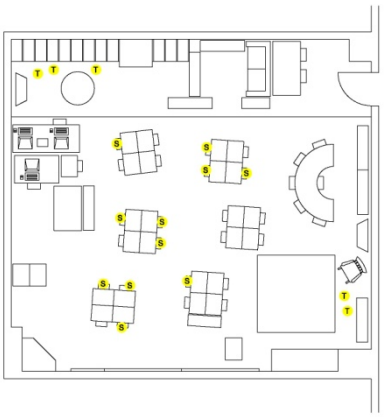
8:49 am Math Centers



11:25am Writing Activity

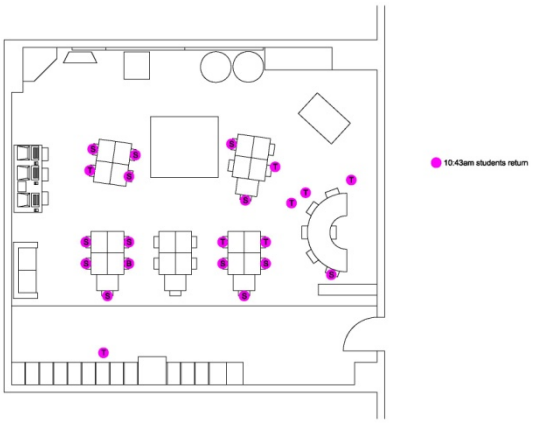


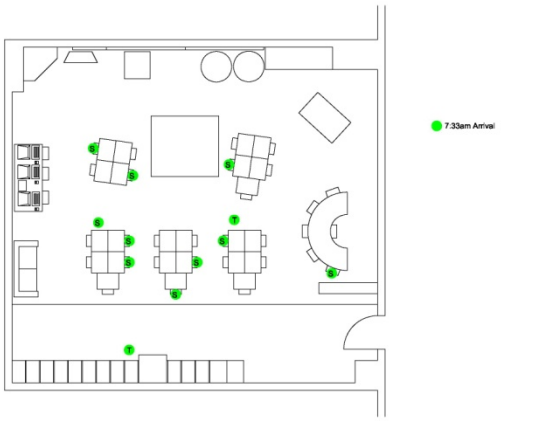
9:52 am Reading Pairs

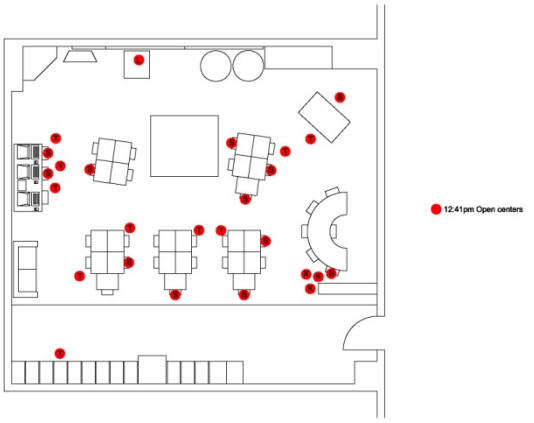


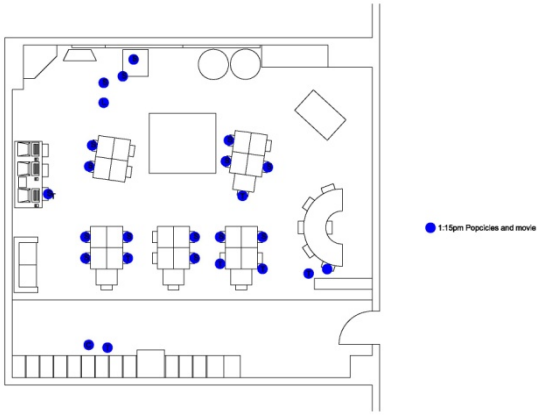
7:36 am Arrival

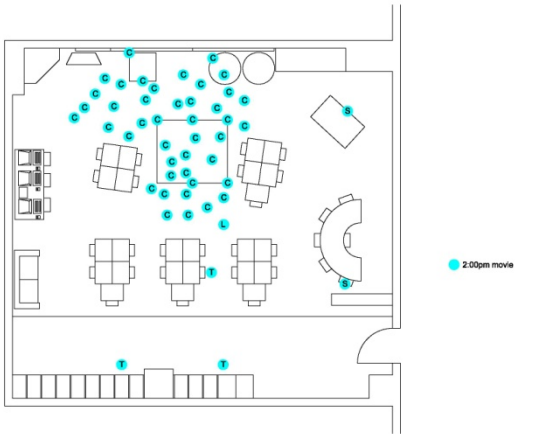
Classroom C

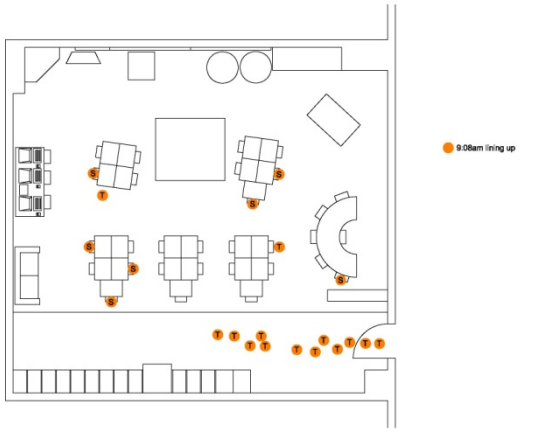

10:43am students return


7:33am Arrival

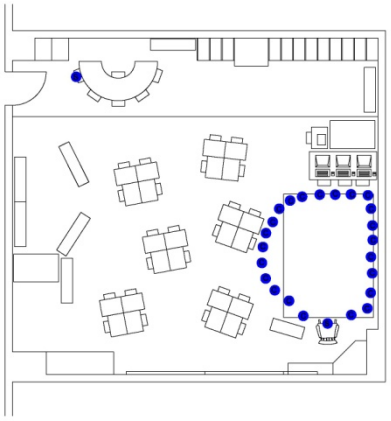

12:41pm Open centers


1:15pm Popcicles and movie

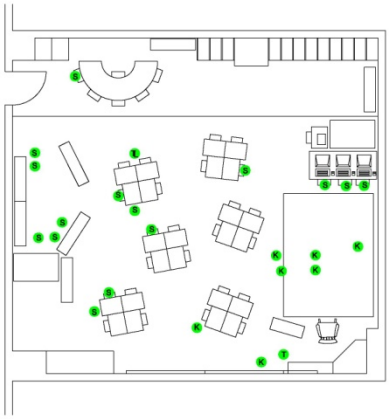

2:00pm movie


9:08am lining up

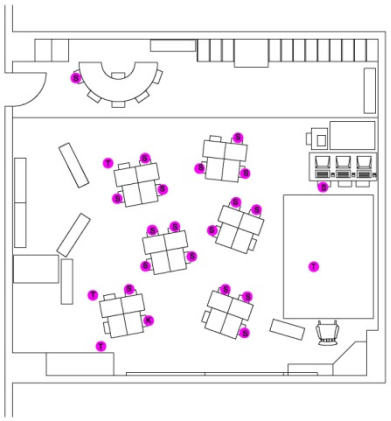
Classroom D



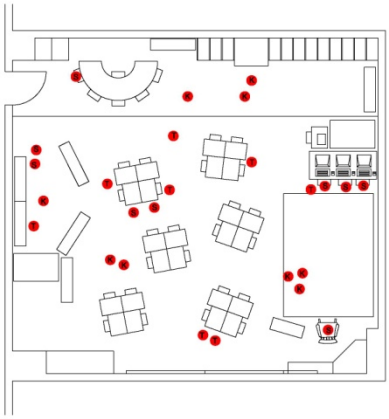
8:05am



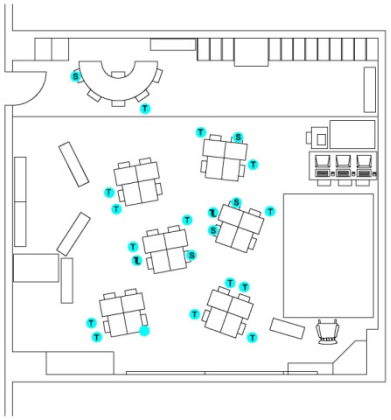
10:49am Free centers



8:57am Charades



11:30am centers



9:44am Bubble blowing

1:37pm ice cream

APPENDIX E

STUDENT DRAWING ACTIVITY AND ANALYSIS

DRAWING ACTIVITY SCRIPT

Good Morning/Afternoon, my name is Stephanie Brooker. I am a graduate student at the University of North Carolina at Greensboro or UNCG. I am here in your classroom today to ask for your help on a research project about classroom furniture.

What furniture is in the classroom now? (Students will name furniture in the classroom)

What is your favorite spot in the classroom? Where do you like to be in your classroom?

If you were asked to change the classroom to make it better, what would you do? Would you change the places that the furniture are in? Would you make it a different color? Would you change all the desks and chairs?

For my project I am going to be drawing and making new classroom furniture that is different than the furniture you are using today.

So what I need you help with is sharing your ideas and telling me through a picture how your classroom furniture could be better.

I ask you to be in a drawing activity today. For this drawing activity I will give you two pieces of paper. On the first piece it says “My favorite spot”. On this piece you will draw a picture of your favorite spot in the room. On the second piece of paper it says “How I would make the furniture better”. On this piece of paper you will draw a picture to show me how you would change the furniture in the classroom to make it better.

For these drawings first think about what your favorite spot in the classroom is and why is that your favorite spot in the classroom? Then for the second drawing this about how you would make the classroom furniture better. Ask yourself what furniture you use in the classroom and why do you like using that furniture? Also ask yourself what furniture you do not like to use in the classroom and why do you not like using that furniture? Could you move the furniture in the classroom? Would you use different colors? Would you use different types of furniture? Would you change the desks or chairs?

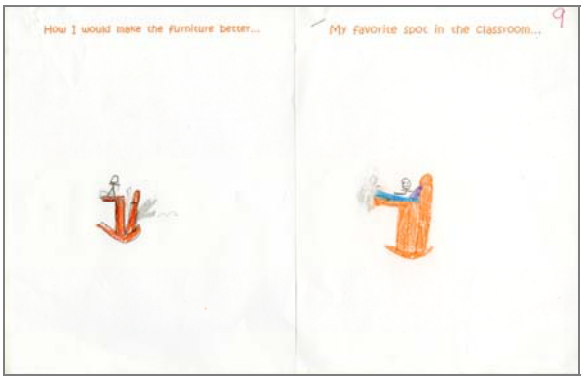
I have crayons for you to use and share to draw your pictures. You will have thirty minutes to draw your pictures. While you are drawing I will walk around to your desks and if you want to you can tell me about your drawings and ideas. I thank you for helping me with my project and am excited about hearing your ideas and seeing your drawings.

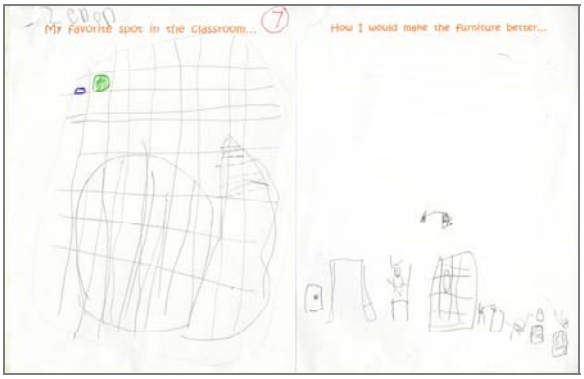
Are there any questions?

Classroom A

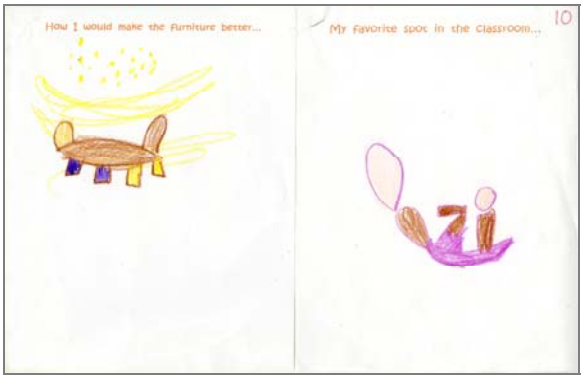
My favorite spot in the classroom... 8
the drawing seter
How I would make the furniture better...
a Litte Chir

How I would make the furniture better...
My favorite spot in the classroom... 12
Joel

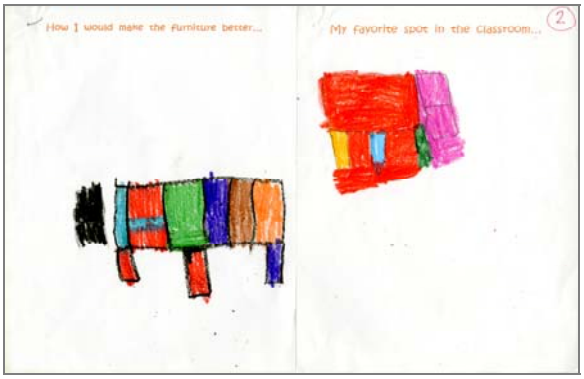

How I would make the furniture better...
My favorite spot in the classroom... 9

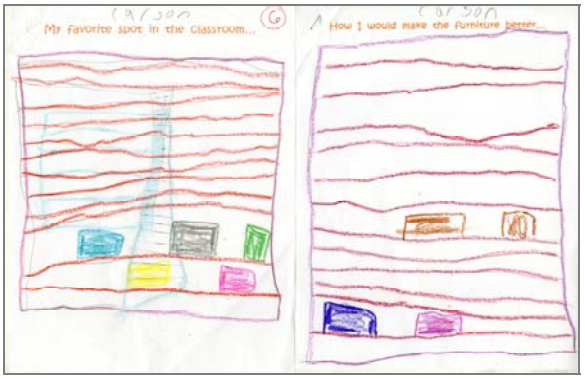

My favorite spot in the classroom... 7
How I would make the furniture better...

How I would make the furniture better...
My favorite spot in the classroom... 13


How I would make the furniture better...
My favorite spot in the classroom... 10

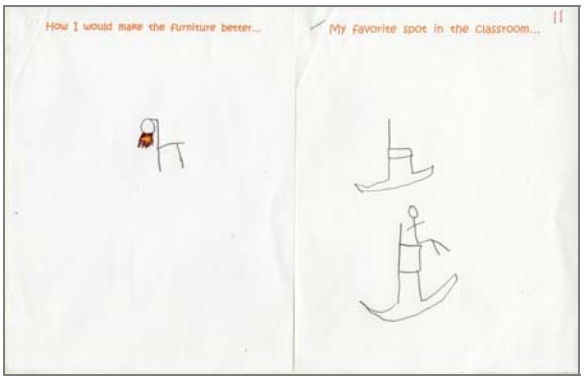
How I would make the furniture better...
My favorite spot in the classroom...
5


How I would make the furniture better...
My favorite spot in the classroom...
2

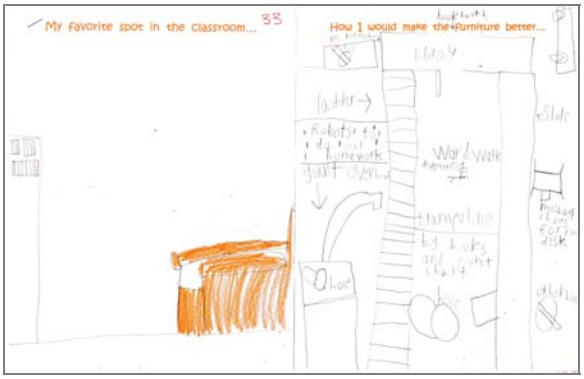

My favorite spot in the classroom...
6
How I would make the furniture better...

My favorite spot in the classroom...
4
How I would make the furniture better...

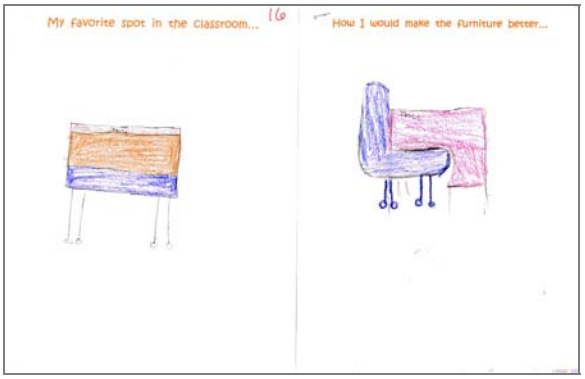
How I would make the furniture better...
My favorite spot in the classroom...
3


How I would make the furniture better...
My favorite spot in the classroom...
11

How I would make the furniture better...
My favorite spot in the classroom... 14


My favorite spot in the classroom... 33
How I would make the furniture better...

Classroom B

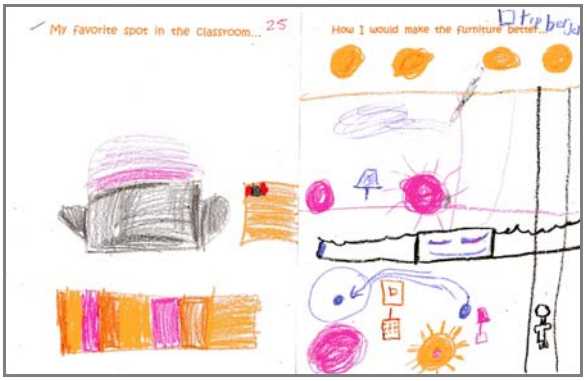

My favorite spot in the classroom... 16
How I would make the furniture better...

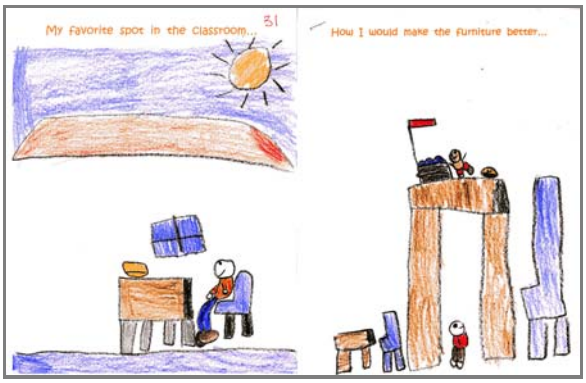
My favorite spot in the classroom... 22
How I would make the furniture better...

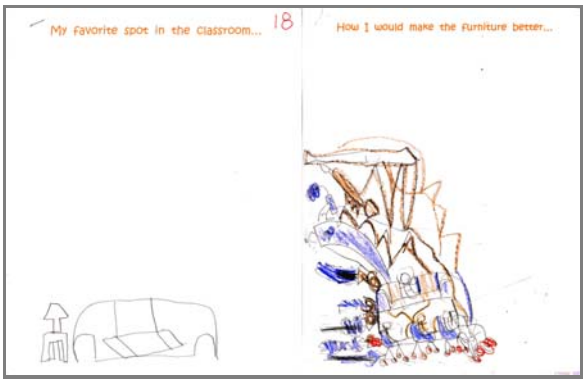
My favorite spot in the classroom... 26
How I would make the furniture better...
Weather
rain
sun
wind

My favorite spot in the classroom... 19
How I would make the furniture better...

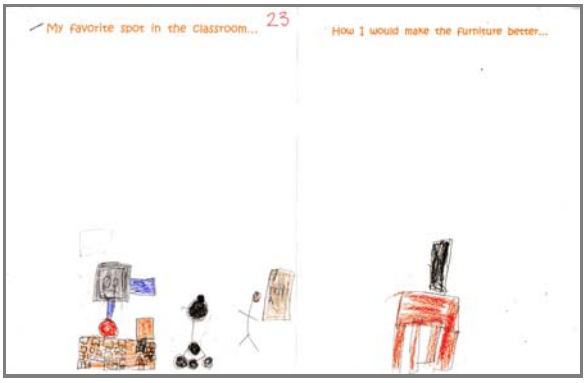
My favorite spot in the classroom... 15
How I would make the furniture better...
Books
Books
Books


My favorite spot in the classroom... 25
How I would make the furniture better...

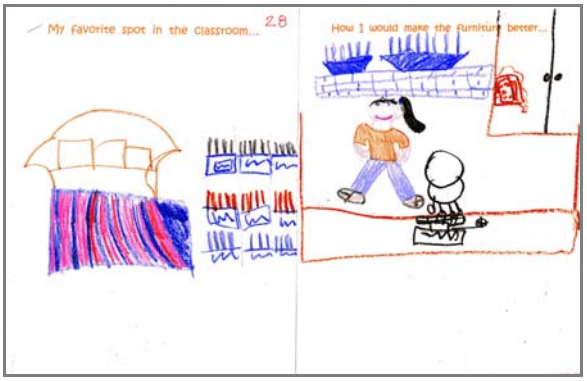

My favorite spot in the classroom... 31
How I would make the furniture better...

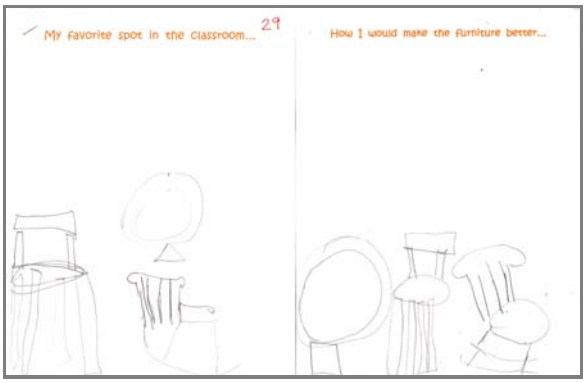

My favorite spot in the classroom... 18
How I would make the furniture better...

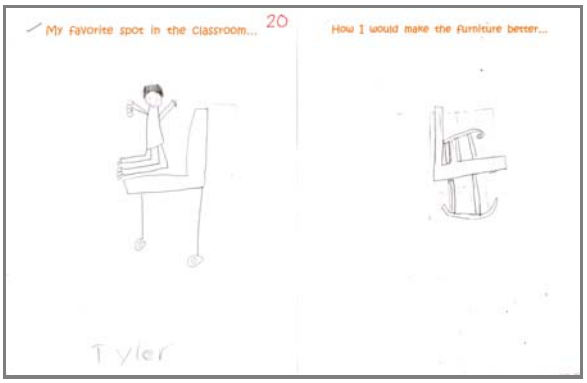
My favorite spot in the classroom... 32
How I would make the furniture better...

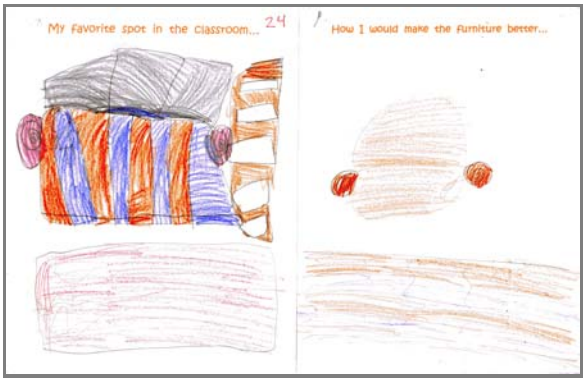

My favorite spot in the classroom... 23
How I would make the furniture better...

My favorite spot in the classroom... 17
How I would make the furniture better...

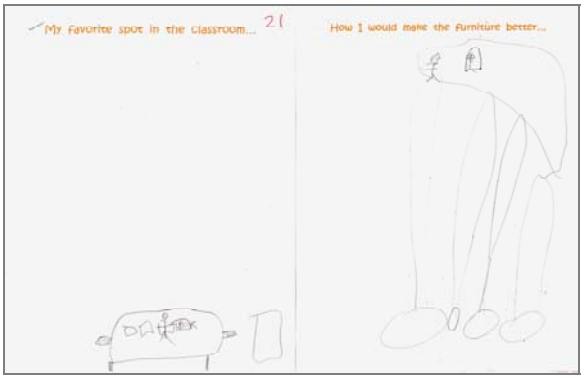

My favorite spot in the classroom... 28
How I would make the furniture better...

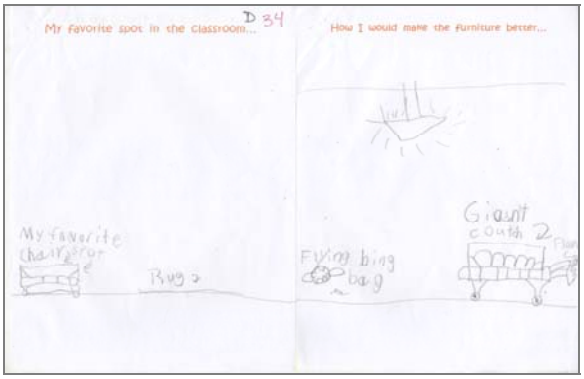

My favorite spot in the classroom... 29
How I would make the furniture better...


My favorite spot in the classroom... 20
How I would make the furniture better...
Tyler

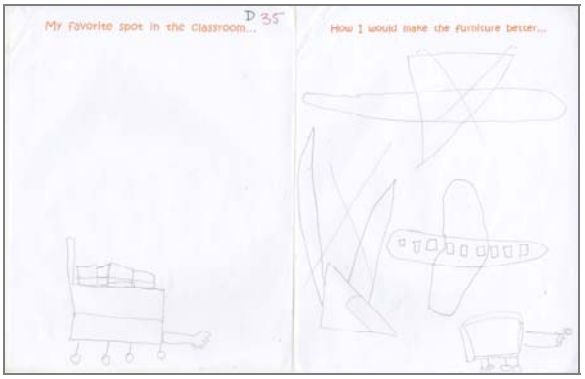

My favorite spot in the classroom... 24
How I would make the furniture better...

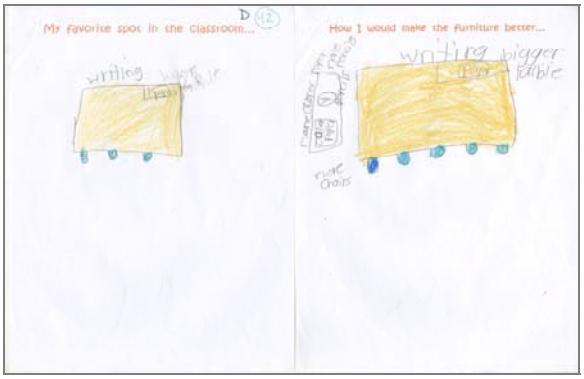
My favorite spot in the classroom... 30
How I would make the furniture better...

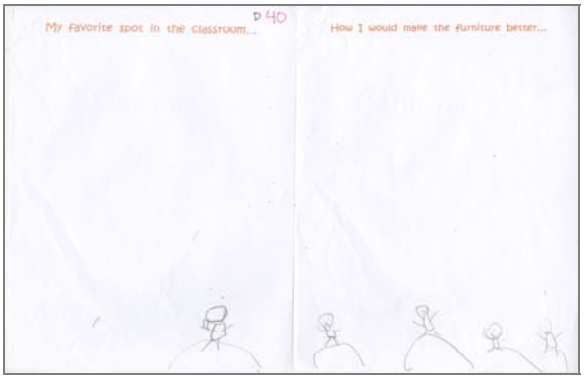

My favorite spot in the classroom... 21
How I would make the furniture better...

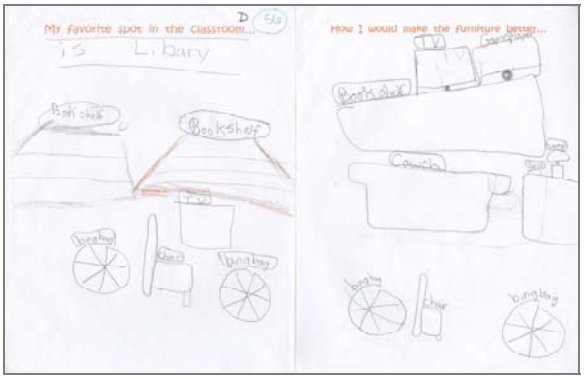

My favorite spot in the classroom... D 34
How I would make the furniture better...
My favorite chair
Rug 2
Flying bing bag
Giant couch 2

Classroom D

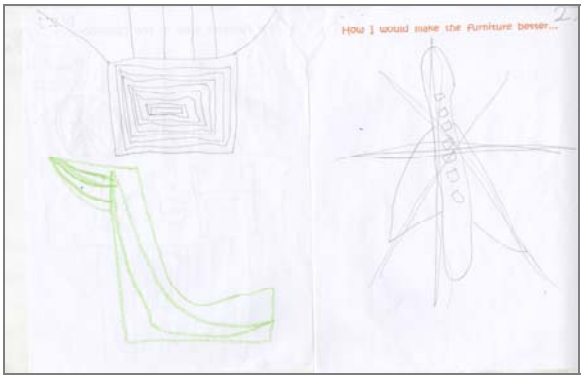

My favorite spot in the classroom... D 35
How I would make the furniture better...


My favorite spot in the classroom... D 42
How I would make the furniture better...
writing
writing bigger
rule chairs

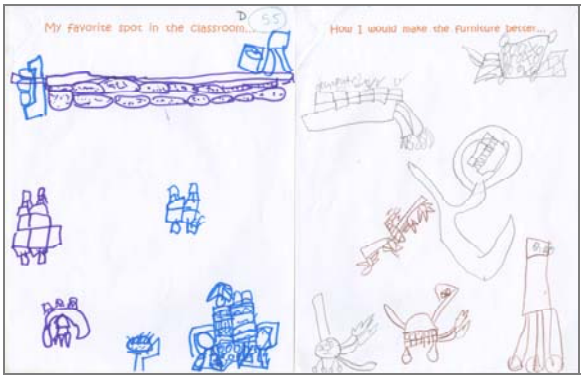

My favorite spot in the classroom... D 40
How I would make the furniture better...

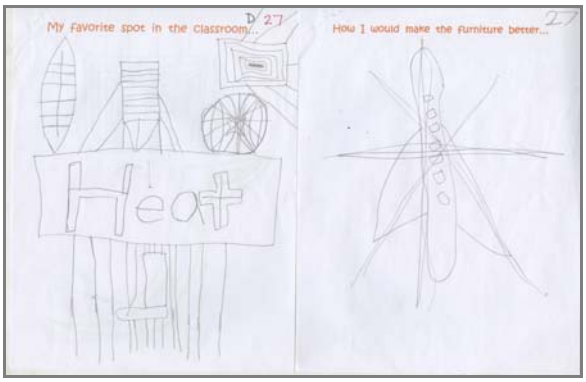

My favorite spot in the classroom... D 56
is Libary
How I would make the furniture better...
Bookshelf
Cowch
bingbag
chair

My favorite spot in the classroom...
How I would make the furniture better...
yes


How I would make the furniture better...

My favorite spot in the classroom...
How I would make the furniture better...


My favorite spot in the classroom...
How I would make the furniture better...


My favorite spot in the classroom...
How I would make the furniture better...
Heart

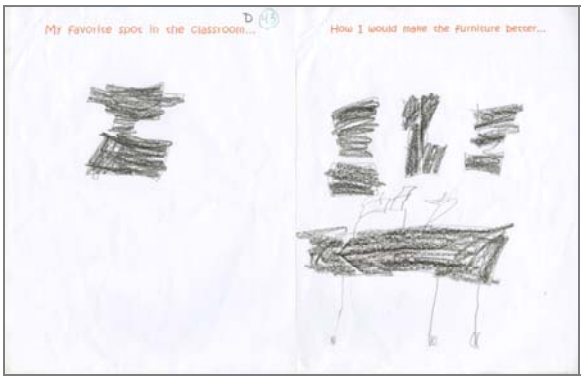

My favorite spot in the classroom...
How I would make the furniture better...

Figure E.1. Visualization of Favorite Spots in the Classroom

Favorite Spots in the Classroom Identified by Students:

- Reading Center
- Computer Station
- Rocking Chair Teacher Chair
- Drawing Center
- Desk
- Rug
- Object not present in classroom
- Chairs
- Table

Figure E.2. Visualization of Student Improvements

Suggested Improvements by the Students:

- New furniture introduced
- Movement
- Scale
- New space
- Purpose
- Community or whole class
- Technology
- Function
- Form
- Color

APPENDIX F

PROGRAM DOCUMENT

Primary Objects Programming

Project Description

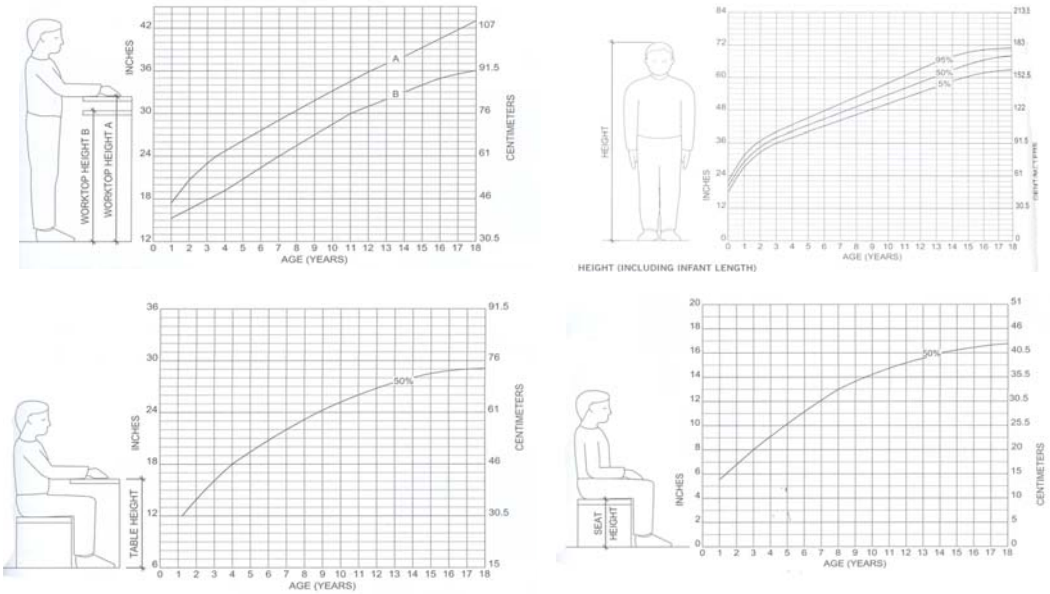
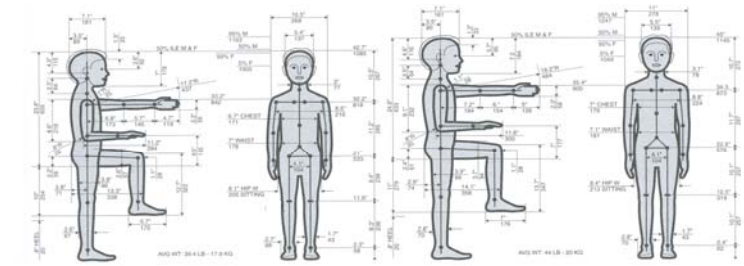
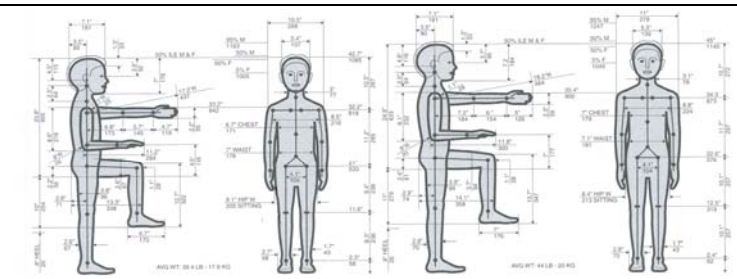
Project Questions	1. What is the relationship between the child and classroom products? 2. How can the products support a child's development? 3. What aesthetic and functional elements can be adopted to create a new typology for active classroom furniture?
Project Issues	Child Safety Encourages divergent thinking in a convergent thinking curriculum Promotes an active environment even with a passive curriculum

Location

Description	A typical first or second grade classroom located in an Elementary School.

Users

Type of User	Description	Current Activities	Potential needs and Interactions
Teacher	occupy classroom for 8 hours a day. Have controll over layout and classroom management	adjusts desks, plans activities, directs students where to go, walks around room to assist students, sits at teacher desk or kidney bean table	classroom management, provide for scaffolding, storage needs, organizational assistance, assistance with educational activities
Parents	visit classroom occasionally	sit in student chairs or stand	seating when visit, assist with clean-up
First Grade Student	occupy classroom for 7 hours a day	sit lean sitting on floor walking line up stand laydown	laydown, work in groups, use surface space for drawing, writing, and reading,
Second Grade Student	occupy classroom for 7 hours a day	sit lean sitting on floor walking line up stand laydown	laydown, work in groups, use surface space for drawing, writing, and reading,

Anthropometrics of Child Users	
Type of User	**Detailed Information**
Child	
Measurements for 5 to 6 years	
Measurements for 7 to 8 years	
Height Range Standards	User Heights: Child Age 6 to 8: 40" to 52" Adult Height: Varies Seat Heights: Child Seat Height Range: 10" to 13" Adult Seat Height Range: 18" to varies Surface Heights: Child Seated on Chair: 19" to 23" Child Seated on Floor: 10" to 13" Child Standing: 21" to 25"
*Data and Graphics used in this section were adopted from *Interior Graphic Standards* by McGowan & Kruse (2004).	

Actions and Positions of Student Users		
Classroom	**Positions Noted**	**Activities observed**
Classroom A	Sitting Standing Sitting Cross-legged Kneeling	sitting in chair, walking around room, cross-legged on floor, kneeling, using supplies, carrying bins and supplies, standing, talking, leaning on furniture, laying on floor, using table surface, looking around, rocking, switching lights on and off, moving furniture
Classroom B	Sitting Standing Laying down Kneeling Sitting cross-legged	sitting in chair, walking around room, leaning on furniture, talking, crossed-legged on floor, on floor, moving furniture, kneeling, looking around, standing, using supplies, carrying bins and supplies, using table as surface, stretching, laying on floor, rocking, jumping
Classroom C	Sitting Standing Laying down Kneeling Sitting cross-legged	sitting in chair, walking around room, standing, moving furniture, carrying bins and supplies, using table surface, on floor, using supplies, looking around, leaning on furniture, talking, kneeling, crossed-legged on floor, jumping, stretching, rocking, switching lights off on, laying on floor
Classroom D	Sitting cross-legged Sitting Standing Kneeling Leaning on Desk	standing, sitting in chair, walking around room, carrying bins and supplies, talking, moving furniture, using supplies, crossed-legged on floor, on floor, looking around, leaning on furniture, kneeling, jumping, using table surface, stretching, switching lights on and off, rocking

Child User Developmental Dimensions			
	Prohibiting Elements	**Desired Conditions**	**Complimenting Elements**
Physical	Set heights	At this age children improve their physical abilities in activities such as balancing, running, jumping, and throwing, while enhancing their fine motor skills (Zembar et al., 2009). Perceptual skills evolve and include a “shift in dominate sensory, increase in intrasensory communication, and development of perception of body awareness” (p.103).	Adjustable to accommodate a variety of student sizes, encourage student to move, light enough for students to lift,
Cognitive	Supports only convergent activities	Cognitive development in middle childhood focuses on “how children develop thought and problem-solving skills in direct interactions with the environment through the processes of assimilation and accommodation” (Zembar et al. 2009, p. 188). Cognitive development for children at 6 to 8 is marked by a number of components including “increased short term capacity, faster processing speed, improved [attention and] focus, improved mnemonic strategies, increased knowledge base, greater automaticity, and greater metacognition” (p. 176).	allow for divergent thinking activities, requires the user to consider placement for activitiy, encouraging imaginative interactions, encourages user to make calculation.
Affective	all furniture identical	Children develop their individual sense of self-worth and self competency during these years (Zembar et al.,2009). Children are mostly motivated through challenging activities that lead to “curiosity, persistence, task autonomy, [and] desire for novelty” (p. 246). Experiences designed to motivate a child are characterized by immersion “in an activity, merging actions and awareness, focusing attention, lacking self-consciousness, and feeling in control of the environment and actions” (p. 246).	provide variety in furniture, allows for the opportunity to play and experiement,
Social	students placed in specific spot	Children learn through observation by watching their peers, family, and friends to determine appropriate and achievable behavior (Zembar et al., 2009).	provide for a diverse forms of interaction, usable with others.

Environmental Conditions		
	Existing Conditions	**Desired Conditions**
Dimensional	furniture used by occupants and traffic paths dominate floor space of classroom	create a flexible space using new prodcuts that can be manipulated by occupants and can confrom to easily and quickly provide a clear floor space
Electrical	outlets located around room, some stationary furniture used to support electronics (CD player, projector,etc)	provide furniture that can easily be moved that supports the technology included in the classroom such as computers, projectors, and music players.
Lighting	(16) 2 x 4 fluorescent flush mounted with parabolic diffusers, some table lamps present, daylighting through windows	more variety in lighting to compliment activity, possible lighting options in activity centers
Temperature	temperature constant in classrooms, temperature of furniture often cold to touch with plastic and metal	remain comfortable
Configuration	configuration of furniture is set in groups, static desk or table arrangements	allow for movement and unlimited configurations
Organization	limited storage compared to needs. Items are often exposed leading to clutter	Items hidden until needed, reachable by students and teachers easily
Olfactory		engage the senses or provide associations with other scents
Tactile Elements	cold hard surfaces, hard floor with carpet over concrete, classrooms that provide couch provide tactile experience	touchable surfaces
Third Teacher Principles		
	Existing Conditions	**Desired Conditions**
Transparency	teacher area clearly marked, space divided by activities	uninhibited movement in the classroom, awareness of everything
Active Learning	static environment, students move to learning centers to engage with materials,	provide furniture that can be easily moved to create different learning stations, create environment that compliments the students active movements
Flexibility	small items move such as books, activity packets, when another class visits they are cramped	moveable and changeable furniture, not just flexible in movement but also flexible for activity
Collaboration	Classroom predominantly changed by teacher	provide products that allow for all stakeholders to work with and in the environment
Reciprocity	the classrooms do not respond to students but rather students respond to environment	provide products the respond to students, teachers, and stakeholders
Bringing the outdoors in	some classrooms include plants	embody the elements seen in nature, make the classroom seem alive
Relationships	define the relationship, could students define relationship	provide furniture that enables a positive relationship
Aesthetics	many posters	incorporate students art, change, engage the senses

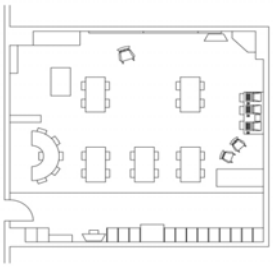
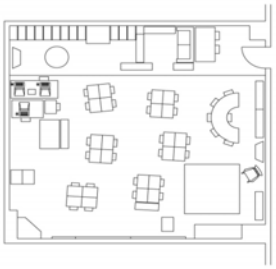
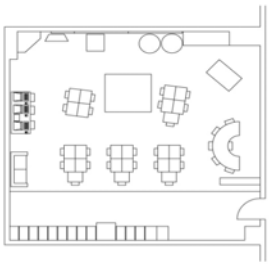
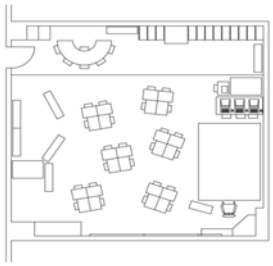
Photographs of Existing Furniture	
Chair and Table Combination:	
Student Rocking Chairs in Reading Center:	
Reading Centers with Upholstered Sofa	
Desks set to same height and configured by teachers:	

Sofa Pillows on Floor:

Multi-Use Easel for Presentation and Storage:

Make-shift 'centers' hangers and poles:

Storage Shelf with Removable Separator:

Spatial Dimensions/needs			
Existing Square Footage			
	Dimensions	**Square Footage**	**Floor Plan**
Classroom A	32'-6" x 30'-0"	960 sq ft	Classroom Characteristics: - chairs and tables support the students - Furniture is placed in set location - U-shape to allow for clear floor space 
Classroom B	32'-6" x 30'-0"	960 sq ft	Classroom Characteristics: - chairs and desks support the students - Furniture is placed in set location - Floor space provided in corner of room 
Classroom C	32'-6" x 30'-0"	960 sq ft	Classroom Characteristics: - chairs and desks support the students - Furniture is placed in set location - U-shape to allow for clear floor space 
Classroom D	32'-6" x 30'-0"	960 sq ft	Classroom Characteristics: - chairs and desks support the students - furniture is placed in set location - floor space provided on side of room 

Spatial and Product Needs					
Case Study Spatial Distribution					
	Classroom A	**Classroom B**	**Classroom C**	**Classroom D**	**Average Used Spae**
Line Up Space	75	42	75	42	58.5
Coat and Backpack Storage	90	90	90	90	90
Morning Work Space	132	159	148	192	157.75
Reading Center	36	56	73	71	59
Snack Area	132	159	148	159	149.5
Teacher Area	56	65	47	35	50.75
Clear Floor Space	99	94	84	131	102
Computer Area	24	23	27	23	24.25

Design Concerns and Constraints	
Usability	students must understand how to use furniture (Cognitive)
Accessibility	Design of products must not exclude anyone from participating in use activities
Support	Design must support students in intended positions, but must also support student in unintending positions, Also support visitors to the classroom including adults
Safety	Balance, material, weight, moveability, finger-pinching, falling, stability…
Developmentally Appropriate	challenges students physical, cognitive, affective, and social abilities. Not over challenging though
Adaptability	Able to adapt and support various activties in the classroom
Material Selection	Safe, tactile, cleanable, cost

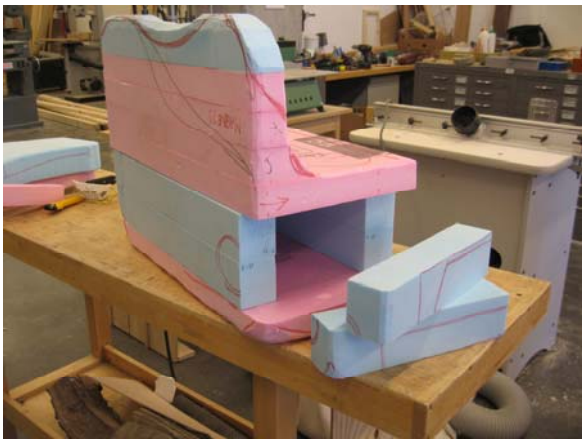
Existing Product Descriptions			
	Description	**Uses**	**Design issues**
Chairs	Plastic formed, supports upright position	sit, stand, kneel, turn, push	one direction seating, one height seating, tip over
Desks	Static, box form, features name tag on desk, storage for student supplies	write-on, eat-on, lean, stretch, sit, security	one direction use, not easy to move, tip over,
Tables	Static position, used by group of students	write-on, eat-on	non-individual, one height, student must move to accommodate
*see existing inventories available by classroom			

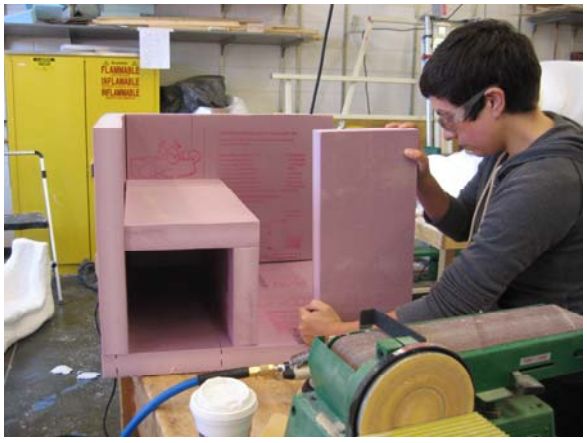
Design Concept	
Descriptive Adjectives	movable, dynamic, asymetrical, reflection of child-user, small scale, proportionally balanced, part to part relationships.
Objectives	support the developmental needs of a child age 6 to 8, engage active relationships, promote flexibility, allow for movement, provide multiple positions, encourage creative use, and enable building.

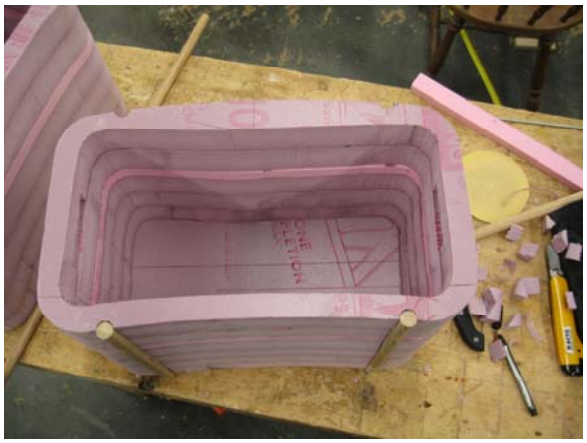
*Formating of programming document adopted from course documents distributed in Social & Behavioral Aspects of Interior Architecture . IAR 331 taught by Marshall-Baker (2010).

APPENDIX G

FOAM PROTOTYPE CONSTRUCTION







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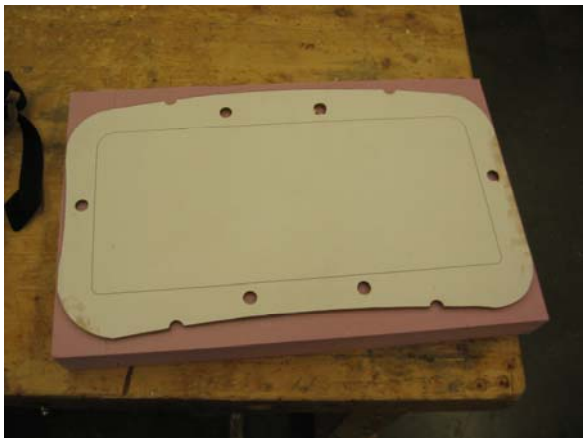

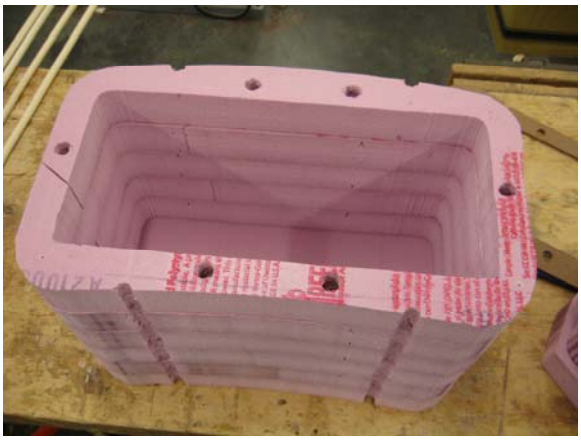

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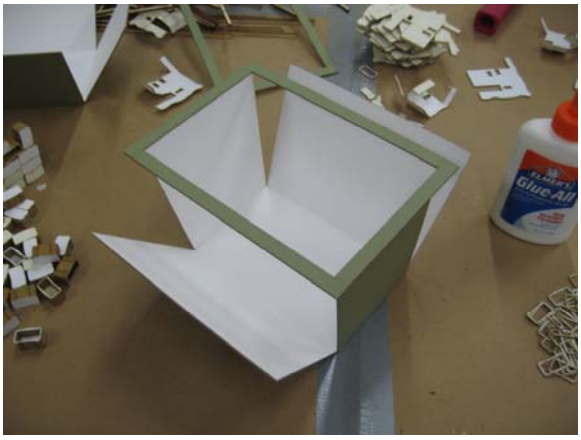
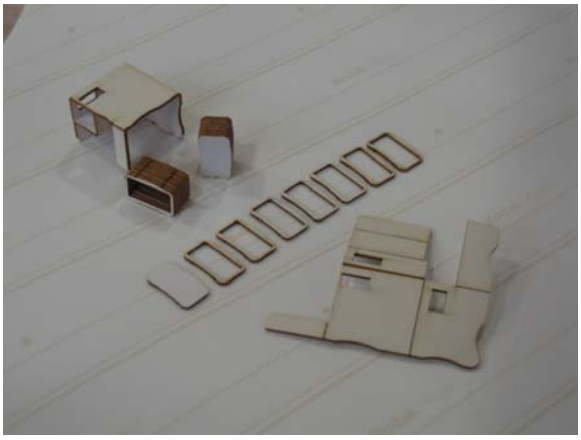
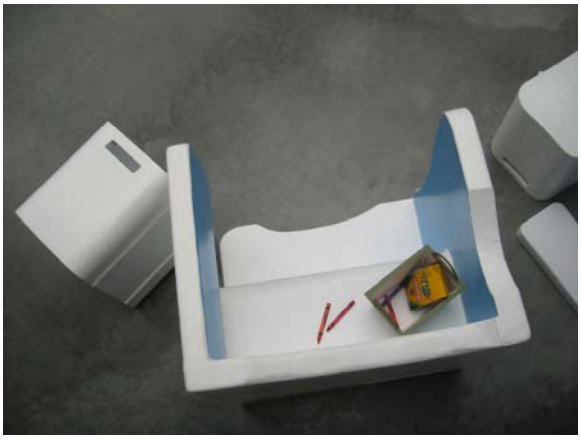




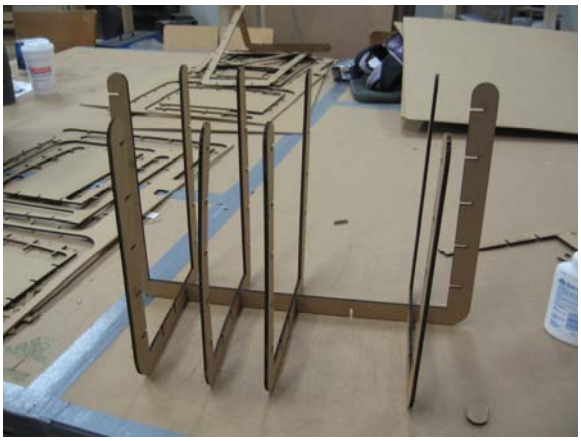
APPENDIX H

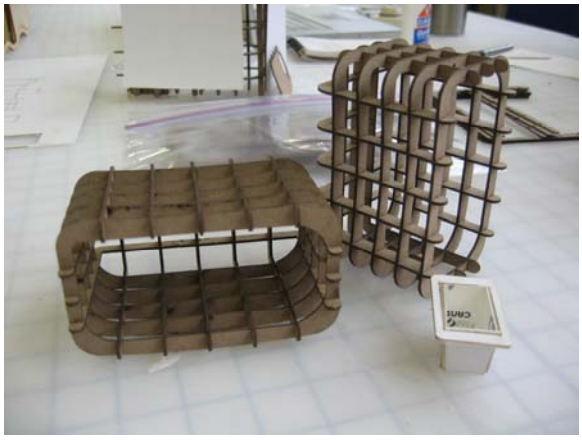
FOAM PROTOTYPE PHOTO SHOOTS

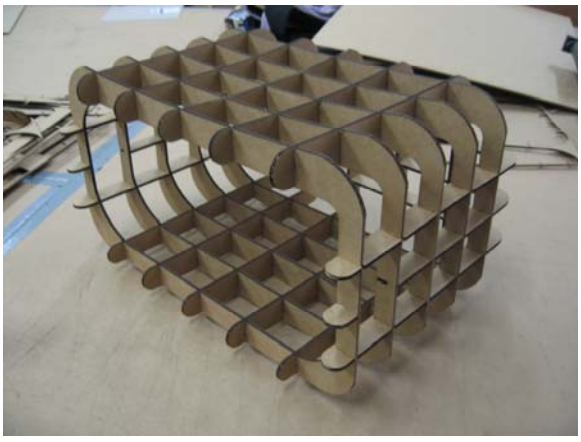


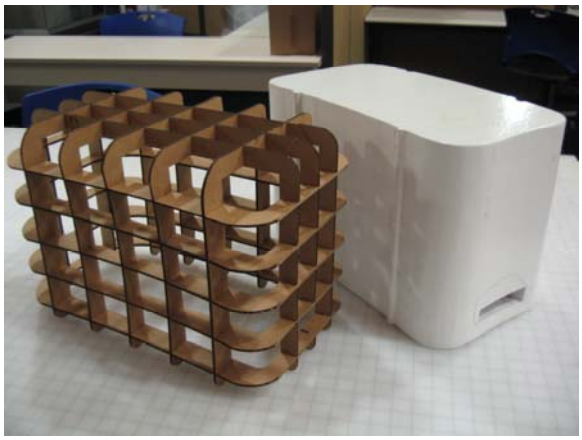
APPENDIX I

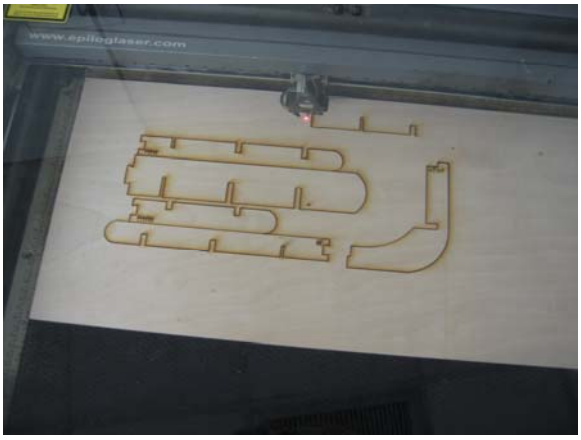
WOODEN PROTOTYPE CONSTRUCTION







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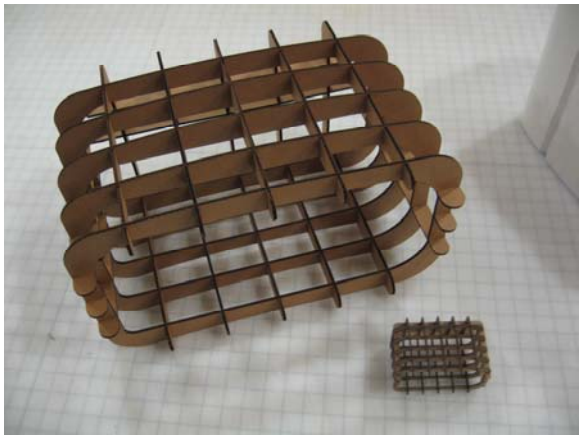

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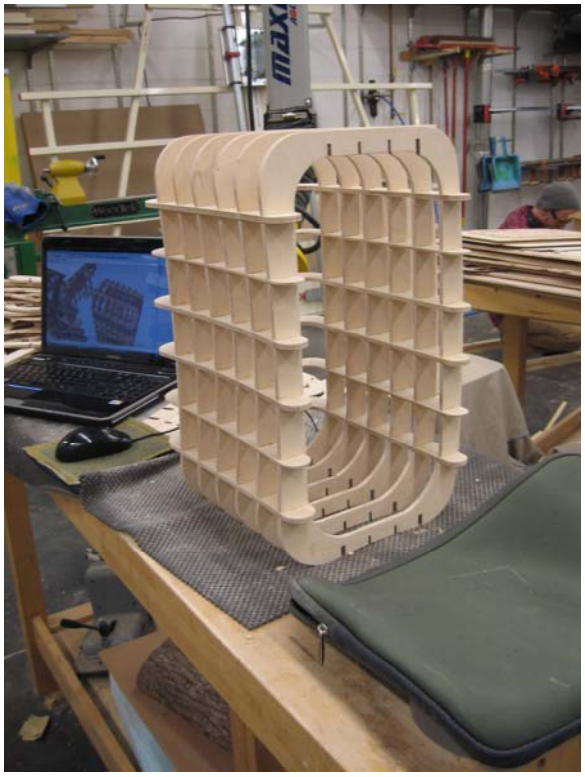
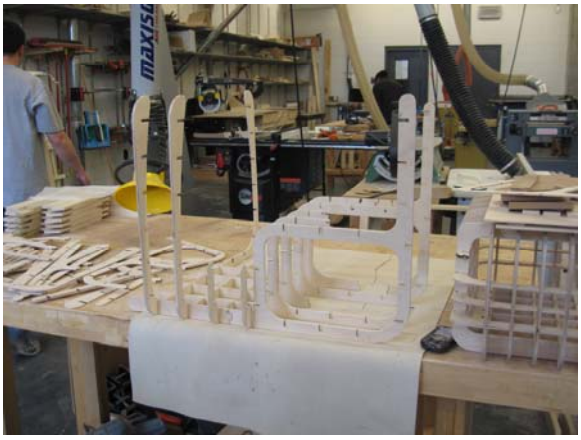
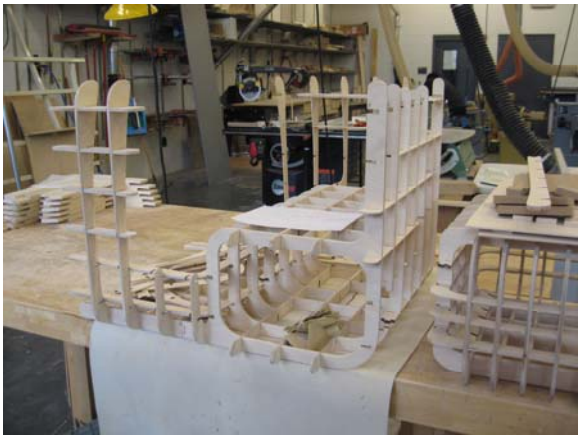
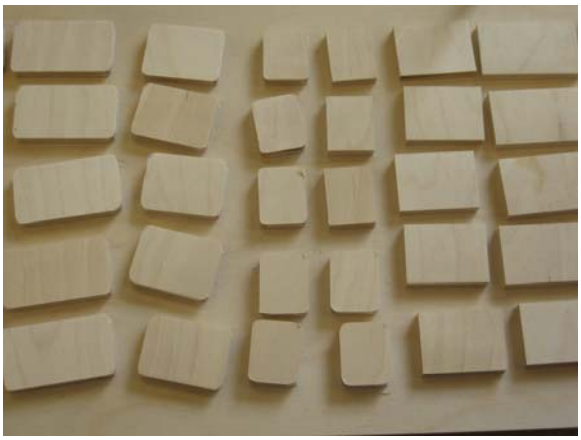
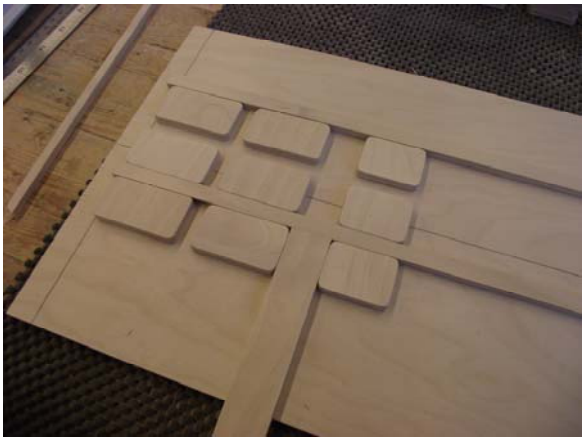
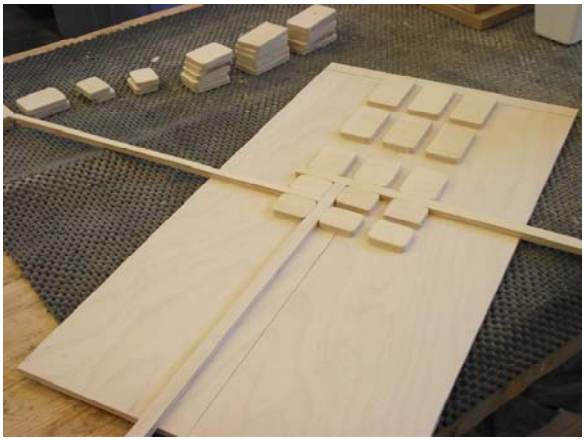


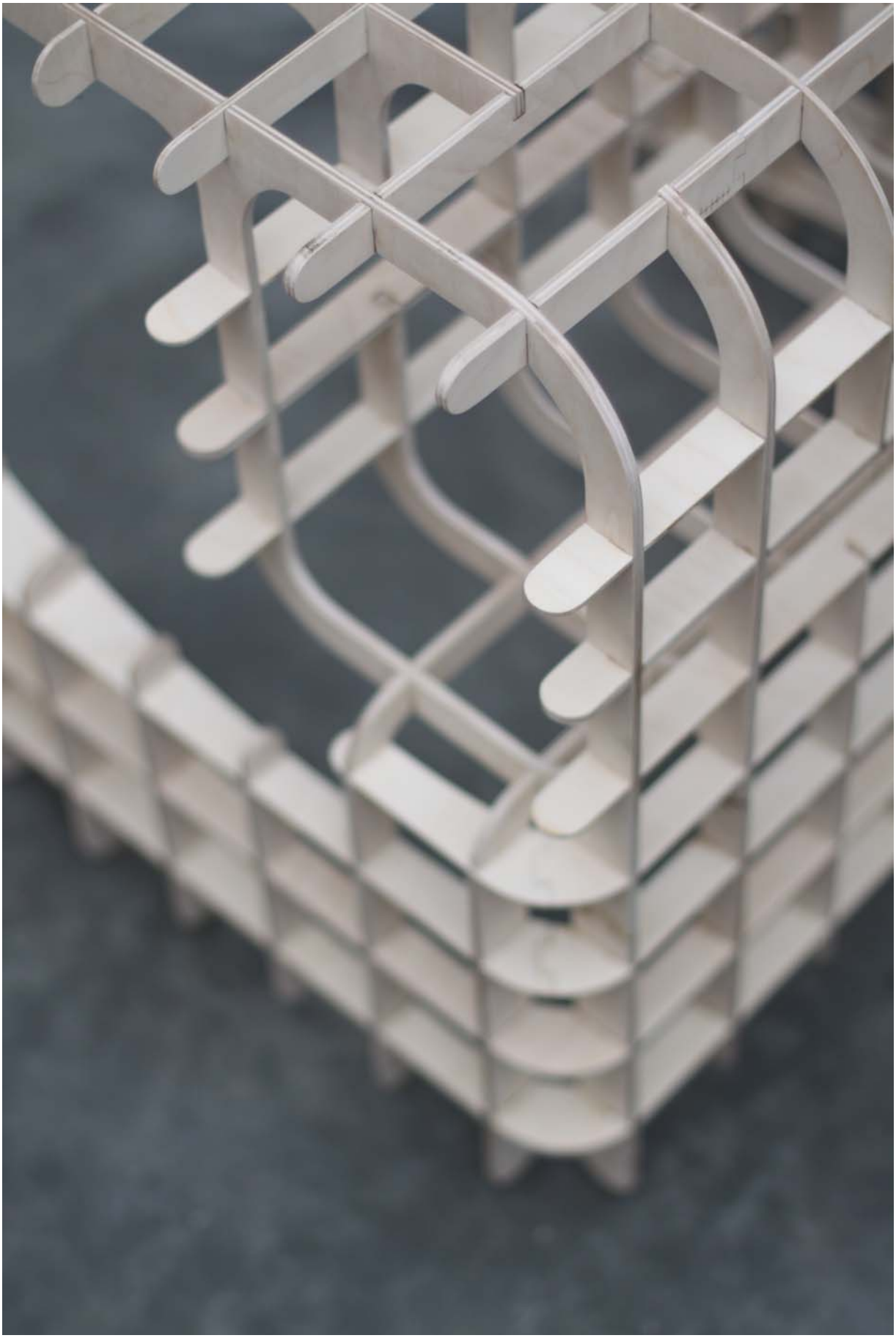
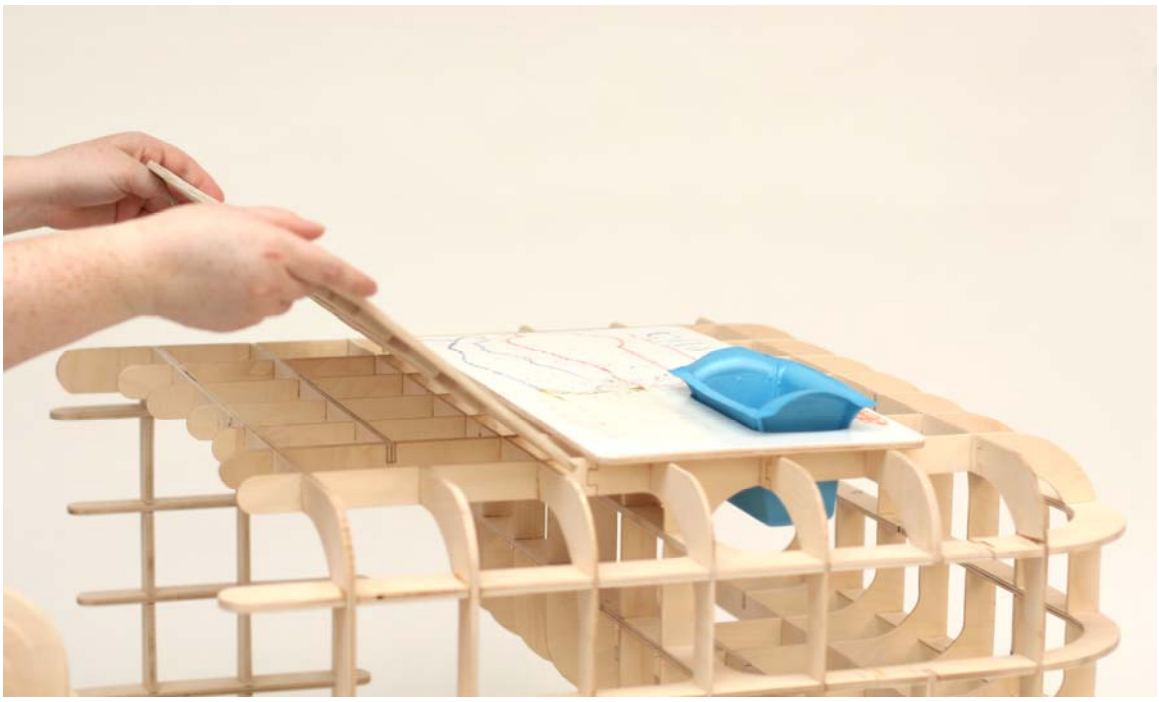
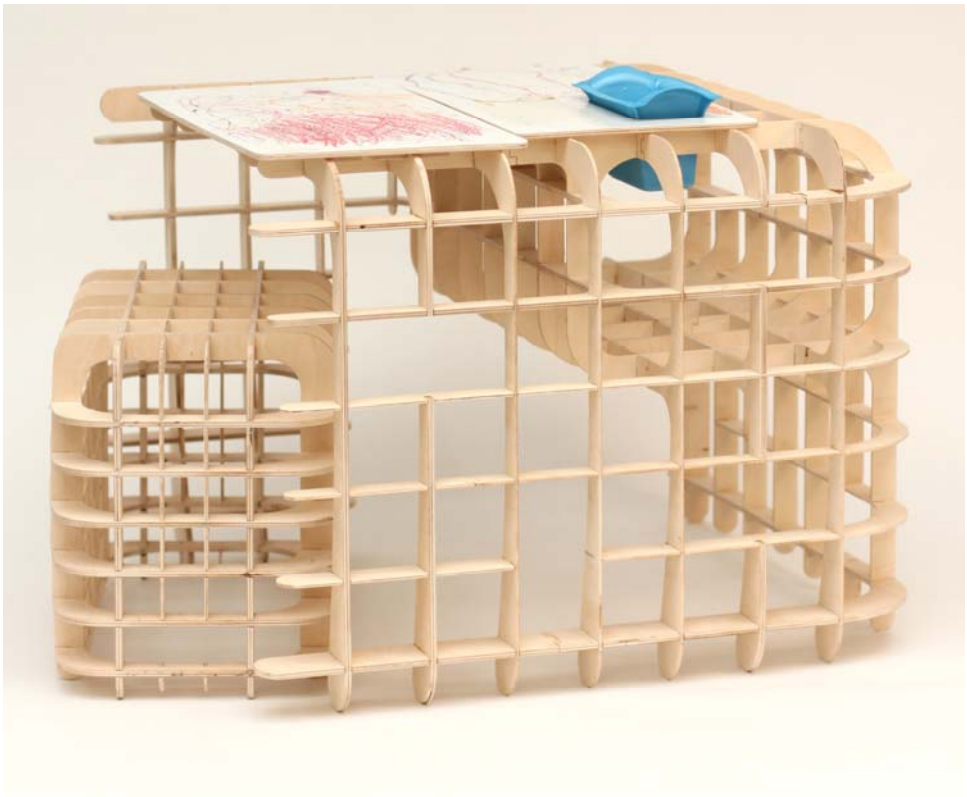
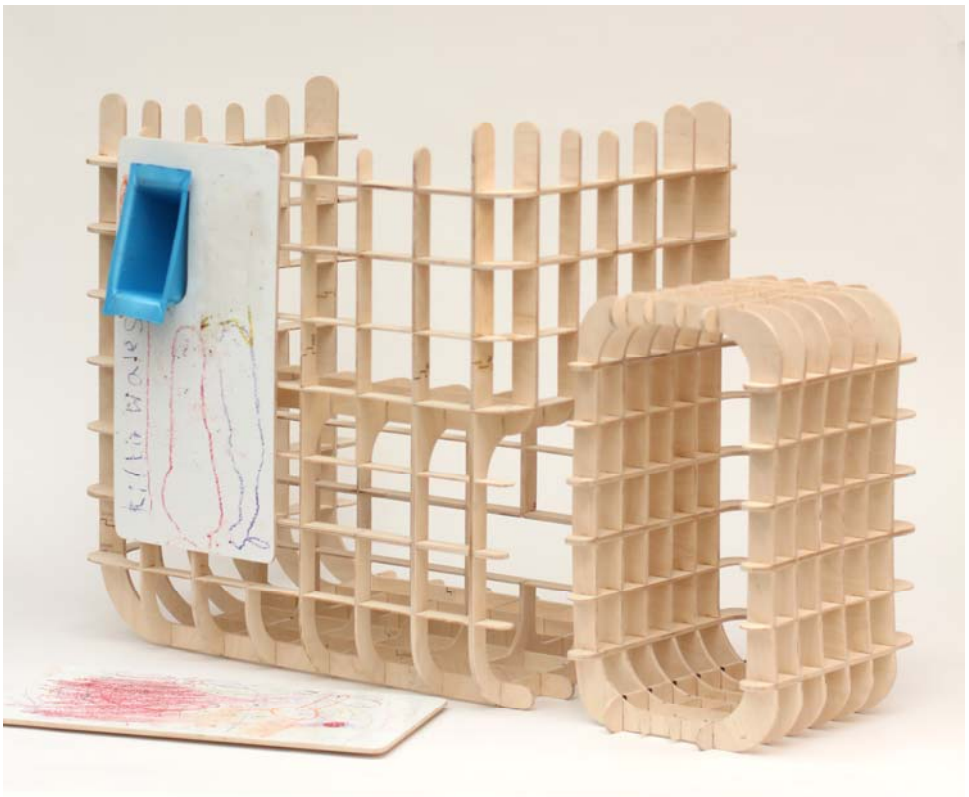










APPENDIX J

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