DESIGN ELEMENTS FOR A VERTICAL SCHOOL

CASE STUDY: KAKA‘AKO

A DARCH PROJECT SUBMITTED TO THE GRADUATE DIVISION OF THE UNIVERSITY OF HAWAI‘I AT MĀNOA IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF

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Keywords: Vertical School, Education, Architecture

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I would also like to thank my family for their support over the years.

Abstract

This dissertation proposes the vertical school as an opportunity to reconceptualize the design of public school facilities in Hawai‘i. In recent years, Honolulu has seen an upward growth in population and development. With an increase in population and limited available land in an urban environment, the vertical school becomes a viable school typology.

During the summer of 2017, Professor Karla Sierralta, the principal investigator, led a research project to study potential concepts and design guidelines for this novel typology, to be located at the Pohukaina site in the Kaka‘ako district in Honolulu, Hawai‘i. Part of this project involved an intense four-week design workshop for the State of Hawai‘i Department of Education. Jason Hashimoto, Chris Songvilay, and the author served as student project assistants for this investigation. This dissertation continues Professor Sierralta’s investigation of the vertical school typology as a potential prototype to improve learning environments for public school students in Hawai‘i.

To enhance the education of Hawai‘i’s Keiki this study aligns the development of the child and pedagogical models with architecture and the environment and creates a conceptual design guideline centered around the child- encompassing three concepts- Play, Nurture, and Learn. These guidelines will highlight elements needed for a highly functional learning environment.

This dissertation culminates in applying the guidelines to the conceptual design for a vertical elementary school in the Kaka’ako neighborhood of Honolulu. The guidelines and design will provide future designers and architects with ideas for a conceptual approach to develop future vertical schools in Hawai‘i.

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1.1 Organization

The environment significantly affects a child's education.[1] The problem of building a vertical school in Kaka'ako revolves around the current state of local school facilities and the need for a child-centered learning environment. The secondary aspect of the problem lies in the challenges of going vertical in a developing urban setting. When a predominantly horizontal building typology converts into a vertical layout, the interrelationships of spaces change, requiring attention to aspects of design such as adjacencies of spaces, relationship to outdoor/ indoor space, and access to play areas. By combining the two ideas of a child-centered learning environment and the advantages of verticality, this dissertation aims to use the vertical school building typology as an opportunity to create a vibrant learning environment for Hawai'i's public-school students. Figure 1-1 Preliminary Brainstorming Mapshows the preliminary brainstorming map of the project and its various components. To recognize the needs behind the design of a vertical school this dissertation seeks to bridge the concepts behind architecture and education. Ultimately, the outcome of this dissertation is to provide architects, designers, and educators with a set of design guidelines as well as a thoughtful design for a vertical school in Kaka'ako. The conceptual proposal intends to spark new ideas, create interdisciplinary collaboration, and harvest new design potential for the future of Hawai'i's public-school fa cilities.

The research conducted for this dissertation begins with the child and various s developmental factors that occur within the child's early life. The cognitive, social, emotional, and physical development of children in grades K-5 were studied to recognize the needs of the student. Following this, educational models related to the development of the child were studied. Both international and local pedagogical methods have been explored to understand how curricula inform the environment and the arrangement of spaces.

A child's education also lies outside of the classroom. Various pedagogical models explain the idea of interaction and the multiple scales in which children interface with other individuals. These scales of interaction will serve as the bridge between pedagogy and the environment. By bridging the two disciplines, a design guideline will be established. Following the creation of the design guideline, a study on various precedents will provide a basis for designing vertically. The design guideline and studies on verticality will then be utilized to design a child-centered vertical school.

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[1] Cannon Design, VS Furniture, and Bruce Mau Design, *The Third Teacher: 79 Ways You Can Use Design to Transform Teaching & Learning* (New York: Abrams, 2010), 10.

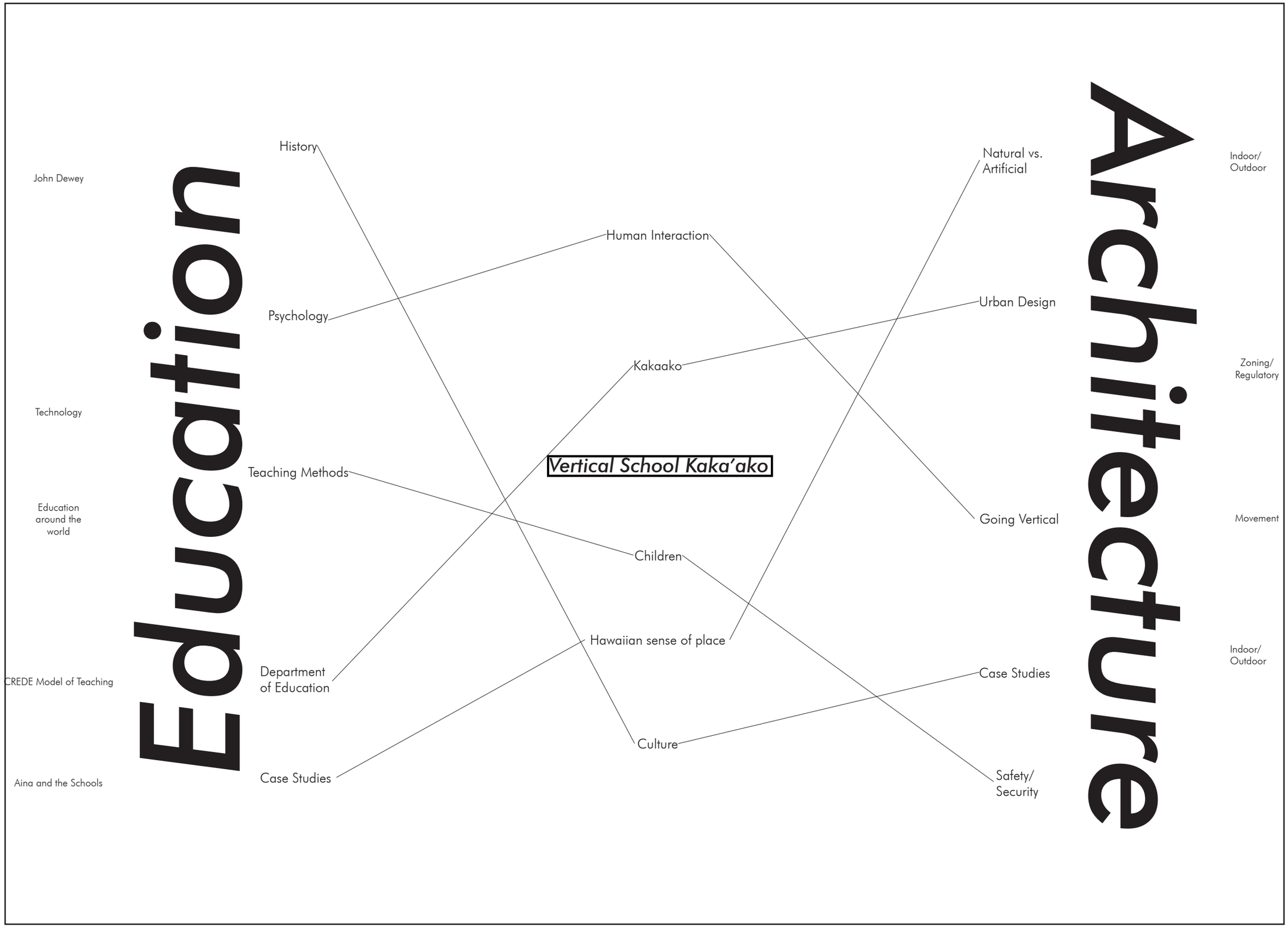

Figure 1-1 Preliminary Brainstorming Map
Source: Author

DESIGN FRAMEWORK

A CHILD-CENTERED APPROACH

CHAPTER 2
THE DEVELOMENT OF THE CHILD
COGNITIVE
PHYSICAL
EMOTIONAL AND SOCIAL

CHAPTER 3
PEDAGOGY
CHILD CENTERED
TEACHING MODELS

CHAPTER 4
THE SCHOOL ENVIRONMENT

THREE MAJOR CONCEPTS
PLAY
NURTURE
LEARN

SCALES OF LEARNING
SMALL
MEDIUM
LARGE

CHAPTER 5
GUIDELINES

UNDERSTANDING VERTICALITY

UHCDC STUDY
PRECEDENT STUDIES
GOING VERTICAL
RELATIONSHIP OF INDOOR OUTDOOR SPACE

CHAPTER 6
STACKING OF ELEMENTS

CHAPTER 7
FINAL DESIGN

LEGEND
SCOPE OF DISSERTATION
EXISTING RESEARCH

Figure 1-2 Project Design Framework
Source: Author

1.2 Problem Statement

Challenges facing the vertical school

This dissertation will address the needs of a child-centered learning environment and later address the effects of going vertical in a school layout. Figure 1-5 shows the site layouts of typical elementary school facilities in Hawai'i. Many of the facilities are spread throughout a large parcel of land and buildings are separated by the various grade levels and functions of the facility, giving it a predominantly horizontal layout. Green space is also very readily available, which helps children access to outdoor spaces. The challenge faced by the vertical school is the ability for children to have a connection to the outdoors. Being situated in an urban environment severely restricts the student from having these connections.

In 2013, Governor Neil Abercrombie released 26.2 million dollars for capital improvement projects to improve Hawai'i's public-school facilities. Abercrombie stated that "The majority of these funds will go toward statewide projects and programs aimed at providing the suitable, learning-friendly environment for students and teachers that they each deserve."[2] Rather than fix the existing the current state of school facilities, it is important to look to the future and create facilities which adapt to the needs of the child. According to Sir Ken Robinson, who is a leading researcher in educational practices around the world, if educators are "looking for new pedagogical practices, we have to have facilities that will enable those to happen."[3]

Figure 1-3 Example of a public-school classroom in Hawai'i
Source: Hawai'i Department of Education

Subsequently, a highly functional learning environment should be adaptable and facilitate different modes of learning. The task of this dissertation is to combine the challenges of verticality with innovative school design.

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[2] "Abercrombie releases $26 million for education facilities," Hawai'i News Now, accessed Feburary 16, 2018. http://www.hawaiinewsnow.com/story/21770235/abercrombie-releases-26-million-for-education-facilities.

[3] Cannon Design, VS Furniture, and Bruce Mau Design, *The Third Teacher: 79 Ways You Can Use Design to Transform Teaching & Learning* (New York: Abrams, 2010), 58.

Increasing Population

Kaka'ako is facing an upward growth in population for the past ten years. In 2010, there were 6,131 housing units. With the increase in condominiums and affordable housing units geared towards local families and individuals, the number of children under the age of 18 has increased over the recent years. Of the 10,034 residents that lived in these Kaka'ako units, 713 were children between the ages of 5-14 years old. For example, the Ke Kilohana is a residential tower currently under construction for "young professionals and new families who work in the area."[4]

Figure 1-4 Ke Kilohana Towers
Source: Business Wire

Subsequently, the neighborhood is becoming an increasingly dense area with the development of residential and mixed-use towers. Located near central Honolulu and city centers such as Ala Moana and Downtown, Kaka'ako is an attractive area for developers and residents alike. As the population increases, it is necessary to accommodate the different types of services that would go into a typical urban community. Due to the limited amount of space in the area, a vertical school becomes a necessity to accommodate the influx of population.

In cities such as New York, where population density is nearly five times that of Hawai'i,[5] many of the school buildings are vertical structures. It then becomes crucial that the architects of Hawai'i recognize the urban context and understand the implications that designing a vertical school will have on the present and future city of Honolulu.

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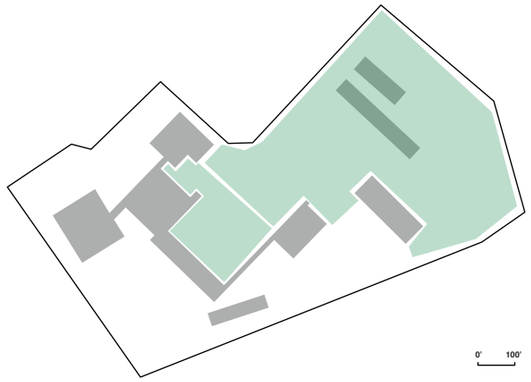
[4] State of Hawai'i, *Kaka'ako, Urban Core Living*, (Honolulu: Department of Business, Economic Development and Tourism, 2014), 3.

[5] "New York City Population," New York Department of City Planning, accessed March 15, 2018. https://www1.nyc.gov/site/planning/data-maps/nyc-population/population-facts.page.

JEFFERSON ELEMENTARY



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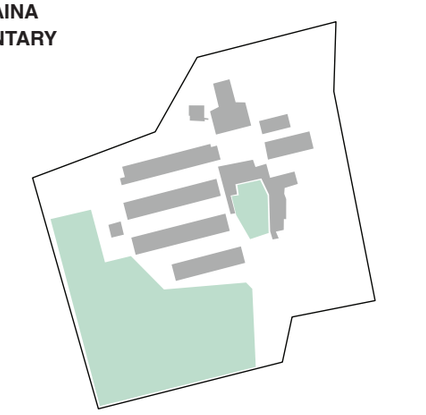

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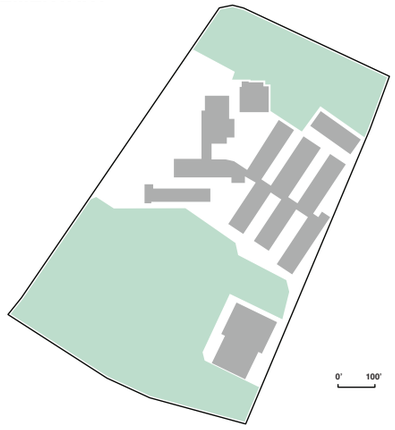

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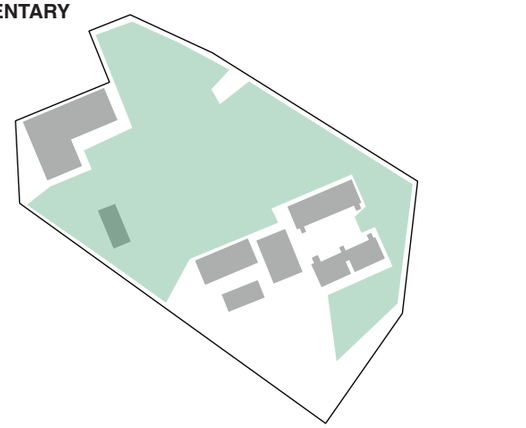

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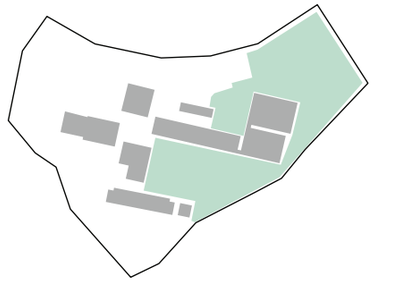

WAIKIKI ELEMENTARY

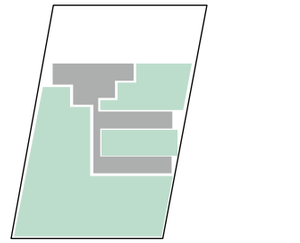

Figure 1-5 Elementary School Facility Layouts in Hawaii
Source: Author

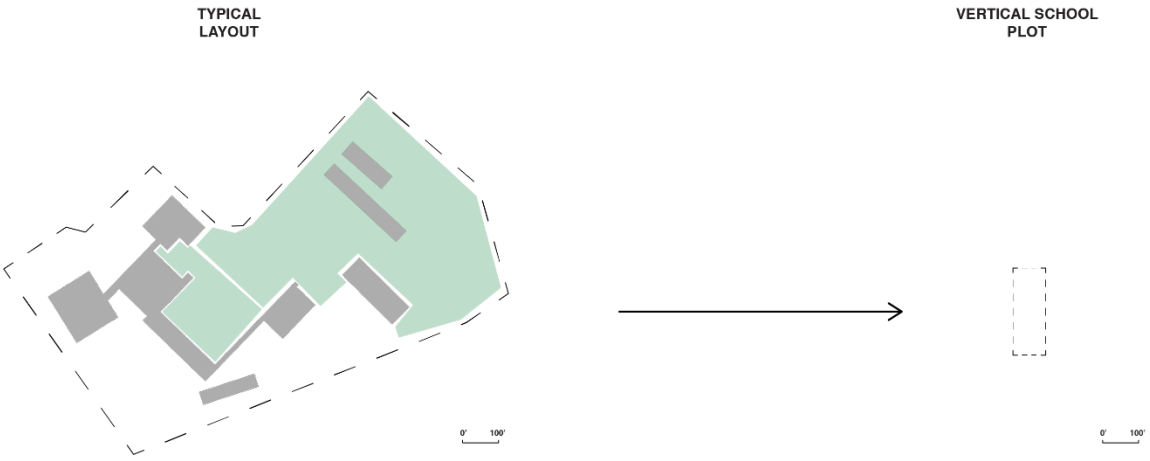

Figure 1-6 Typical Layout of a Horizontal School to Vertical School
Source: Author

UHCDC Study

In the summer of 2017, the State of Hawai'i Department of Education asked Professor Karla Sierralta and the University of Hawai'i Community Design Center to conduct a four-week study on the design of a K-5 vertical school in the heart of Kaka'ako. Professor Sierralta, the principal investigator, led a research project to study potential concepts and design guidelines for this novel typology, to be located at the Pohukaina site in the Kaka'ako district in Honolulu, Hawai'i. Part of this project involved an intense four-week design workshop for the State of Hawai'i Department of Education. Jason Hashimoto, Christopher Songvilay, and the author served as student project assistants for this investigation. The purpose of this study was to study the effects of going vertical and to recognize the implications that a vertical school would have on Hawai'i and how it would fit within the growing context of Kaka'ako.

Through the four-week study, numerous amounts of precedent studies were selected, ranging from school facilities, vertical buildings, and vertical schools. Historical studies of the site were conducted, as well as a general site analysis of the site. The team held interim meetings with the Department of Education and the commissioned project architect, WRNS Studio. The meetings informed the direction of the study, which ultimately led to the creation of three conceptual schemes representing basic volumetric organization of the building. This dissertation continues Professor Sierralta's investigation of the vertical school typology as a potential prototype to improve learning environments for public school students in Hawai'i.

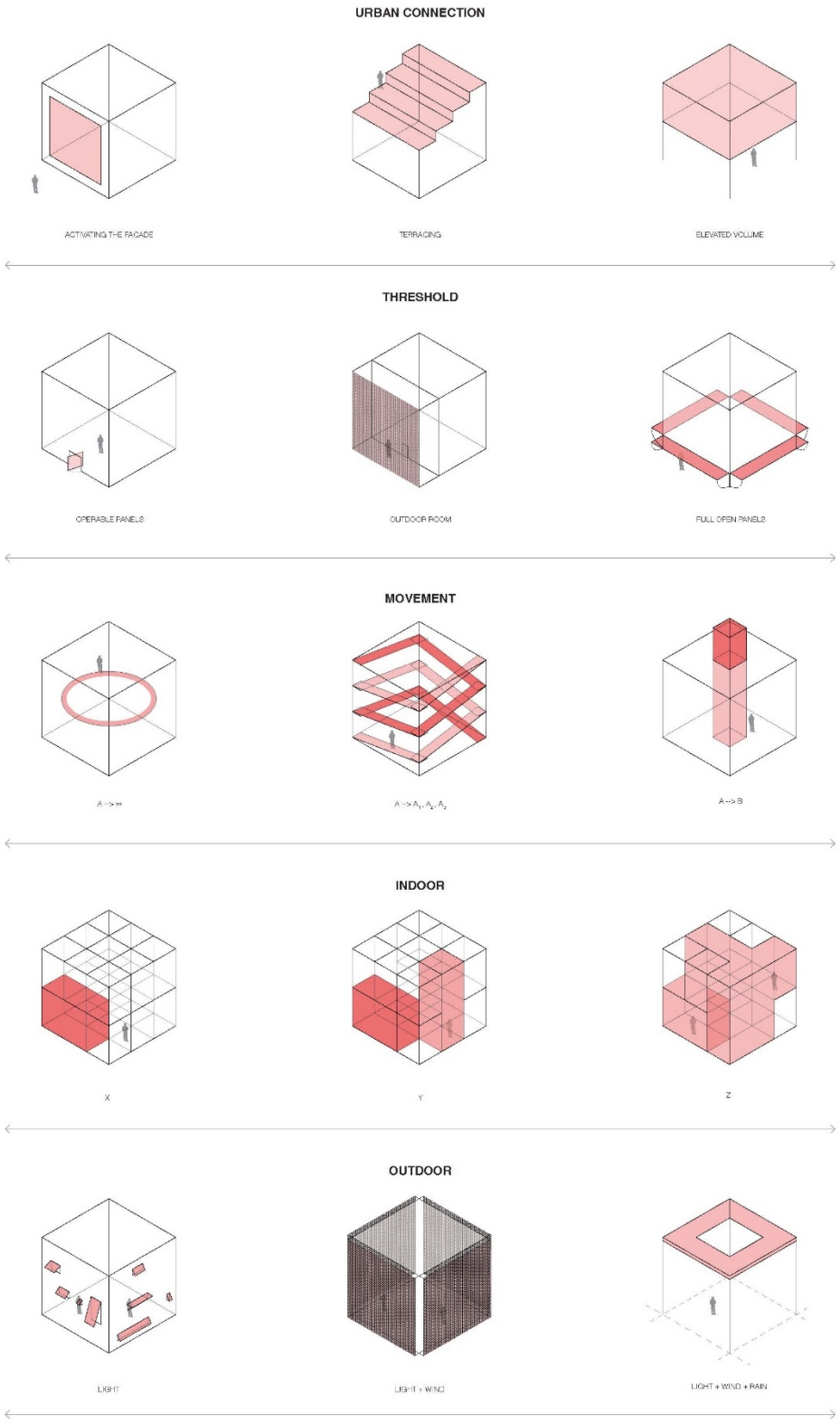

Figure 1-7 Design Categories for a Vertical School
Source: Sierralta K, et al., *Design Framework for a Vertical School in Kakaʻako Hawaiʻi.* University of Hawaiʻi Community Design Center.

Following the study of precedent studies and relevant literature related to the architectural trends in modern school design, various ideas were extracted from pioneering designs of a vertical school. These ideas were organized into five major categories as shown in Figure 1-7. The categories were urban connection, threshold, movement, indoor, and outdoor. Urban connection defines the ability for the school to connect with its surrounding context and community. Threshold categorizes the different types of entrances the school can have, from closed off to open completely. During the study, the team found that movement is a significant part of the way children interact with the building. This posed questions such as- What if the school utilized play spaces as circulation? What types of experiences can an elevator provide for students? The fourth category dealt with the volumetric layout of the interior, and how the manipulation in the X, Y, and Z direction significantly altered the space inside. Finally, the category of outdoor space defined the permeability of the project, and if it allowed light, light and air, or light, air, and wind. Each category was then set on a spectrum ranging from least extreme to most extreme, resulting in nine different elements. Using a combination of these elements, three conceptual schemes were presented to the Department of Education.

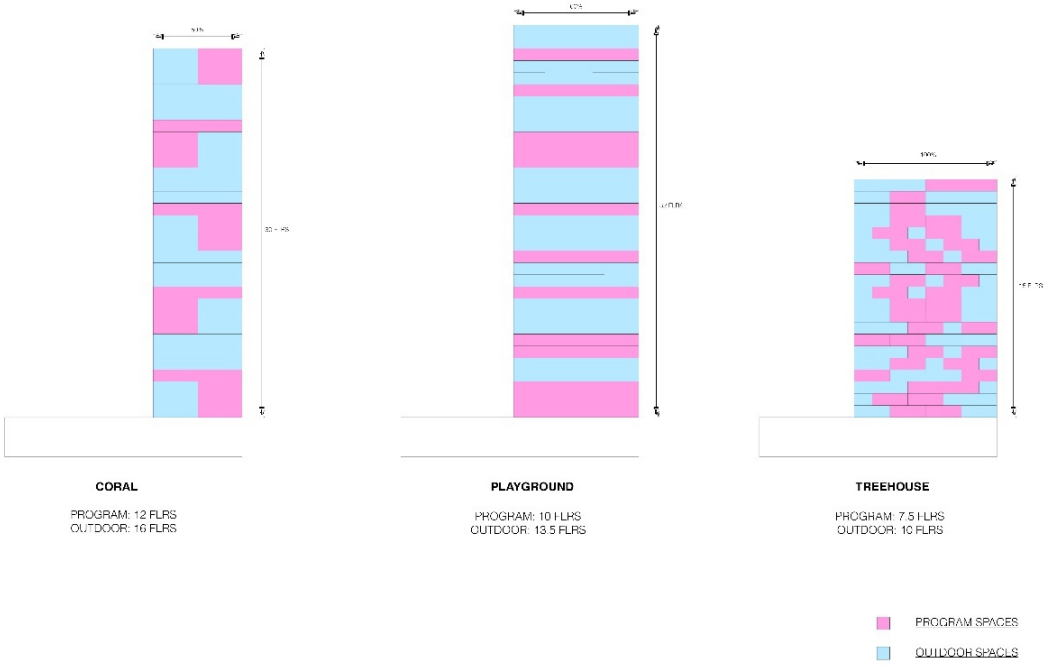

Figure 1-8 Section Diagrams showing the relationship of program and outdoor spaces
Source: Sierralta K, et al., *Design Framework for a Vertical School in Kaka'ako Hawai'i.* University of Hawai'i Community Design Center.

The final three schemes were formed by selecting different elements from the principles mentioned earlier. Another element that factored into the design was the floor area ratio and building heights of the Kaka'ako district as regulated by the city's zoning and regulatory codes.

Figure 1-9 Playground Scheme
Source: Sierralta K, et al., *Design Framework for a Vertical School in Kaka'ako Hawai'i.* University of Hawai'i Community Design Center.

Playground Scheme

The first scheme, shown in Figure 1-9, was titled Playground, where the entire floorplate was dedicated to play courts and play spaces. In some instances, play spaces utilized double height spaces to create a more dynamic play space. The intermediary volumes represent spaces. The plinth is semi-permeable, meaning that it opens to the adjacent Mother Waldron Park. The building footprint was also reduced to allow additional open space at grade. This scheme shows the possibility of still allowing for ample play spaces regardless of the compact building footprint.

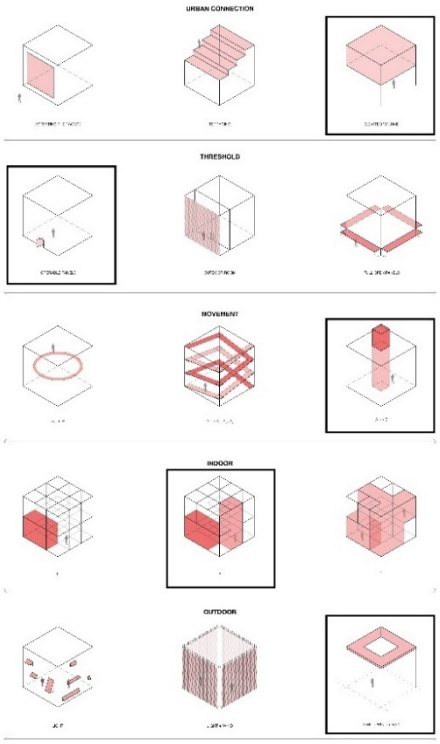

Figure 1-10 Playground Scheme Elements
Source: Sierralta K, et al., *Design Framework for a Vertical School in Kaka'ako Hawai'i.* University of Hawai'i Community Design Center.

Figure 1-11 Reef Scheme
Source: Sierralta K, et al., *Design Framework for a Vertical School in Kaka'ako Hawai'i.* University of Hawai'i Community Design Center.

Reef Scheme

The second scheme, shown in Figure 1-11 Reef Schemewas titled Reef due to its punctured volumes. This scheme utilizes urban lanai's as outdoor spaces and creates views from all sides of the building. The plinth is a terraced stairway, creating an active public space connected to the school. The building volumes are also staggered vertically, with configurations of double and triple height spaces.

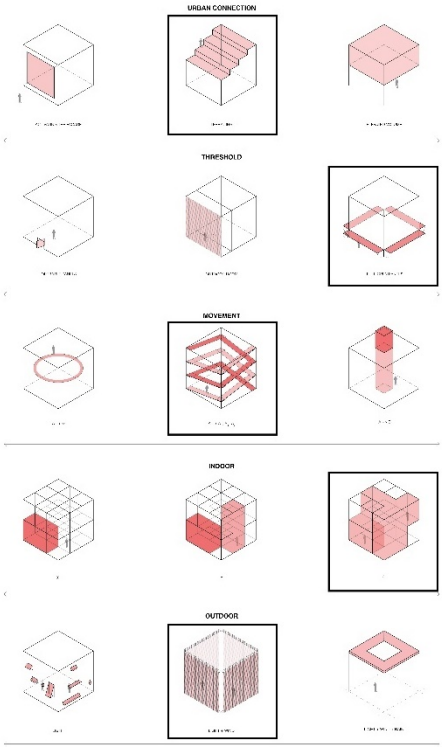

Figure 1-12 Coral Scheme Elements
Source: Sierralta K, et al., *Design Framework for a Vertical School in Kaka'ako Hawai'i.* University of Hawai'i Community Design Center.

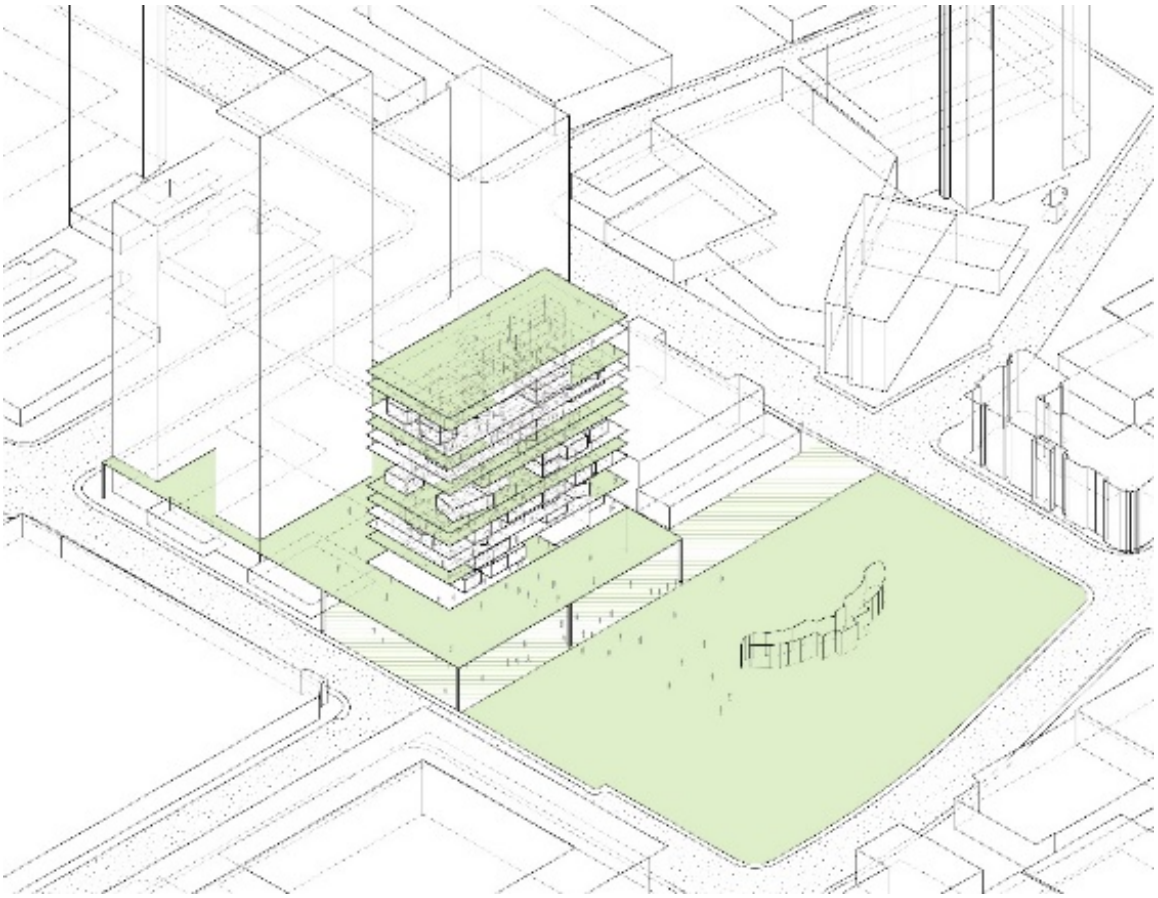

Figure 1-13 Treehouse Scheme
Source: Sierralta K, et al., *Design Framework for a Vertical School in Kaka'ako Hawai'i.* University of Hawai'i Community Design Center.

Treehouse Scheme

The third and final scheme presented to the Department of Education was the Treehouse Scheme. As shown in Figure 1-13 Treehouse Scheme the building is very porous and transparent. Each floor is unique, creating a dynamic space in the interior. Excluding the roof, this scheme is completely covered on all levels with the same floor plate. However, the element that makes each floor unique is the configuration of the volumes on each level. Some volumes may be stacked in double or triple heights, which creates an intricate and complex relationship between levels. These sets of studies helped the Department of Education and the project architect understand the challenges of building vertically.

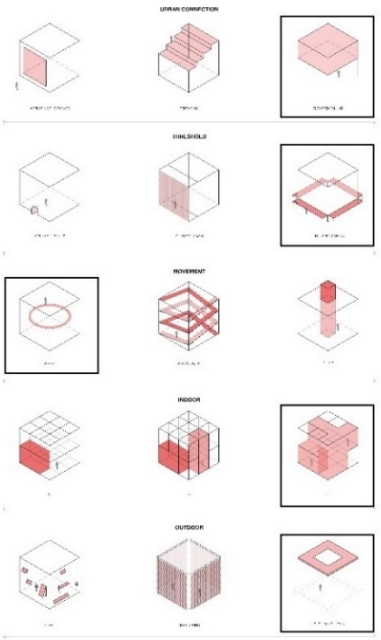

Figure 1-14 Treehouse Scheme Elements
Source: Sierralta K, et al., *Design Framework for a Vertical School in Kaka'ako Hawai'i.* University of Hawai'i Community Design Center.

GUIDELINES

	VERTICAL The search for efficiency in vertical structures often leads to:	SCHOOL The following opportunities were identified from precedent studies:	KAKAAKO, HAWAII Physical, Social and Cultural Contexts offer the following opportunities:	GUIDELINES A Vertical School in Kakaako should:
1	“Stacked” or “Pancake” repetitions of similar floor plates, usually isolated from one another.	Open spatial relationships can provoke student to student interactions and encourage learning from each other.	Hawaiian concepts such as Laulima (many hands working together), Ohana (one family), and Malama Kokua (nurture, take care of each other) support socio-petal spatial arrangements.	**Break the Stack** to foster open learning environments.
2	An isolation from the urban community below, except for the spaces with privileged views.	Students can learn from the city via viewing platforms, shared activities, and field trips to places within the community.	The location of the site in front of Mother Waldron Park (the only public space in Kakaako Mauka), offers the potential for the school to become the cultural center of the neighborhood.	**Offer Soft Thresholds** to learn from the city and contribute to the local community.
3	A compact stair and elevator core that reduces daily circulation to going “up” or “down”.	Expanding circulation beyond typical stair and elevator cores can encourage exercise and promote health and wellness.	Hawaii is ranked one of the healthiest states in the US. An active population that loves surfing, swimming, hiking, jogging, biking, etc, will support activities that encourage movement.	**Hike the School** to encourage exercise and promote health and wellness.
4	Physical interaction with the outdoors usually limited to the ground level.	Blurring indoor / outdoors can allow learning and playing both inside and outside while connecting students to the natural environment.	The program requirements of the school are half indoors and half outdoors. In addition, Hawaiian concepts such as Aloha Aina (love of the land) encourage appreciation of nature.	**Multiply Outdoors** to allow learning and playing both inside and outside
5	A loss of human scale occurring at the ground level, where the building meets the street.	Urban gestures to the human scale have the potential of mediating between the public and the private without compromising safety.	The location of the site in between the planned train station and Cooke Street, which will connect to the Waterfront park, is an opportunity to become a key moment on this path.	**Be Public Space** by mediating between the public and the private and adding to the designed public space of the city.

Figure 1-15 Final Guidelines created by UHCDC team
Source: Sierralta K, et al. Design Framework for a Vertical School in Kakaako Hawaii. University of Hawaii Community Design Center.

Utilizing the UHCDC study

This dissertation springboards off a study conducted by the University of Hawai'i Community Design Center. Due to the time constraint behind exploring the vertical school typology within a four-week study, the UHCDC team was not able to delve into the needs of a child as an individual and the specific pedagogical models that have been apparent in education today. This dissertation attempts to approach the topic from a different perspective and incorporate ideas from the summer study to create a conceptual design for a vertical school in Kaka'ako.

The first problem lies behind the current state of facilities. The average age of a school facility in Hawai'i is 65 years old.[6] Learning spaces are not designed to promote child-centered educational models and severely limit how physical space is used to supplement the education of children. Most classrooms are rectilinear spaces filled with desks, designed for a teacher-centered approach to teaching and learning. The challenge of this design project is to create and design spaces that provide sufficient opportunities for a more active and engaging learning environment in a vertical school.

Due to the lack of need and zoning regulations, many of the public elementary school facilities in Hawai'i have predominantly been one to two-story structures. Therefore, many of the public-school facilities in Hawai'i are primarily horizontal in layout, with structures spread across the parcel. According to the Hawai'i Institute for Public Affairs, "most Hawai'i public schools are built on horizontal designs that are outmoded and not aligned with modern learning environments."[7] The institute also elaborates that "complexes on all islands suffer from aging schools, maintenance backlogs, and budget shortfalls."[8] It is predicted that it would take 150 years to repair all the schools in Hawai'i in its current pace of repair and state of school facilities. This validates the fact that new construction in Hawai'i should accommodate for modern learning methods, as well as be flexible to address the needs of the child.

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[6] "School Facilities," Hawai'i State Department of Education, accessed December 20, 2017. http://www.hawaiipublicschools.org/ConnectWithUs/Organization/SchoolFacilities/Pages/home.aspx.

[7] Hawai'i Institute for Public Affairs, *Building Better School Facilities*, (Honolulu: Hawai'i Institute for Public Affairs, 2016), 9.

[8] Ibid, 11.

1.3 Solution

The study conducted by the University of Hawai'i Community Design Center team will provide a basis for the research of a child-centered learning environment. Understanding the vertical factors beforehand will aid in the design process after research is conducted. This dissertation will first study the various aspects of a child's development. The understanding of the developmental stages is solidified through analysis of innovative teaching methods centered around the child. After these various curricula are studied, a design guideline centered around the child is created. The design guideline is used to create a vertical school design that will aid in improving the education environment in a vertical space within a densely populated urban community.

DESIGN FRAMEWORK

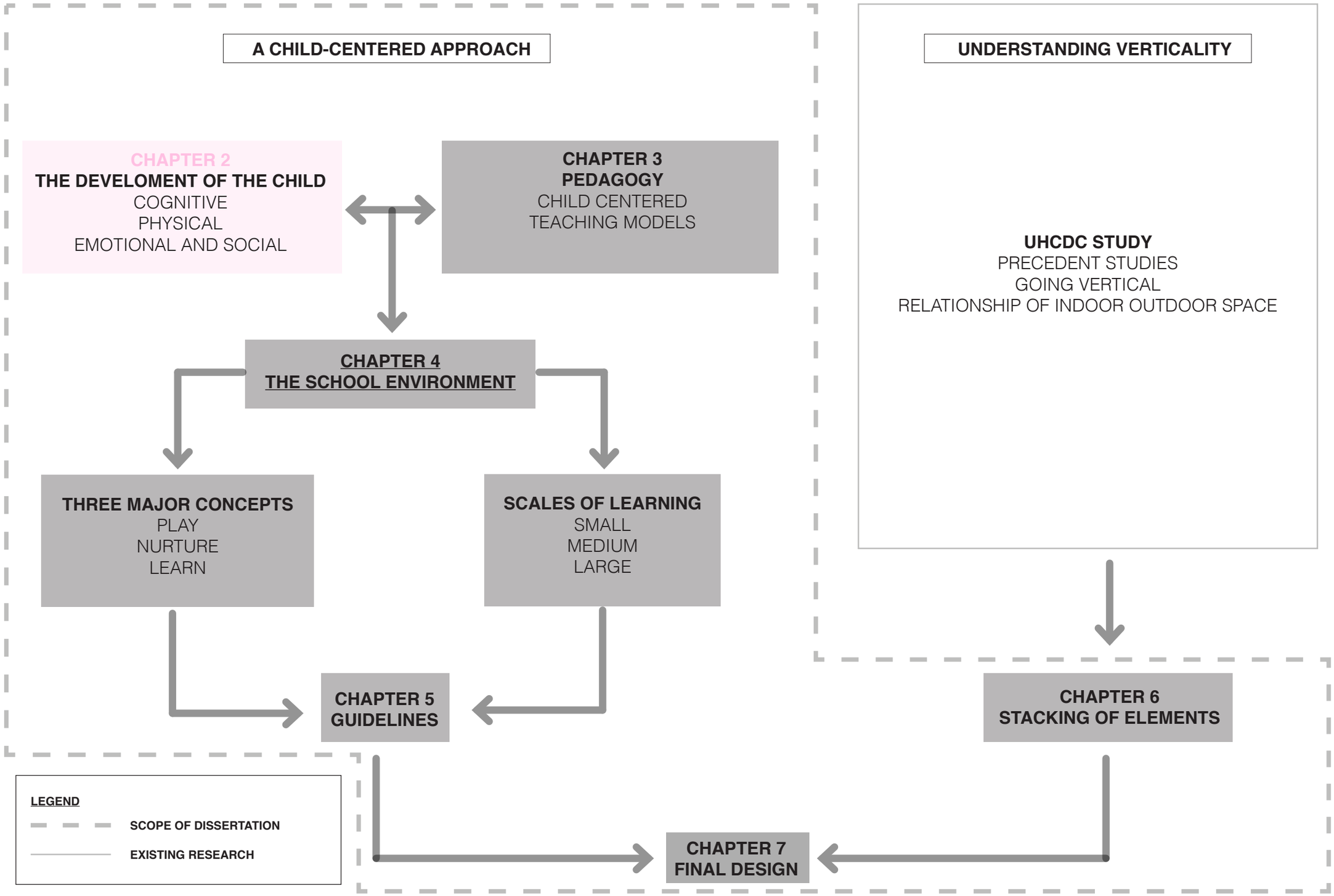

Figure 1-16 Chapter 2 Framework
Source: Author

Chapter 2: The Development of the Child

The primary users of the vertical school are children between kindergarten and fifth grade. The needs of a child must first be considered when designing a school, as well as the educational philosophy that is guiding teaching and learning. To better understand the needs of the child, this chapter will analyze the development of the whole child.

Education plays a fundamental role in the development of a child through adolescence. The study of understanding the different evolving stages of a child's mind is the study of developmental psychology. Jean Piaget was a prominent figure in this field of study. His work categorized the sequential stages that occur in a child's life. As shown in Figure 2-1, the human brain's ability to change based on experiences in much more significant in a child than it is for an adult. At a young age, the child's brain is more malleable. Hence, its ability to retain new information is greater. Education plays a role in communicating and relaying information to the mind of the child. This growth occurs chronologically, starting from the least complex area, the brainstem, to the most complex, the cortex. Eighty-five percent of the brain's core structure are created by the time the child is three years old. It is especially crucial for the child to have experiences of their own to develop the intricate parts of the brain. Piaget's most famous theory is coined Cognitive Development Theory, in which he categorized these developmental stages of a child's brain based on age. Between the ages of two and seven, the child thinks in more complex terms, where he begins to understand concepts such as symbols and time. This stage is called the sensorimotor stage. The concrete operational stage occurs between the ages of seven and eleven, where children begin to understand their individual emotions. William Blows explains that "Education plays a vital role in the process of molding the brain, as those synaptic pathways that are regularly used will be reinforced, and this forms the basis of learning."[9] This data is particularly significant because it will allow educators to effectively teach students in a way that is most natural to their developmental stage.

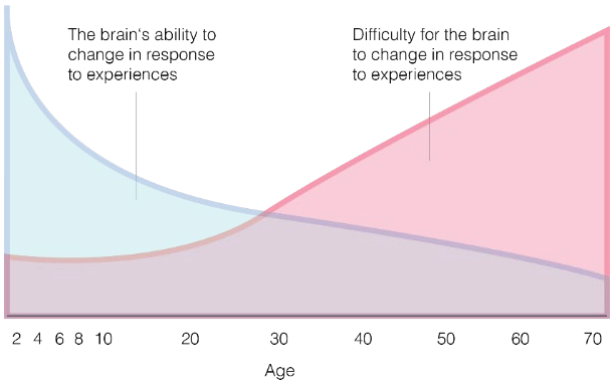

Figure 2-1 The Human Brain's ability to change based on age
Source: Author

[9] William T. Blows, "Child Brain Development," *Nursing Times 99,* April 29, 2003, 28.

2.1 Cognitive Development

It is particularly important to understand how the child's brain works and grows to relate back to the educational methods used in schools. This topic is addressed first to understand the child the developmental patterns of the child, and what types of factors affect their growth. Piaget categorized the development of a child's mind into four different stages. The four stages are the sensorimotor stage, preoperational stage, concrete operations, and formal operations.

Sensorimotor Stage

The Sensorimotor stage occurs from birth to age two. During this stage, the child is familiarized with the senses- touch, sight, smell, scent, and taste. Using these senses, the child understands and perceives the world around him. An observation that Piaget made is object permanence. This theory states that if a child understands that an object still exists even if it is not in view. For example, if a child's toy were covered with a blanket, he would search for the toy because he understands that it still exists. Similarly, if the child is still developing and hasn't fully grasped the concept of object permanence, he would lose interest and forget about the toy.[10]

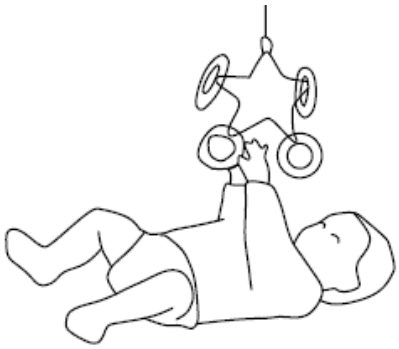

Figure 2-2 Sensorimotor Stage

Preoperational Reasoning Stage

The preoperational reasoning stage occurs between the ages of two to seven years old. Once the child is familiar with his senses, he interacts with the world through symbols. He understands methods of communication such as language, shapes, and symbols. It is an especially important period in the child's development as it is the first time he is exposed to intangible concepts such as time and language. During this stage, the child begins to understand concepts such as the past

Figure 2-3 Preoperational Reasoning Stage

[10] "Sensorimotor Stage," accessed December 20, 2017. http://web.cortland.edu/andersmd/PIAGET/sms.HTML.

and present.[11] As Tuddenham notes, "By process of "decentering," the child during this stage learns gradually to conceive of a time scale and of a spatial world which exists independent of himself. In dealing with physical objects and quantities, the child pays attention to one aspect to the neglect of other aspects. He concludes, for example, that there is more water in a glass graduate than in a beaker, though he has just seen it poured from the one vessel into the other."[12] In other words, the child deduces the differences between objects through a comparison between two things. The child is not yet able to understand things from an objective point of view. Also, children who are going through this stage often play alone rather than with other children. The child is absorbed into his private world, and if he decides to communicate, it is to share his thoughts rather than communicate with others.[13] This observation can inform the designer on the types of spaces needed for this age group of students. For example, if a child prefers to play alone, there can be a play space with multiple nooks that allow for both individual and group play.

Concrete Operational Stage

The third stage is the concrete operational stage which begins around the ages of six or seven and ends anytime between eleven to fourteen years old. Unlike the previous stage, the child thinks logically, and the individualistic ideals are not as prominent in his thinking. Although he observes and thinks logically, the child is not able to relate to things that haven't happened to him through personal experience. This means that the more experiences the child has during this period will prepare him for the future.[14] As an example, creating a rich environment which yields new experiences to the child's mental vocabulary can significantly benefit the concrete operational stage of the child. According to a study done by the University of Alabama, creating flexible classroom spaces can enhance the students learning.[15] Flexible and easily moveable furniture can increase the different types of interactions that the student faces, thus improving his ability to interact with others in the future.

Figure 2-4 Concrete Operational Stage
Source: Author

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[11] Melvin L. Silberman, Jerome S. Allender, Jay M. Yanoff, *The Psychology of Open Teaching and Learning* (Little, Brown and Company, 1972),129.

[12] Read D. Tuddenham, "Jean Piaget and the World of the Child," *The American Psychologist 23*, (1966): 133.

[13] Sean McLeod, "Preoperational Stage," accessed November 16, 2017, https://www.simplypsychology.org/preoperational.html.

[14] Melvin L. Silberman, Jerome S. Allender, Jay M. Yanoff, *The Psychology of Open Teaching and Learning* (Little, Brown and Company, 1972), 133.

[15] Caroline S. Parsons, "Reforming the Environment: The Influence of the Roundtable Classroom Design on Interactive Learning" *Journal of Learning Spaces* 6, (2017): 23-33.

Formal Operational Reasoning Stage

The fourth and final stage of cognitive development is the formal operational reasoning stage. During this stage, the child's thinking fully develops, and the individual understands things that he did not directly experience. The child is also able to understand the concept of cause and effect and understand consequences and how to avoid specific actions based on their morals.[16]

Synthesis

From the perspective of design, the cognitive development of a child presents the designer with many opportunities. The findings show that a variety of changes occur in a child's psychological understanding of the world around them through each stage. This understanding begins to inform the way in which the architect designs spaces, as with each stage, the child perceives the world differently. For example, during the early stages of the sensorimotor stage the child will most likely feel at home in a quiet and simple space. Designing appropriately to fit the need of the child best and the lesson taught is a major factor when considering the cognitive development of the student.

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[16] Melvin L. Silberman, Jerome S. Allender, Jay M. Yanoff, *The Psychology of Open Teaching and Learning* (Little, Brown and Company, 1972), 134.

2.2 Physical Development

The physical development of the child is equally as significant as the cognitive development of the child. Based on a study conducted by researchers at the School of Kinesiology at the Shanghai University of Sport, "physical activity is positively associated with cognitive function and academic performance in early life."[17]

Similarly, in the context of physical space, the space allotted per child must increase as the child grows. For this reason, it is essential for designers to address the growing body of a student and accommodate the space accordingly. Figure 2-5 shows the growth of a male from ages two through twenty. Aside from puberty, the most significant growth occurs during the elementary ages of five through ten.

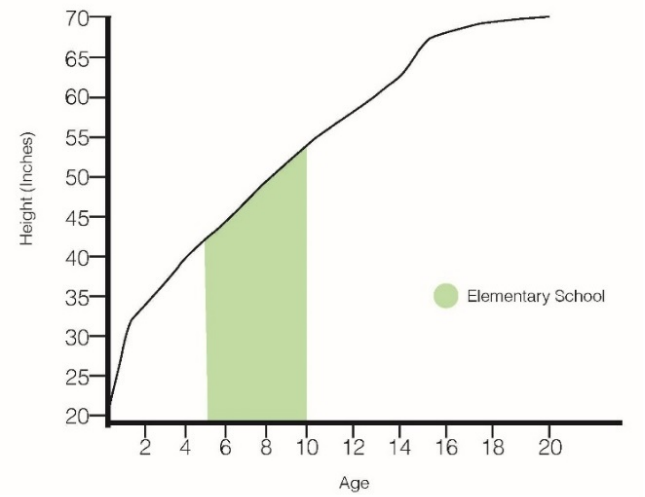

Figure 2-5 The Physical Development of a male through the ages of 2-20
Source: Author

As an example, as defined by the National Health and Safety Performance Standards Guidelines, the floor space required for children's activities should be a minimum of forty-two square feet per child.[18] This means that a class of twenty students should be at minimum 840 square feet, not including the instructor's area.

Based on this accommodation, it can be assumed that the classroom should increase in size based on grade level to better accommodate the needs of the growing child. This section will study the effects of the physical development of the child.

Typically, a child will enter elementary school when they are five or six years old. By this age, he has completed the preschooler stage of physical development. At this age, children should be

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[17] School of Kinesiology, Shanghai University of Sport, "Effect of Physical Activity on Cognitive Development" *Biomed Research International*.

[18] National Resource Center for Health and Safety in Child Care and Early Education, "Chapter 5: Facilities, Supplies, Equipment, and Environmental Health," accessed Feburary 20, 2018, http://cfoc.nrckids.org/StandardView/5.1.2.1.

able to perform basic motor functions such as walking. In addition to basic functions, children should be able to "stand on one foot for ten seconds or more, hop and skip, swing and climb, throw, and catch a ball, use a fork and spoon, and draw a person with a body."[19]

Many correlations can be made between the cognitive and physical development of the child. For example, during the toddler stage of physical development, the child should be able to "hold a cup of water and scribble with a crayon."[20] Similarly, during the sensorimotor stage of cognitive development, and child is unable to grasp the concept of object permanence, which can explain why the physical activities conducted are mainly single actions, as opposed to an older child who can conduct multiple tasks at once.

Synthesis

Physical activity is necessary for the developing child. Not only does it keep the child physically healthy, but emotionally healthy as well. Playspaces, such as playgrounds or fields, contribute to a significant portion of the area when designing a school. These spaces serve as a place for children to exercise their bodies as well as their minds. This information about physical development informs the design of hybrid spaces that combine learning and playing within one space.

[19] Ngozi Oguejiofo, "Stages of Physical Development in Children" accessed January 10, 2018, https://www.livestrong.com/article/104652-stages-physical-development-children/.

[20] Ibid.

2.3 Emotional and Social Development

Mental health is an ongoing issue in North America, and children are some of the most vulnerable individuals. One in ten children is affected by mental health problems. Many of these problems are caused by traumatic events that happen in their personal lives. This section will highlight specific beneficial interventions that can supplement a child's emotional wellbeing.

The school community can help a child become more resilient which supports a child's emotional and social development by recognizing and facilitating opportunities for engaging in play. Play is known to decrease stress levels and increase academic performance.[21]

The second aspect that helps a child is having a "loving family that gets along well most of the time."[22] By having a strong foundation, the child can focus during his classes and increase academic performance.

Social development is mainly driven by the human interactions that the child experiences over time. When attending school, a child is faced with many different types of social interactions per day. Although an argument can be made that each child relates differently to their social group, humans require some positive interaction to thrive. Like cognitive development, the social and emotional development of a child becomes more complex over time.

A significant figure in the history of the study of social development is the researcher Lev Vygotsky. Vygotsky's Sociocultural Theory states that "social interaction and children's participation in authentic cultural activities are necessary for development to occur."[23] His theory also states that over time, the social interactions of the individual become more complex over time.

Children can also learn from more knowledgeable members of their society. Therefore, children are especially influenced by individuals who are older than them. Vygotsky coined this individual "the expert."[24]

Vygotsky also believed that imaginative play and role-playing served a great benefit to the child's development. Children learn through imitating others, and by putting themselves in someone else's shoes, it allows them to form a language that is unfamiliar to their identity.

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[21] "Children and Young People" accessed Feburary 1, 2018, https://www.mentalhealth.org.uk/a-to-z/c/children-and-young-people.

[22] Ibid.

[23] Francis Wardle, *Approaches to Early Childhood and Elementary Education* (New York: Nova Science Publishers, 2009), 133

[24] Ibid, 132.

Conclusion

Based on the literature in child development, a child is easily affected by experiences with others at a young age. After the child develops into an adult, the brain is less malleable, and not as affected by the experiences he faces. Therefore, elementary education plays a significant role in aiding the development of the child's brain during this time, and the method of teaching is equally as beneficial. The following section will analyze selected teaching methods educators have identified as effective in teaching and learning in the school environment.

DESIGN FRAMEWORK

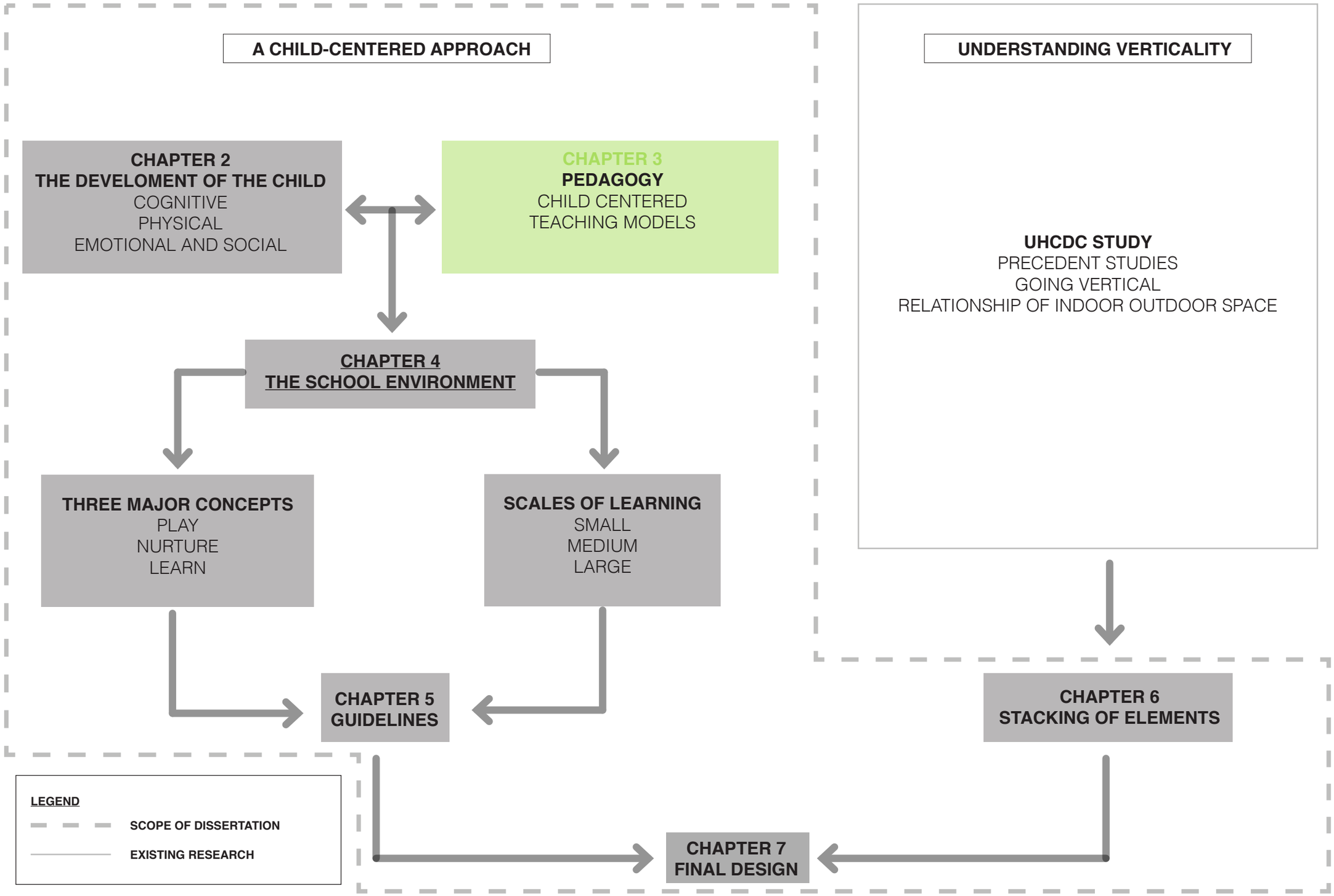

Figure 2-6 Chapter 3 Framework
Source: Author

Chapter 3: Pedagogy

3.1 Innovative teaching methods and child-centered teaching models

Based on the findings from Chapter 2, it is understood that the child's development plays a major role in the way children perceive the world. To understand the necessary components that go into the design of a school environment, the innovative pedagogical methods that determine the way in which the space is used should be determined. The innovative methods studied were John Dewey's theory of Learning by Doing, Montessori, and Reggio Emilia. The models local to Hawai'i that were studied are the CREDE Model of Teaching and ʻ Āina in Schools. These innovative models have been popularized over the years and have been implemented within public and private schools. Each of these teaching methods addresses the developmental aspects discussed in the previous chapter. From these teaching methods, this dissertation will categorize three major concepts related to the architectural components of a school environment.

John Dewey, Learning by Doing

The John Dewey philosophy focuses on the idea that children learn by experience. The philosophy is that by experiencing something, the child can effectively learn what he/she is doing. Dewey believed that experience shapes education, through discipline, scope, sequence, and goals. Moreover, he believed that education and experience were an organic connection and that it was the only natural way for children to learn. In addition to this belief, Dewey theorized two types of experiences that are educational for the child. The first type is experiences that pertain to areas/topics of interest to the individual. For example, if a child is interested in airplanes, the subject of flying or motors may be of interest. The second type of experience is the experiences that create future experiences and learning. Dewey believed that teaching should not train the child for the future, but instead prepare them for the social expectations of the future. He criticized educators who introduced unrelated topics in a child's early education. By doing this, the child has no personal experience to base the topic on, which creates a disconnect and overall disinterest towards the topic.

The curriculum of the John Dewey education is categorized into two parts — the scope and sequence. The scope focuses on the content. By incorporating experiences from the child's life into the curriculum, the child would be able to relate to the content. Furthermore, Dewey believed that the school should be a place for the child to experience things, rather than gain knowledge. The sequence deals with the order in which the content should be taught. Like Piaget's cognitive theory, Dewey understood that the child had different stages of learning and development and believed that the sequential structure of the curriculum should directly correlate to the growth of the child's knowledge and level of skill.

Another concept that Dewey focuses on is the child's relationship with his family. "Children's first knowledge of social systems is the family. Further, both empirical research and theory indicate that the family is the most influential context for the child's wellbeing, development, and learning, and therefore the family's central importance to each child is clear."[25] This particular statement correlates to the emotional and social development previously discussed in Chapter 2.3. Thus, an argument can be made that part of the child's emotional and social development rests on the relationships he experiences at home.

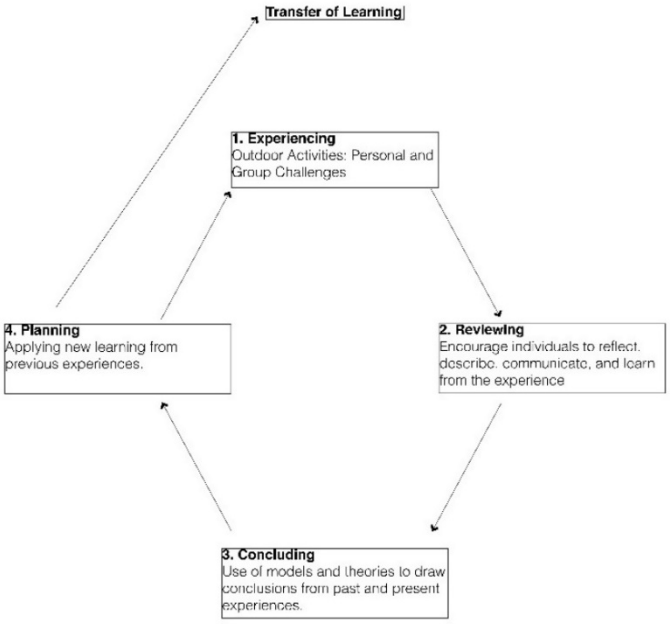

Figure 3-1 Dewey's Method of Teaching
Source: Author

Montessori

The name Montessori derives from the founder, Maria Montessori. She was the first female doctor in Italy and dedicated her life to studying children she had met while working as a psychiatrist at Rome University. The Montessori style of teaching is a popular style of teaching and is adopted by many school systems around the world. The primary idea behind the Montessori method is comparable to Piaget's theory that every child goes through developmental stages. The Montessori approach categorizes schooling into different age groups. Each stage is 6 years long and begins at birth. The stages are Infancy (0-6 years old), childhood (6-12) years old, adolescence (12-18 years old), and maturity (18-24) years old. The Montessori method categorizes infancy and adolescence as the basic stages, meaning that these are the stages in which the most development changes occur. This correlates to the cognitive development theory of Piaget, which was previously discussed at the beginning of Chapter 2.

Order, aesthetics, and child-sized furniture and equipment characterize the Montessori education environment. The teacher's role is to design and create the environment carefully, to assist children in exploring and using the environment, and then to reorder the environment to promote new

[25] Francis Wardle, *Approaches to Early Childhood and Elementary Education* (New York: Nova Science Publishers, 2009), 17.

and challenging learning experiences. The teacher's role is not to teach directly, but to carefully set-up the environment so self-directed learning can take place.

Another characteristic that sets the Montessori method apart from the other methods of teaching is the idea that "movement and learning are perpetually entwined in the curriculum."[26] For example, for a toddler who has not yet learned to walk, they would be placed on the floor rather than in the crib so that he can explore the things around him. This then continues in school, where the educational lesson revolves around having to move. Below is an example of how the Montessori classroom is structured around movement. Montessori believed that "cognitive development involves kinesthetic movement, both fine motor and gross motor."[27]

"In Primary classrooms, children move to wash tables and trace Sandpaper Letters, to put large wooden map pieces in place, and to play scales and then compose music on Musical Bells. Older children carry out verbal commands written on cards, both to confront semantic precision and to experience what a verb is. They place colored symbol cards next to words to designate parts of speech. Countable squares and cubes illustrate mathematical concepts: a child can see, feel, and manually count why 3^3 equals 27."[28]

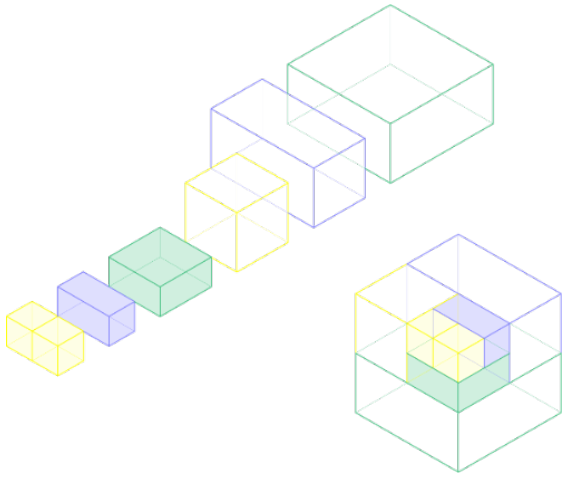

Figure 3-2 The Power of Twos: Hands-on Montessori tool for students to learn how exponents work
Source: Author

[26] Angeline Stoll Lillard, *Montessori The Science behind the Genius.* (New York: Oxford University Press), 54.

[27] Francis Wardle, *Approaches to Early Childhood and Elementary Education* (New York: Nova Science Publishers, 2009), 81.

[28] Angeline Stoll Lillard, *Montessori The Science behind the Genius.* (New York: Oxford University Press), 38.

Through categorization and grouping of children in different groups, it helps the child to familiarize himself with his peers. Subsequently, the child develops an identity, something that is particularly important during the transition from the sensorimotor to preoperational reasoning stage of cognitive development when he begins to decenter and notice others around him. In Figure 3-3 Example of a Montessori Classroom, the setting of the Montessori classroom is shown. Some children work individually, and others work in groups, while the teachers assist the others with their assignments. The flexibility of the classroom becomes important in this scenario, as the children have posters that require a larger area than your typical assignment. The child on the left is utilizing the "Power of Twos" learning tool as shown in Figure 3-2 The Power of Twos: Hands-on Montessori tool for students to learn how exponents work. Therefore, the ability to move furniture and create flexible spaces becomes especially important in the Montessori classroom setting.

Figure 3-3 Example of a Montessori Classroom
Source: Association Montessori Internationale

Reggio Emilia

The Reggio Emilia style of teaching was developed in the 1950s by Loris Malaguzzi after the philosophical ideas set forth by John Dewey and others. The name is derived from the area in which it was founded, Reggio Emilia, Italy. Most of the material in which the Reggio Emilia method was created was through the ideas of John Dewey, Piaget, Vygotsky, and other European scientists.[29] Similar to the ideas of Dewey and Montessori, the Reggio Emilia school method focused on the idea of shaping the class lessons and curriculum around the child. By creating a model of education that revolves around the child and their learning, they are more motivated to learn. The daily schedule is flexible and is set around the child and their learning.

Figure 3-4 Example of a Reggio Emilia Classroom
Source: Kids Collective Preschool

Another significant aspect of the Reggio Emilia method was the focus on the child's relationships with others. Malaguzzi believed that when the child has stable relationships with their classmates, family, teachers, school, and community, they will have a stronger education.

The primary driver of the Reggio Emilia program is the environment. By designing the spaces in a way that creates a pleasant learning environment for the child, space itself can become a third teacher for the students. The idea is that space becomes a learning tool for the children, without the aid of teachers or supervisors. The secondary driver is flexible scheduling, which was influenced by its origins in Italy. In the Reggio Emilia model, the daily schedule consists of everyday tasks. However, the overall day is very malleable and flexible. This "allows children to pursue activities to their logical end or to a logical place to pause, and to allow relationships to develop to their fullest potential."[30] This freedom of choice gives the child the ability to make his own independent decisions.

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[29] Francis Wardle, *Approaches to Early Childhood and Elementary Education* (New York: Nova Science Publishers, 2009), 145.
[30] Francis Wardle, *Approaches to Early Childhood and Elementary Education* (New York: Nova Science Publishers, 2009), 152.

Amalgamation of concepts

As shown in Table 1 Pedagogical Models vs. Developmental Aspects Matrix, the amalgamation of two concepts-the development of the child and innovative teaching methods show a strong correlation to one another. This shows that Dewey, Montessori, and Malaguzzi's ideas directly correlate to the development of the child discussed in Chapter 2. For each stage of development, there is a similar aspect of the teaching method that solidifies the relationship between child development and methods of teaching. The correlation between the two concepts also show how each educational model incorporates research from various developmental aspects in the child's life. By attuning to the overall needs of the whole child, each pedagogical model successfully pinpoints and responds to the child individual needs.

Of the educational models discussed, the most prominent idea was the physical aspect of learning. Because elementary student's minds are not as developed as an adult, it is difficult to keep them engaged in a typical classroom setting with desks facing the teacher at the front of the room. By incorporating ideas of play or physical activity within the classroom, children can learn through play. Therefore, it can be said that schools should incorporate movement and play into most of its program. The secondary element of a school relates to the cognitive development or learning.

	Physical	Cognitive	Social/ Emotional
JOHN DEWEY *Learning by Doing*	*Learning by experience*	*Incorporating experiences from child's life into the*	*Importance of relationship with family*
MARIA MONTESSORI *Montessori*	*Movement and learning are perpetually entwined in the curriculum.*	*Cognitive development involved kinesthetic movement, both fine motor and gross motor.*	*Categorization and grouping of children in different groups*
LORIS MALAGUZZI *Reggio Emilia*	*Flexibility of Schedule- decide when you want to go outside.*	*Aesthetics based learning- environment as a third teacher.*	*Child's relationships with their classmates, family, teacher, school, and community.*

Table 1 Pedagogical Models vs. Developmental Aspects Matrix
Source: Author

3.2 Innovative teaching methods local to Hawai‘i

CREDE Model of Teaching

In Hawai‘i, the University of Hawai‘i at Mānoa, Department of Educational Psychology, College of Education has created a teaching research center called the Center for Research on Education, Diversity and Excellence, otherwise known as CREDE. It was created and founded in Hawai‘i but has gained national attention for the concepts behind the teaching style. “The CREDE Hawai‘i team is dedicated to improving education for Hawai‘i’s youth through providing educators with a range of tools to help them implement best practices for native Hawaiian and other culturally and linguistically diverse students.”[31] The vision of the CREDE Classroom is –

> “Teachers and students are working together, on real products, real problems. Activities are rich in language, with teachers developing students’ capacity to speak, read, and write English and the special languages of mathematics, science, humanities, and art. They teach the curriculum through meaningful activities that relate to the students’ lives and experiences in their families and communities. Teachers challenge students to think in complex ways and to apply their learning to solving meaningful problems. Teachers and students converse; the basic teaching interaction is conversation, not lecture. A variety of activities are in progress simultaneously (individual work; teamwork; practice and rehearsal; mentoring in side-by-side, shoulder-to-shoulder, teacher-student work.) Students have systematic opportunities to work with all other classmates. They all learn and demonstrate self-control and common values: hard work, rich learning, helpfulness to others, mutual respect.” [32]

By incorporating real life problems into the classroom, the CREDE model of teaching integrates problem solving into the curriculum. This is especially important for children because it introduces new experiences into their life, which is something that Dewey believed to be crucial in the development of the child. The vision statement also incorporates ideas from Montessori and Malaguzzi. This innovative teaching style is significant for designing flexible classroom spaces to create a setting that adapts to different learning styles.

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[31] “Center for Research on Education, Diversity, and Excellence Hawai‘i Project” accessed Feburary 1, 2018, http://manoa.hawaii.edu/coe/crede/.

[32] Ronald C. Tharp., Peggy Estrada, Stephanie S. Dalton, and Lois A. Yamauchi. 2000. *Teaching Transformed: Achieving Excellence, Fairness, Inclusion, And Harmony.* (Boulder, Colorado: Westview)

ʻĀina in Schools

ʻĀina in Schools is part of the Kokua Hawaiʻi Foundation and is a non-profit organization that educates children on nutrition education, garden-based learning, and waste management.[33] Similar to Maria Montessori's ideas related to the outdoors as an extension of the classroom[34], the organizations' mission is to "provide students with experiences that will enhance their appreciation for and understanding of their environment, so they will be lifelong stewards of the earth."[35] Similar to Dewey's approach, this program focuses on learning by doing and incorporates a strategy that positively impacts the environment.

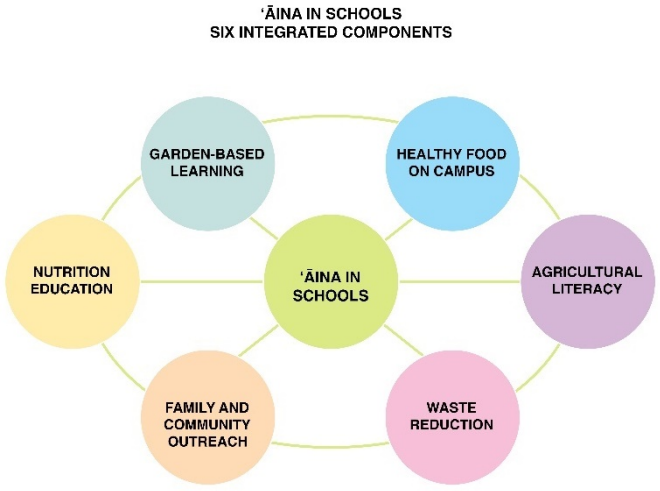

Figure 3-5 ʻĀina in Schools Diagram
Source: Author

Figure 3-6 ʻĀina in Schools
Source: Kokua Hawaiʻi Foundation

[33] "About Us- Kokua Hawaiʻi Foundation" accessed November 30, 2078, https://kokuahawaiifoundation.org/about.

[34] Francis Wardle, *Approaches to Early Childhood and Elementary Education* (New York: Nova Science Publishers, 2009), 84.

[35] "About Us- Kokua Hawaiʻi Foundation" accessed November 30, 2078, https://kokuahawaiifoundation.org/about.

3.3 Aligning the Environment with Education

Understanding different philosophies of education and various curricula that surround early education helps designers understand how the physical environment and various teaching methods can affect the way children learn. As stated by Dewey and others, children learn through experience. Understanding and embracing this concept can positively influence the designing a space for learning. The educational philosophies of (site the people who developed these theories) all use the physical environment to benefit the child's learning experiences. For example, in Montessori schools, it has become a norm to create child-sized furniture and equipment. By understanding the capabilities that children have physically, designers can create an environment that is comfortable and easy to use for children. By creating an open feel with little to no obstructions, the teacher freely decides the layout of the classroom according to the experience the teacher wants to create. In the subsequent chapters, the idea of the environment and how certain spaces affect a child's learning will be addressed.

3.4 Conclusion and Projection of Next Chapter

Analyzing the child's cognitive development and the various educational philosophies and theories that have influenced thinking about how children learn, informs the school architect in designing a space for teaching and learning. The goal is to create a vibrant environment in which children can have a wide variety of learning experiences. Understanding the various stages of child development and philosophies of teaching and student learning inform the architect about innovative ways of thinking that helped shape ideal educational environments. In Dewey's theory of Learning by Doing, he describes that the most efficient way for a child to learn is through topics that are most interesting to the individual. Incorporating play into the child's learning is an effective method for the absorption and retaining of knowledge. Studies have shown that games as a learning tool enhanced long-term retention of knowledge.[36]

[36] Healther Skirton, Gillian Blakely, "Learning through Play" (*Nursing Standard 24, no.8*): 61.

DESIGN FRAMEWORK

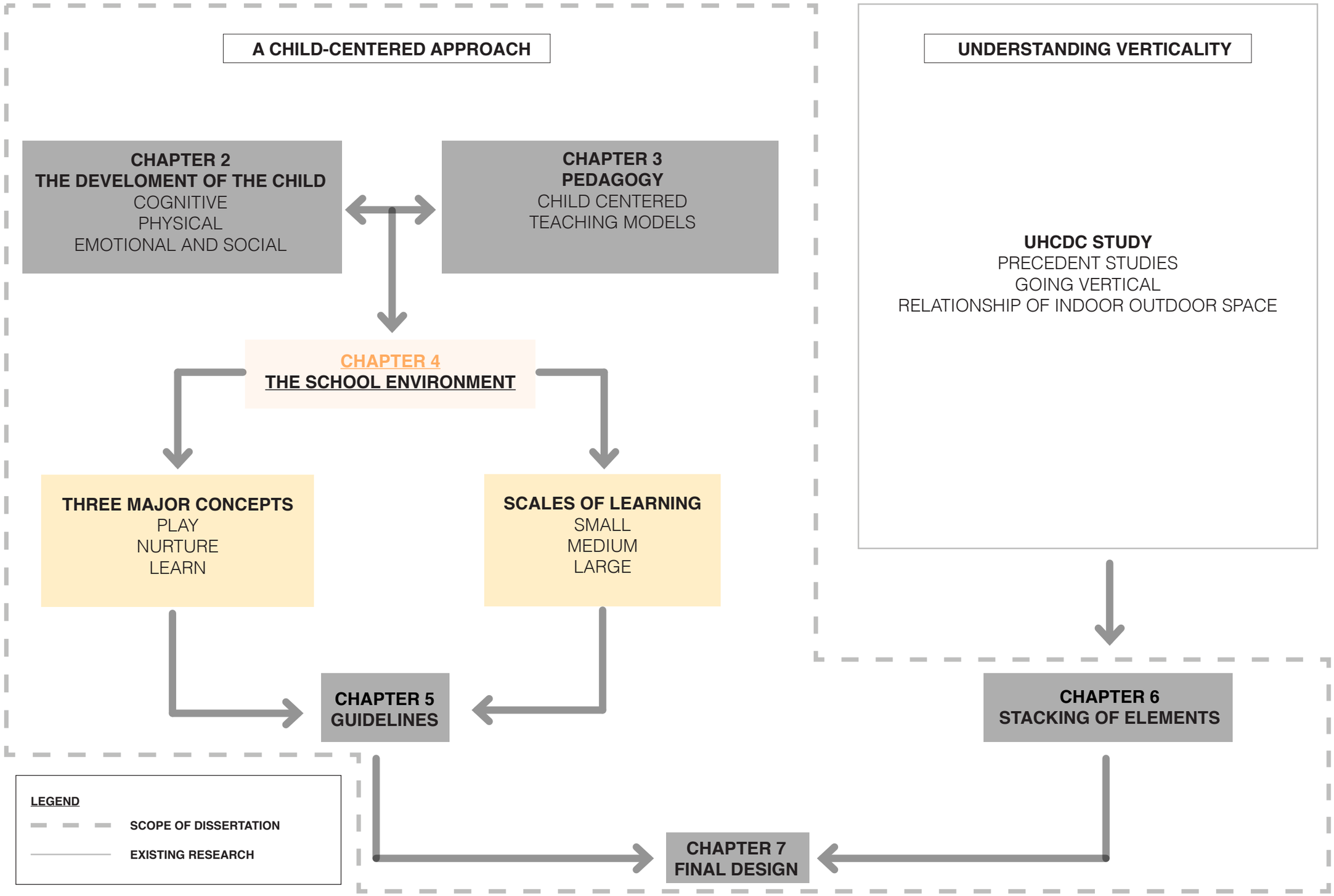

Figure 3-7 Chapter 4 Framework
Source: Author

Chapter 4: The School Environment

4.1 Three Major Concepts on Three Different Scales

Three central concepts: Play, Nurture, and Learn, are used throughout this project to conceptualize the ideas of Dewey, Piaget, Montessori, Malaguzzi, and Tharp, et al. into a conglomerate, which will then lead to the design of the space across a variety of different scales. The first scale is the individual, which focuses on the child alone as an individual. The second scale is the class, where there is a group of children who interact with each other and share an experience. The third scale is the school, and how spaces are laid out. The sections that follow outline how Play, Nurture, and Learn are related to three different scales.

4.1.1 Play

Perhaps the most important, the idea of play is apparent in the educational models discussed in this paper. By incorporating outdoor play spaces into the architecture, the child can make a direct connection between education and play. With the advancement of technology, many children do not experience the outdoors as much as the previous generations. Some other factors that may hinder the child's ability to play are the busy schedule of parents, living in an urban setting with little to no outdoor spaces, etc. Regardless, being confined indoors and not being able to experience the outdoors can hamper the child's possible experiences. Creating gardens and outdoor spaces for enriching the learning environment is linked to increased imagination and creativity in the child. [37]

4.1.2 Learn

Ultimately, the primary purpose of education is for the child to learn. Learning is often associated with developing a deep understanding. Children should be able to learn at their own pace, and in different scales. By designing spaces that are not only flexible but in tune with the child's individual needs of learning, the classroom can become a useful tool in aiding the child's learning. For example, in Piaget's Cognitive Theory, during the Preoperational Reasoning Stage, the child tends to be in his own world, which could mean that children between the ages of 2-7 should have private learning spaces as well as open spaces. Children refer to their past experiences to understand and grasp the new content.

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[37] Vicki L. Stoecklin, "Creating Playgrounds Kids Love," accessed November 18,2017, https://www.whitehutchinson.com/children/articles/playgrndkidslove.shtml.

4.1.3 Nurture

Nurture focuses on the physical and emotional well-being of the child. It is vital that the child has a strong foundation to build future experiences upon. Classmates, teachers, parents, and the school all play a significant role in cultivating a productive learning environment for the child. By encouraging more relationships between the children and their peers, the child will have a more fruitful education. This idea is stemmed from the studies of Vygotsky and Piaget and focuses on creating a rich environment for children to learn from their daily experiences with others and engaging in activities together.

4.2 Scales of Interaction

In the educational philosophies discussed in Chapter 2, there are various ways in which a child interacts with their environment. The first scale at which the child interacts is through themselves. This will be defined as the Small (S) scale of learning since it pertains only to the individual. In Piaget's theory, it is explained that during the Preoperational Reasoning stage, children are engrossed in their world, and tend to enjoy the company of themselves. Children learn better at this stage when they are by themselves, as it gives them self-awareness and identity in the world. The second scale is Medium or M. This is defined as interaction with students within their class. This type of interaction is inevitable for all students and helps to define the way in which children interact with one another. In the Montessori teaching method, learning through others is emphasized, and is one of the principles that all Montessori schools follow. The third scale is termed Large, or L. This is when children of different grades interact and create a mixture of different age groups. In the Reggio Emilia model, grade levels are often fused together to create interaction between grades.

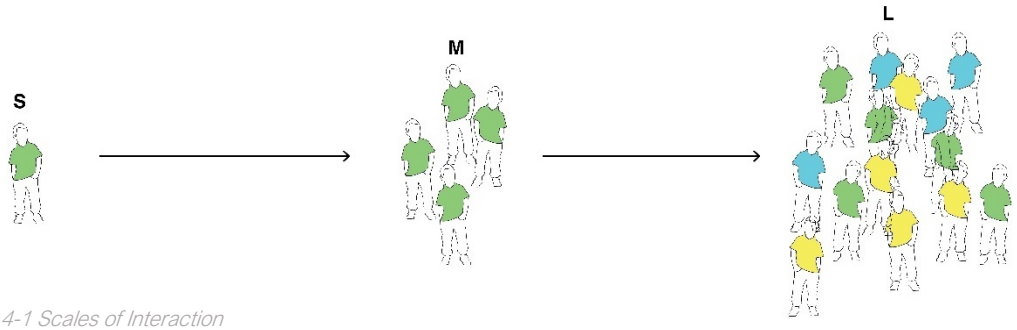

Figure 4-1 Scales of Interaction
Source: Author

4.3 Compartmentalized Analysis of the School

The design of schools has changed drastically over time partly due to the progressive movement in curricula discussed in the previous chapter. However, in Hawai'i, the public-school facilities remain the same, as the average age of a facility is 65 years old.[38] As educators became aware that the perception of the environment plays a significant role in the education of the child, spaces began to be deliberately designed to cultivate a better learning environment for the child. The following sections will highlight the elements that make up a school based on the concepts of Play, Nurture, Learn, and the various scales in which a child interacts with his/her environment. Through this analysis, the designer can better grasp how these three concepts relate to the built environment.

[38] "School Facilities," Hawai'i State Department of Education, accessed December 20, 2017. http://www.hawaiipublicschools.org/ConnectWithUs/Organization/SchoolFacilities/Pages/home.aspx.

	John Dewey- Learning by Doing	Montessori	Reggio Emilia
S *(Pair or Group)*	*Collaborative learning* *Play spaces as a way for educating children through doing.*	*Each child is valued as a unique individual, with an individual learning plan*	*Each child is valued as a unique individual, with an individual learning plan*
M *(Class)*	*Should be able to provide genuine 1st hand experience*	*Freedom in Activity* *Classroom with aesthetics in mind* *Movement*	*Amiable school. The school is designed in such a way to encourage desired be-haviors and learning*
L *(School)*	*School itself must be a reflection of the community life with all its social characteristics, to allows students to develop shared com-mon experiences*	*Multi-age classes* *Combination Classes* *Double grade*	*Cooperation between teachers Atelierist and Atelier- In every school a teacher trained in the visual arts works closely with the teachers and the children*

Table 2 Pedagogical Models vs. Scales of Interaction Matrix
Source: Author

4.4 Play" Spaces

Based on theories by Dewey and Montessori, playing is an effective method for children to learn by doing.

Small

Figure 4-2 Small Play Spaces
Source: ArchDaily

Playing alone is a critical component in a child's life. It gives children a sense of independence and allows them to feel comfortable alone.[39] In Piaget's Cognitive theory, children between the ages of 2 and 7 are in the Preoperational Reasoning Stage, where they are entranced in themselves. Small play spaces are usually sized to accommodate for an individual and focuses directly on the student.

At the Wenzhou Dalton Elementary School located in Wenzhou, Zhejiang, China, the architecture firm incorporates play into the circulation of the building. In the top left image of Figure 4-2 Small Play Spaces the yellow slide serves as an alternative method of descending from the lobby

[39] Apryl Duncan, "Why Playing Alone is Important for Children," accessed November 4, 2017, https://www.thespruce.com/why-playing-alone-is-important-3129415

level to the central courtyard space. This also provides the students with an alternative play space on rainy days.

In the King Solomon School, quiet play spaces are utilized for children to have conversations while still incorporating playful elements and colors. This type of play space is especially beneficial for children of the younger age, as it provides a spectrum of the large development during the preoperational reasoning stage. It is important to provide the child with a diverse menu of play spaces.

At the Green Acres Academy (Bottom Left) and The Trefpunt (Bottom Right), the architecture allows for flex spaces that can be utilized to create intermediary and sometimes informal play areas that allow for all types of play. Flex spaces are especially important because it can have a dual purpose of becoming a play space and another function when it is not being utilized. At the Green Acres Academy, the extra space in the classroom is utilized as a play space for children during recess. At the Trefpunt, the main circulation corridor is used to create a dynamic environment for children to play in. The architectural form helps to shape the way these spaces can be used.

As stated in *The Third Teacher: 79 Ways You Can Use Design to Transform Teaching & Learning*,

> Because physical education involves pupils in socially challenging situations where they learn to cooperate with, trust, and rely on one another, good physical education and school sport can improve all markers of personal development, including confidence, body image, and communication skills. Some pupils who lack confidence in other parts of the school curriculum may find a place where they can shine. Where other pupils feel less confident about engaging in physical activity, offering a range of activities in a secure, comfortable, and welcoming environment can help to create a positive attitude to participating in physical education and school sport. Once increased confidence has begun to emerge, the benefits of this can be transferred to other areas of life and of the school curriculum.[40]

[40] Cannon Design, VS Furniture, and Bruce Mau Design, *The Third Teacher: 79 Ways You Can Use Design to Transform Teaching & Learning* (New York: Abrams, 2010), 90.

Medium

Figure 4-3 Medium Play Space
Source: ArchDaily

The medium sized play space is an area where children can play with other children as a group. Innovative playgrounds have been a recent trend in architectural school design and encourages students to "test their limits or to repeat skills until they have mastered them."[41]

The medium sized play spaces at the Wenzhou Dalton Elementary School and Haarlem Primary School utilize covered areas protected from the elements. This ensures the ability for physical movement and play, even when the weather does not permit. While these spaces are indoors, it can be noted that the architecture still allows for adequate light and air with operable partitions and clerestory windows. As shown in the two images on the left-hand side of Figure 4-3, both examples are designed to allow for group play.

At the Playground Charlotte Sharman Primary School and Primary School Gertenhof, the architects utilize playground equipment to encourage group play. Because the equipment is larger

[41] Aileen Shackell, Nicola Butler, Phil Doyle and David Ball, *Design for Play: A guide to creating successful play spaces* (Crown/ Play England/Big Lottery Fund), 10.

and more robust, it allows for multiple children to use it at once. As opposed to traditional playground equipment where each component of the playground is predominantly for singular activities the innovative equipment is shown on the right -hand side of Figure 4-3 Medium Play Spaceare designed to encourage group interaction.

The medium play space is especially significant because it is usually the first space in which children learn how to interact with other students. It is important for these spaces to accommodate for positive and fostering experiences in the student's school life.

Large

Figure 4-4 Large Play Spaces
Source: ArchDaily

The largest play space pertains to the cluster or conglomeration of play and outdoor spaces. This is especially significant in the overall design of the school and defines the amount of space allocated to play. These spaces also include fields, courts, and playgrounds. In the Hefei No.45 Middle School in Anhui China, students use the large grass hill to return to classes after recess. Similar to the concepts addressed in the Medium Play Spaces section, the Wenzhou Dalton Elementary School, Manturri School, create covered play spaces that fit the entire student body. In the Hefei No.45 Middle School, a large hill was used to change the circulation pattern of the student body. In this example, the students use the large hill to enter the school which encourages physical play.

4.5 “Nurture” Spaces

Small

Figure 4-5 Small Nurture Spaces
Source: ArchDaily

For the youngest grades school can be a new concept. The thought of a new environment can be intimidating, and children need a space that reminds them of home. As stated in chapter 2 regarding the emotional and social development of the child having a strong home environment creates a strong foundation for the student. By incorporating elements of the home into the school, children will feel more at ease with familiar elements. Many children feel comfortable when they are given time alone, in a small and confined space. Small nurture spaces include amenities such as a sink adjusted to varying heights of children and railings to keep children away from danger. Another idea that has been incorporated in innovative school designs are alcoves punctured in the wall to create a nest like environment students to feel safe.

Medium

Figure 4-6 Medium Nurture Spaces
Source: ArchDaily

In the classroom scale, it is essential to create a safe yet productive environment. Colors can be used to enhance the user experience of the space. For example, in the King Solomon Elementary School in Figure 4-6 Medium Nurture Spaces, engraved walls panels are used to create the atmosphere of the cafeteria. Wayfinding is equally as important and helps the user get from point A to point B without getting lost or confused in the space. Natural materials such as wood and concrete can heighten the sensory functions of a child. Montessori also believed that triggering the five senses of a child will benefit the child's learning. She also believed that imagination was triggered by the deposit of the vocabulary collected from the triggering of the five senses.

"Imaginative use of materials can bring these spaces to life, particularly where there are large floor and wall areas. Color can help to define territories for different sports and games, as well as enliven the often drab surfaces of urban play areas. Using natural daylight reinforces the connection of physical activity and well-being with the natural world."[42]

[42] Cannon Design, VS Furniture, and Bruce Mau Design, *The Third Teacher: 79 Ways You Can Use Design to Transform Teaching & Learning* (New York: Abrams, 2010), 90.

Large

Figure 4-7 Large Nurture Spaces
Source: ArchDaily

Large Nurture spaces comprise of spaces that have to do with the exterior of the building. Exciting instances can be created when the vertical component of the school is shifted or subtracted from to create an atrium or void space through the primary volume. This can be done by "creating different degrees of transparency- where light travels through a building- and viewing opportunities will make pupils more aware of the activities that are taking place."[43] Another aspect of large nurture spaces is how the community engages with the school. For example, at the Silverland Middle School, films can be projected on the exterior wall for the community to get together to have a movie night. The Ecopolis Plaza allows for the community to use the outdoor play areas during the off hours of school. This connects the school to the community and rises interaction amongst students with the rest of the community.

[43] Cannon Design, VS Furniture, and Bruce Mau Design, *The Third Teacher: 79 Ways You Can Use Design to Transform Teaching & Learning* (New York: Abrams, 2010), 90.

4.6 “Learn” Spaces

Small

Figure 4-8 Small Learn Spaces
Source: ArchDaily

The design of the school starts with the individual. This section will analyze architectural components geared to learning from the individual scale to the largest scale of the school. As discussed earlier, the first scale relates to the child as an individual. Many pedagogical models, including the Reggio Emilia method, have incorporated the idea that children should be valued as an individual with personal learning needs and accommodations. The components in this category can include chairs, tables, floor/carpet, cubbies, plants, swings, and guardrails. These elements are especially important because it deals with the individual comfort of the student, which play a significant role in concentration and overall quality of work. At the Dae-Eun Elementary school, green and orange seating is used to help the students with their learning. It is also important for students to have individual sessions with the teacher. Allowing for a space to meet privately with the teacher aids in providing a child with a more effective educational experience.

Medium

Figure 4-9 Medium Learn Spaces
Source: ArchDaily

The medium scale relates to how the child interacts in a group setting. Typically, these types of interactions occur in the classroom and playground. This scale directly relates to the dynamic of the class, and how the child experiences the world from others. For example, in the Our Lady of the South Cross Primary School designed by Baldasso Cortese Architects, learning spaces utilize a felt wall for students to pin things for brainstorming. The school also incorporates a collaborative learning space that can be utilized by all ages. It is crucial to have flexible spaces where people can group and re-group, where you're not stuck in one configuration with teachers at the front.

Large

Figure 4-10 Large Learn Spaces
Source: ArchDaily

This scale looks at the components that make up the vertical school, and the various way to bind spaces together. Circulatory elements of the building, such as hallways and stairs are included in this scale. Also included are lobbies and outdoor spaces, which are usually the largest component in school design. Montessori viewed the use of the outdoors as an extension of the classroom. The outdoor world is brought into the classroom using plants, flowers, and classroom animals. Not only does the outdoors provide a wealth of new and different learning materials to explore, investigate and order, but it enables children to develop responsibilities and independence.[44]

According to Sir Ken Robinson, "real innovation and creativity come at the intersections of disciplines- the way they merge and blend. So, you'd want school buildings that allows a permeability of practices, that allowed people across disciplines to work collaboratively."[45]

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[44] Francis Wardle, *Approaches to Early Childhood and Elementary Education* (New York: Nova Science Publishers, 2009), 84.
[45] Cannon Design, VS Furniture, and Bruce Mau Design, *The Third Teacher: 79 Ways You Can Use Design to Transform Teaching & Learning* (New York: Abrams, 2010), 58.

Informing the Guideline

After categorizing the various components of the precedent studies into concepts of Play, Nurture and Learn, these concepts can be translated into architectural elements. It is especially crucial to incorporate these elements into a school design, to better accommodate a child-centered learning environment. These precedent studies help to outline the design guidelines that simplify the ideas presented in this chapter, to serve as a guidebook for designers of learning environments. Based on the findings found in Chapters 2 and 3, a thriving environment should incorporate the ideas presented in this chapter and the following chapter. These ideas serve as a strong design foundation for a school, as it amalgamates modern pedagogical strategies with functional architectural elements.

DESIGN FRAMEWORK

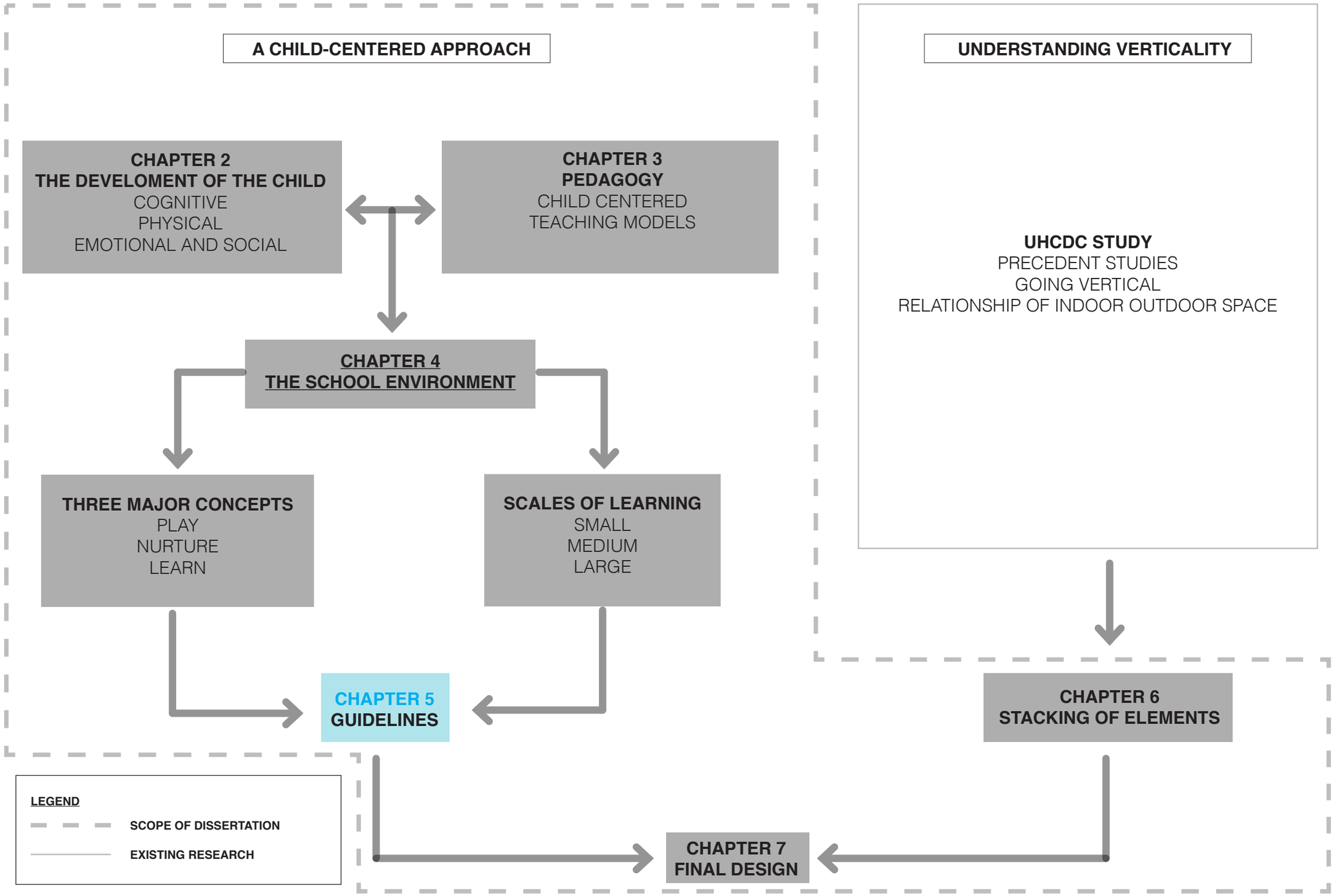

Figure 4-11 Chapter 5 Framework
Source: Author

Chapter 5: Design Guidelines

5.1 Play

5.1.1 Play Small

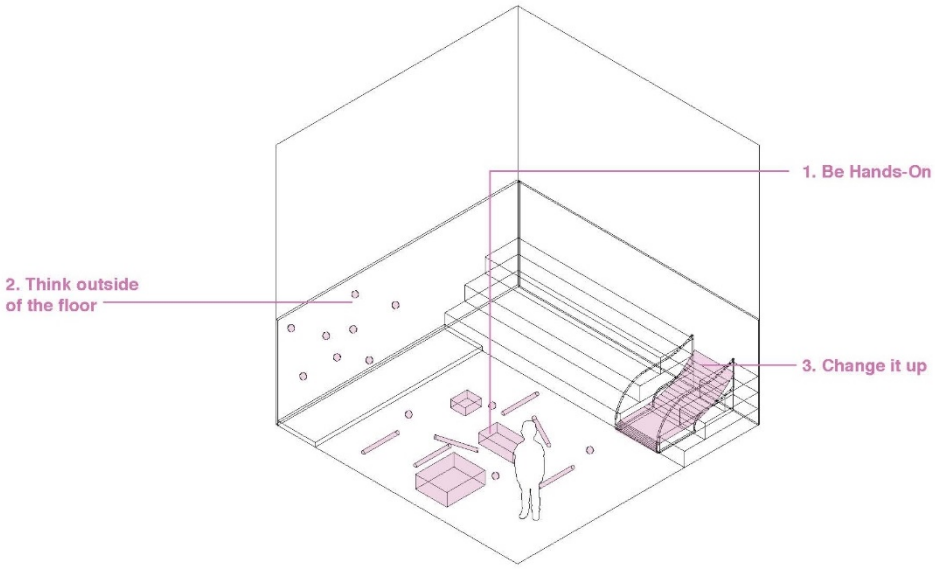

Figure 5-1 Play Small
Source: Author

1. Be hands-on
    a. Provide objects that are ergonomically easy to use- this will
2. Think outside of the floor
    a. Use surfaces other than the floor to create a dynamic play environment for the child.
3. Change it up
    a. Change traditional building circulation patterns to create a fun and alternative route for the child. This facilitates different types of movement and speed within the building.

Figure 5-2 Friends Academy Students climb wall as sports alternative
Source: Dartmouth Week

5.1.2 Play Medium

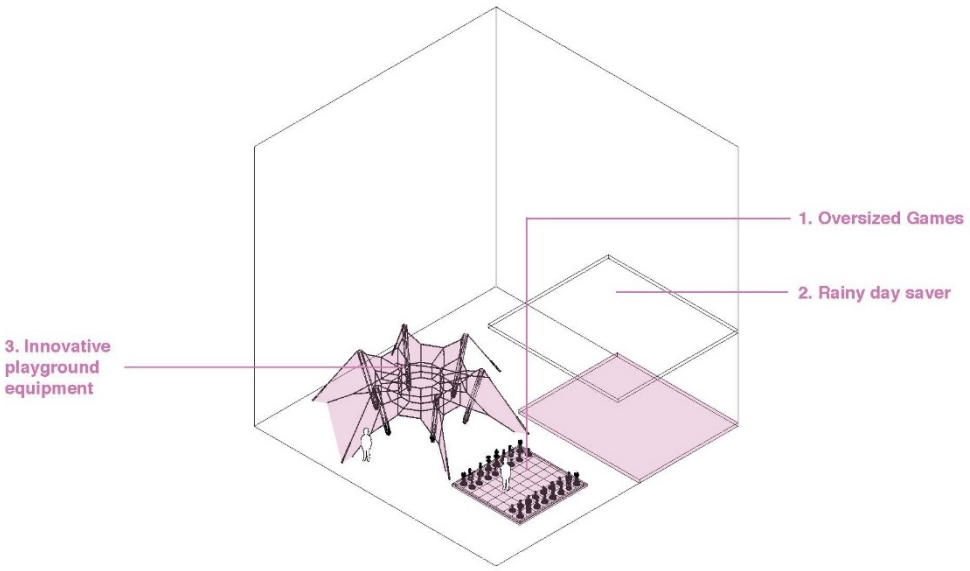

Figure 5-3 Play Medium
Source: Author

1. Oversized games
    a. Allows for children to use their minds while at the same time encouraging physical activity.
    b. Oversized games also encourage group play, increasing the chance of interactions between students.
2. Rainy day saver
    a. This provides a space for children to play when the weather does not permit outdoor play
    b. Indoor play space can be incorporated into the classroom.
3. Innovative Playground Equipment
    a. Playground equipment should encourage physical activity and allow the child to explore his physical capabilities

Figure 5-4 Example of an Oversized Chess Board
Source: Fort Morgan Times

5.1.3 Play Large

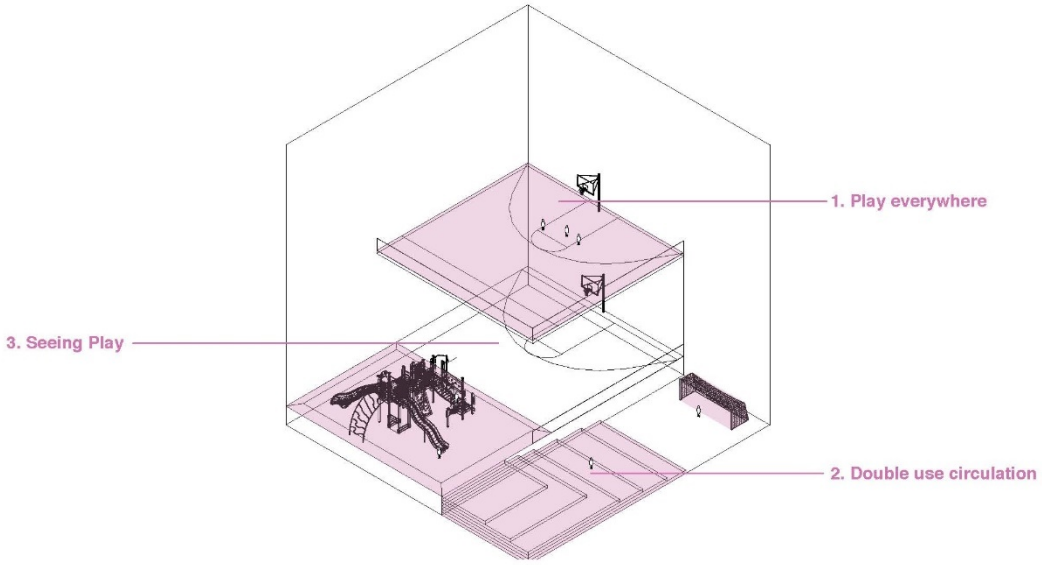

Figure 5-5 Play Large
Source: Author

1. Play everywhere
    a. Create a play space within each floorplate.
    b. Playspaces should allow for multiple activities/sports.
2. Double Use circulation
    a. Create exciting circulation paths that also promote physical exercise.
3. Seeing Play
    a. Allow play to be visible from different areas of the school.

Figure 5-6 Hampden Gurney Church of England Primary School
Source: BDP Placebook

5.2 Nurture

5.2.1Nurture Small

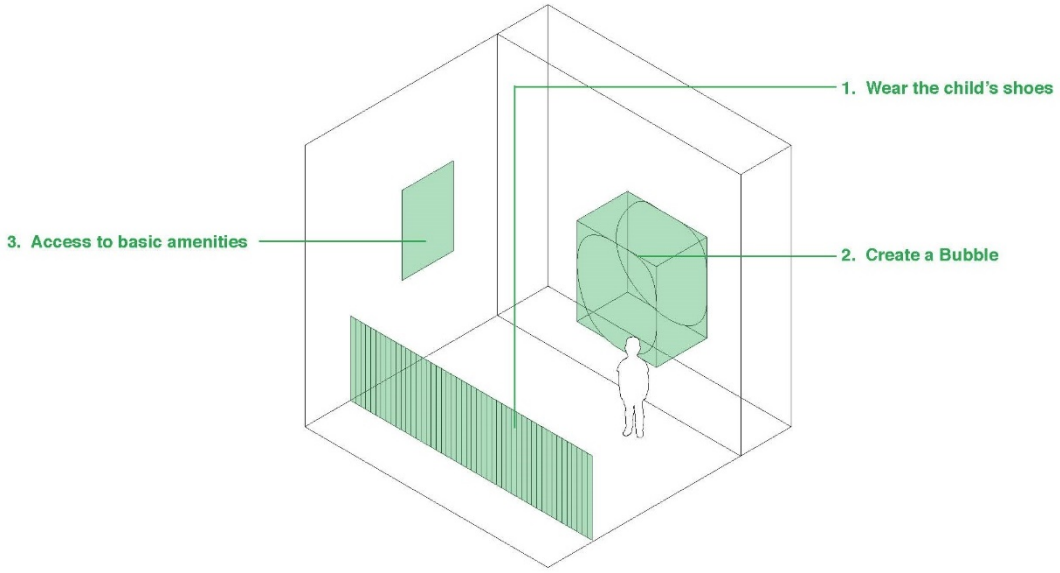

Figure 5-7 Nurture Small
Source: Author

1. Wear the child's shoes
    a. Design in the scale of the child and create safe environments with minimal chance of injury.
2. Create a Bubble
    a. Children need a safe space or a personal bubble where they can be alone
    b. Spaces such as nooks or encapsulating furniture can create a sense of coziness.
3. Access to basic amenities
    a. Children should be able to have access to essential amenities regardless of height.

Figure 5-8 King Solomon Elementary School
Source: ArchDaily

5.2.2 Nurture Medium

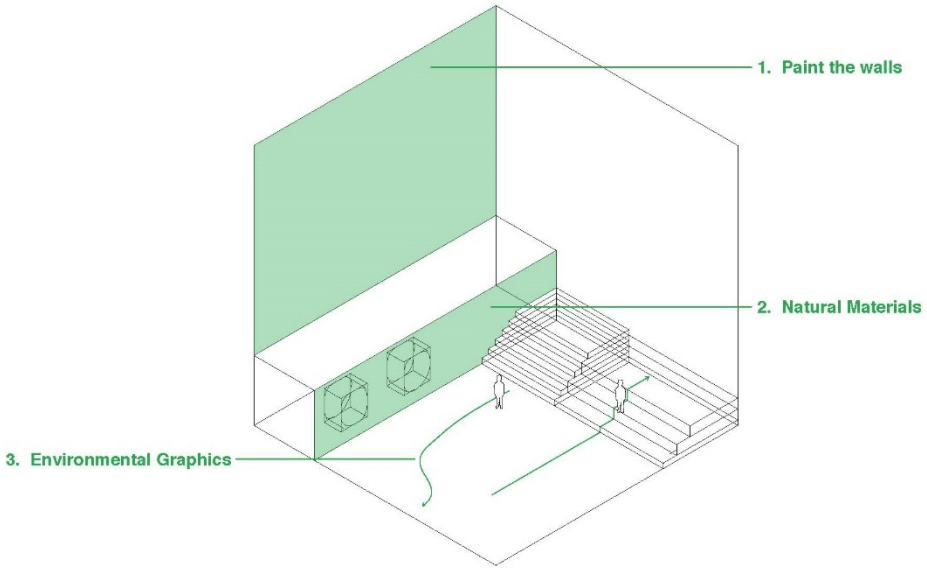

Figure 5-9 Nurture Medium
Source: Author

1. Paint the walls
    a. Creating exciting color patterns in the interior can enhance the experience of the child.
    b. Colors can be used to create themed spaces based on function
2. Natural Materials
    a. Natural materials create a homier feel to the school, and students feel more at ease when the school reminds them of home.
3. Environmental Graphics
    a. Building circulation should be straightforward for all users of the school.

Figure 5-10 Environmental Graphics for KIPP NYC Prep School
Source: Pentagram

5.2.3 Nurture Large

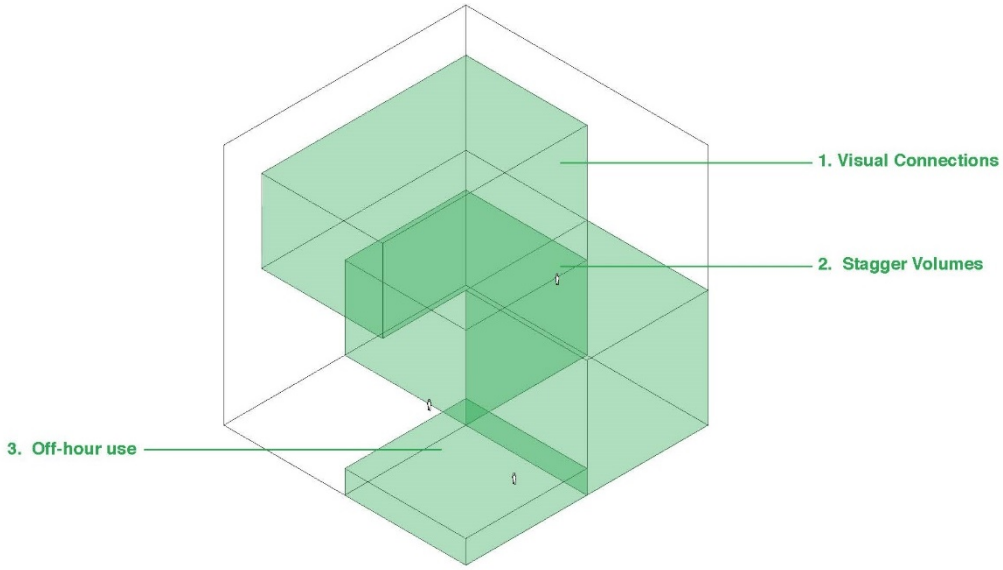

Figure 5-11 Nurture Large
Source: Author

1. Visual Connections
    a. Create both horizontal and vertical visual connections between users.
2. Stagger Volumes
    a. Void spaces can serve as space for light to shine through to create visual access to levels below.
3. Off-hour use
    a. Allow the community to use the outdoor spaces or community centers when the school is closed.

Figure 5-12 One Shelley Street
Source: Clive Wilkinson Architects

5.3 Learn

5.3.1 Learn Small

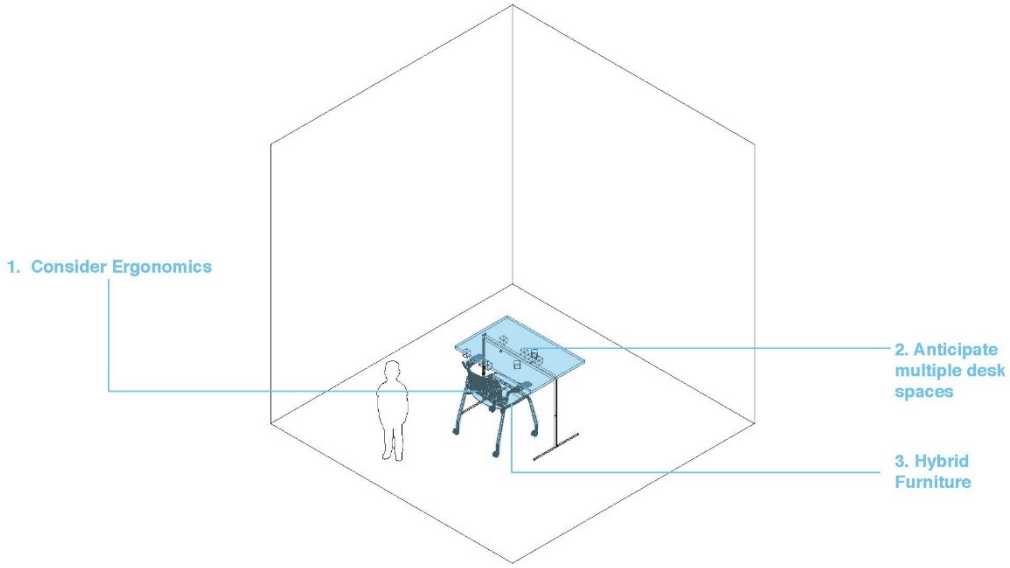

Figure 5-13 Learn Small
Source: Author

1. Consider Ergonomics
    a. Furniture should be comfortable and should not be stationary.
2. Anticipate multiple desk spaces
    a. Every child learns differently, so it is necessary to accommodate for the different learners and styles of learning.
3. Hybrid Furniture
    a. Furniture can have multiple uses. For example, a bookshelf can be used as a space divider, seat, and table.
    b. Create spaces that adjust to the furniture.

Figure 5-14 Steelcase Node Chair
Source: Steelcase

5.3.2 Learn Medium

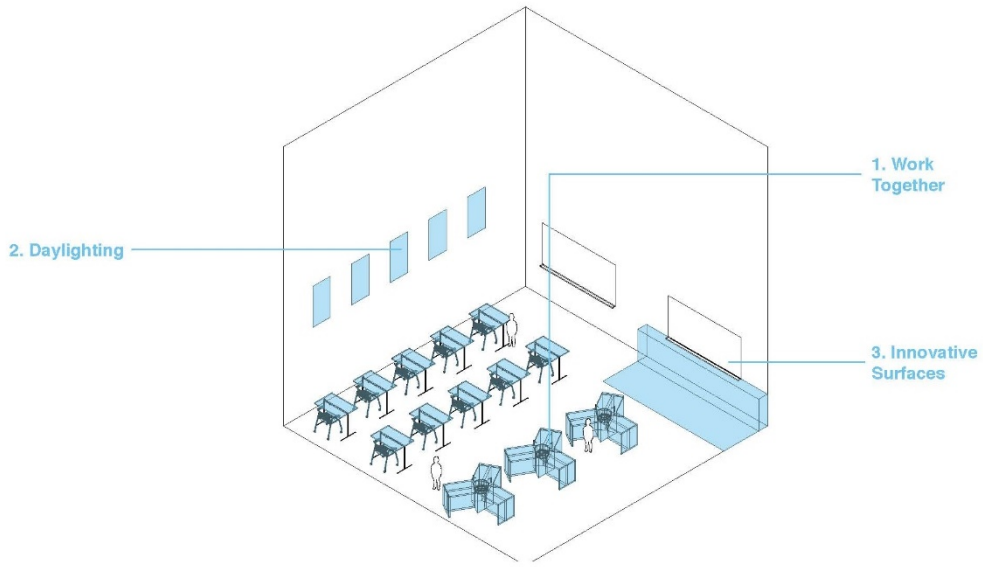

Figure 5-15 Learn Medium
Source: Author

1. Work together
    a. Furniture and class layout should accommodate various types of collaboration.
2. Daylight
    a. Create a space that is lit by daylight for enhanced learning.
3. Innovative surfaces for learning
    a. Utilize surfaces such as the wall and floor to pin things on.

Figure 5-16 Collaborative Learning Space
Source: Steelcase

5.3.3 Learn Large

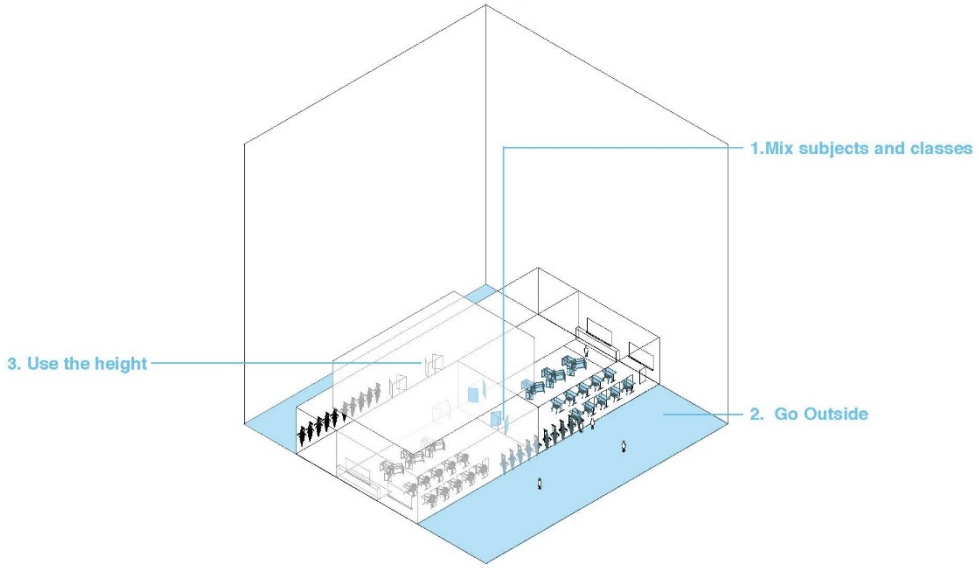

Figure 5-17 Learn Large
Source: Author

1. Mix subjects and classes
    a. Classes should have the ability to allow for collaborative learning and be adaptive to the lesson.
2. Go outside
    a. Using the outdoors to learn can aid in learning.
3. Take advantage of height
    a. Students can use the height of the vertical school to learn about various subjects.

Figure 5-18 Learning Garden
Source: VTN Architects

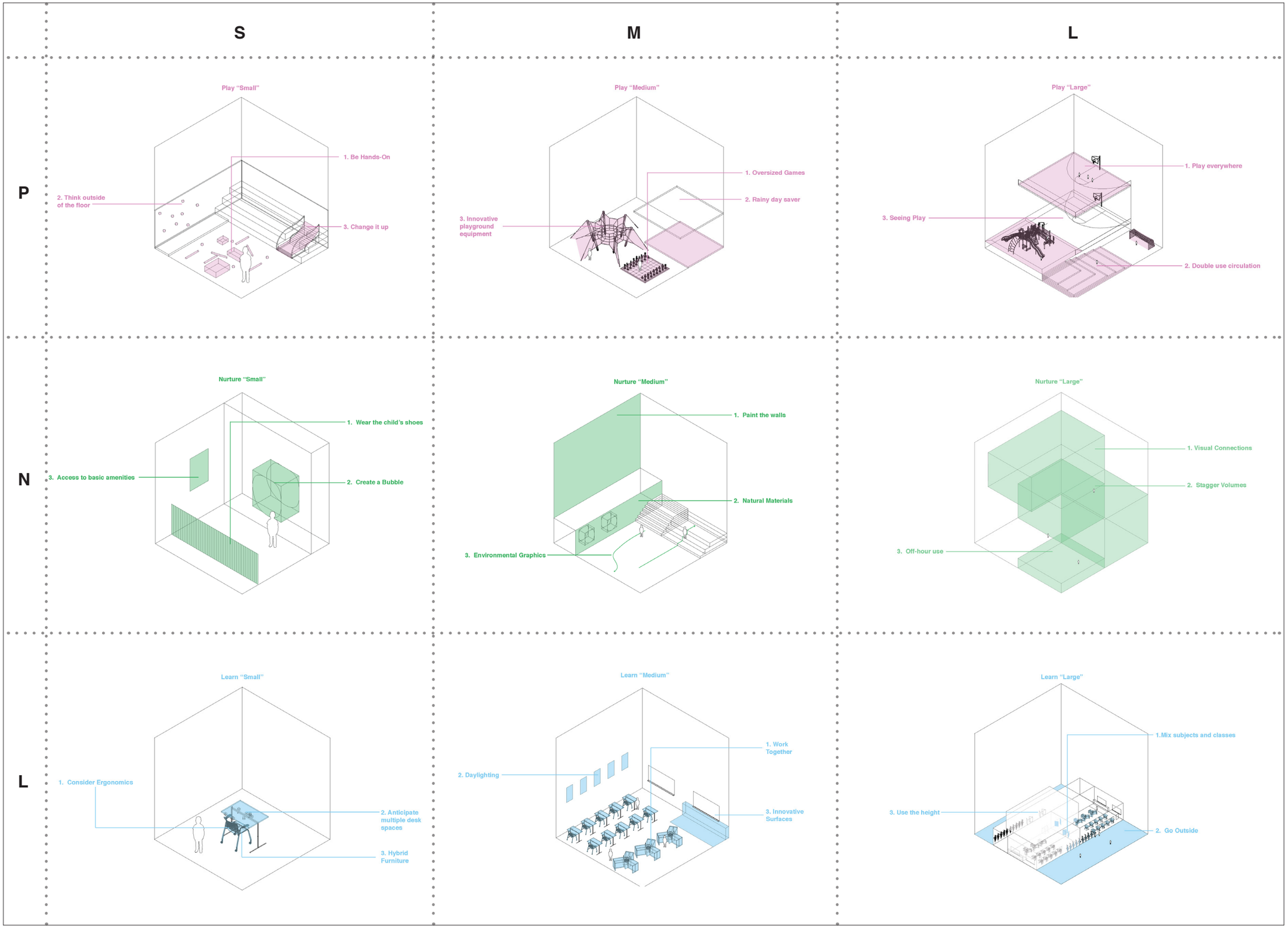

Figure 5-19 Design Guidelines for a Vertical School
Source: Author

Joining Elements

These guidelines serve as a basis for the schematic design of a learning environment and provide the designer with ideas stemmed from trends in both education and architecture. As an analogy, the design elements presented in this chapter provide the designer with ingredients, and it is the designer's responsibility as the chef to arrange and cook the building into a successful design.

Organization of space is just as essential to the school design as the elements. The following chapter will examine precedent studies and categorize the stacking of elements on a spectrum to illustrate the potential benefits of stacking and how innovative projects have used stacking to better the functional qualities of the space.

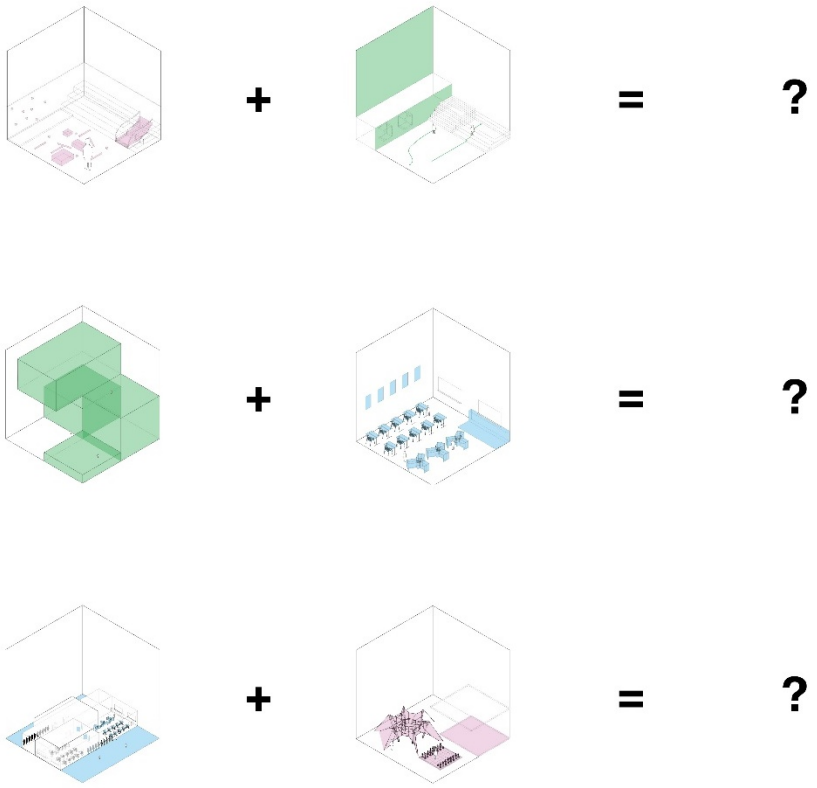

Figure 5-20 Combining Elements
Source: Author

DESIGN FRAMEWORK

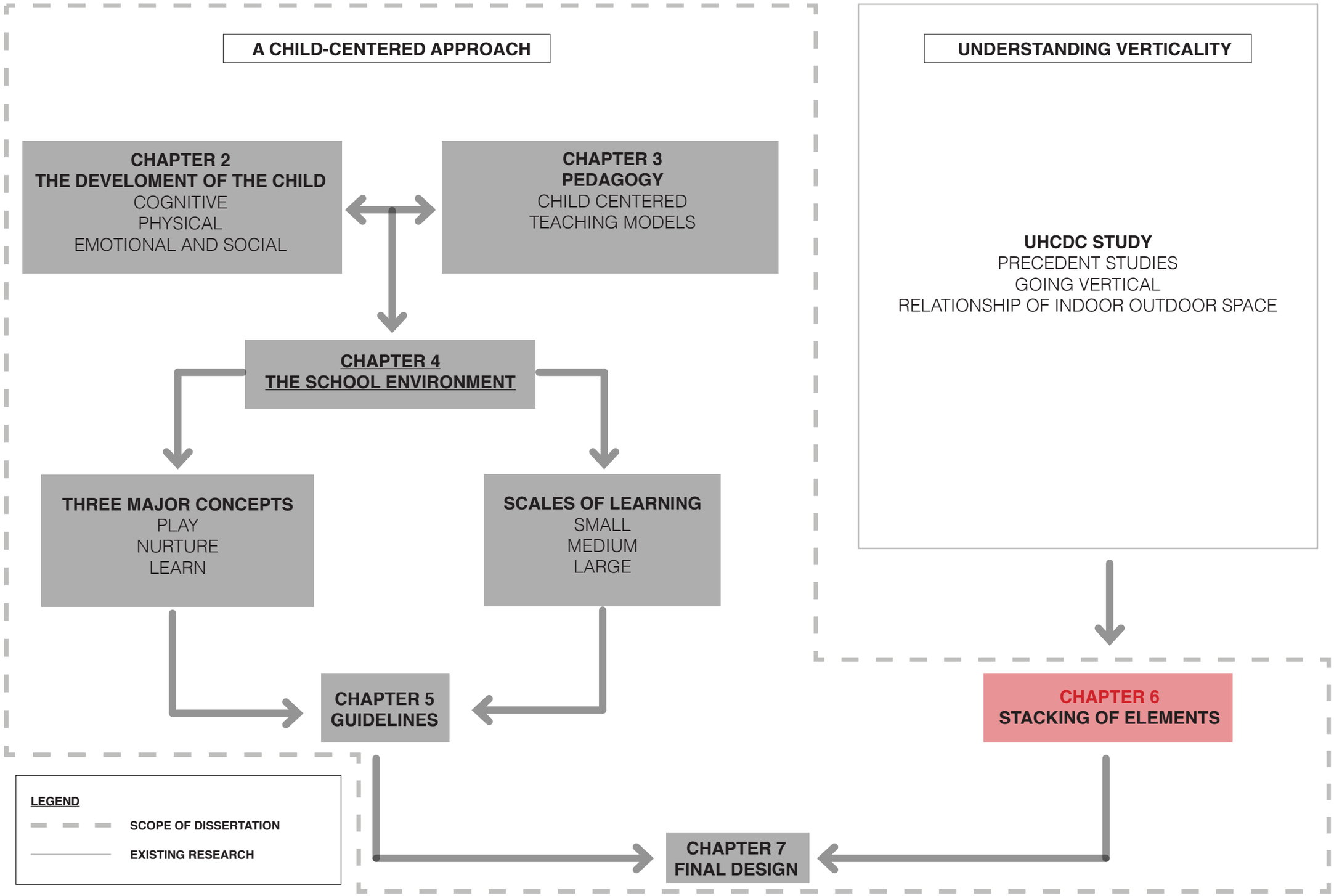

Figure 5-21 Chapter 6 Framework
Source: Author

Chapter 6: Stacking of Elements

6.1 Introduction

The previous chapter outlined the guidelines for the elements of a vertical school. This chapter will analyze the different types of verticality that can be achieved when volumes are organized in various ways. To better understand the effects of going vertical this chapter aims to look at a precedent for each typology and deliberate on the advantages and disadvantages of each configuration. This section will cover buildings that go against the norm of vertical stacking of isolated floorplates and instead create a more dynamic arrangement of spaces to create opportunities for interrelationships and connections and strengthening community.

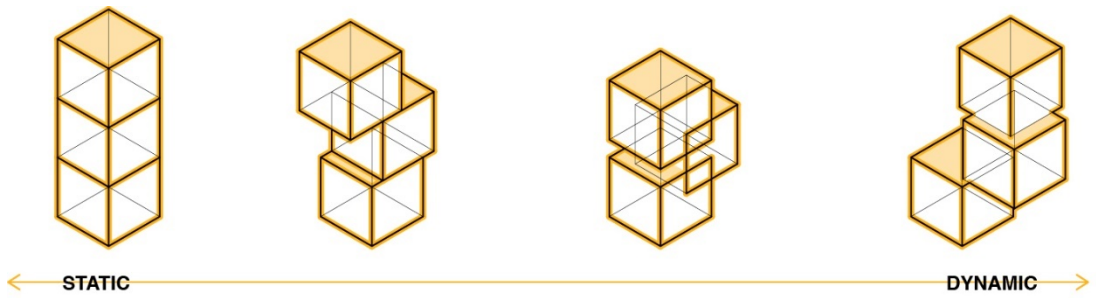

Figure 6-1 Static to Dynamic Typology
Source: Author

Figure 6-1 shows the six types of volumetric configurations that occur when elements are stacked vertically. One the left end of the spectrum is the static configuration, characterized by the straightforward and repetitive configuration of spaces. On the opposite right end is the dynamic configuration, which staggers the volumes in the X, Y, and Z direction.

When building floors are stacked, the primary challenge the designer faces is the inability to accommodate for outdoor space and repetitive floorplates. In the previous chapters, it has been stressed the physical activity, and play is a major component in the lives of school children. The purpose of this chapter is to test the different ways in which outdoor spaces can be allocated through volumetric variations and the interior facilitate movement to promote physical activity. Based on these findings, it will be concluded on which typology suits the specific function of the vertical school.

6.2 Static Typology

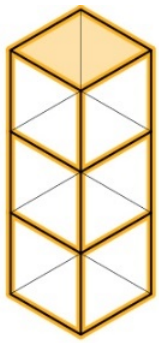

Figure 6-2 Static Typology
Source: Author

The first category of verticality is the “static” typology. This is defined as a building that utilizes equal floor plates and has a straightforward circulatory pattern.

The Zollverein School of Management and Design- SANAA

Figure 6-3 Facade Detail
Source: Author

The Zollverein School of Design is in Essen, Germany. The building was designed by the Japanese architectural firm SANAA and serves as a management and design school. The building is in the shape of a cube and utilizes the static stacking typology. The layout of each floor is straightforward as each of floorplate is identical to one another. However, what makes this project innovative is its deceptive qualities of decoupling the floor from the façade. From the outside, it may seem like this building is a straightforward cube. The architects play with the heights of each floor and puncture the façade of the building to create an illusionary effect that makes it seem like each floor is the same height. The top floor is an open-air terrace, where the same language of the façade

is carried over to the roof. The punctures in the façade provide the users with a window to view the scenery through. This provides precedence on how to open the building up to the elements while still providing shading. This is a way to open the user to the outdoor environment.

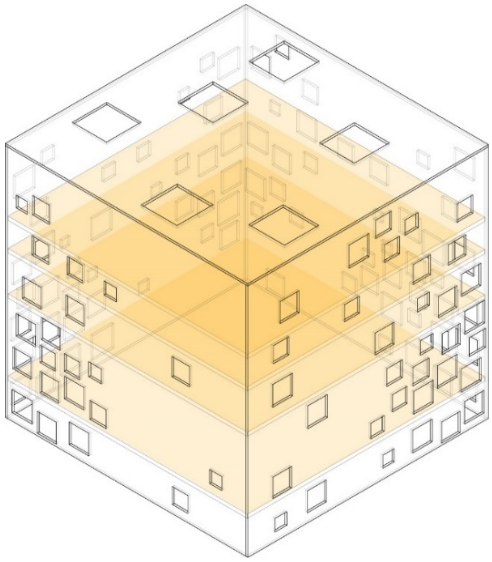

Figure 6-4 Diagram showing the internal floorplates of the Zollverein School
Source: Author

Advantages	Disadvantages
Simple Floor Organization	Repeated Floors
Simple circulatory patterns	No Vertical Openings
Clear relationship between floors	Minimal Daylighting
Privacy between floors	

Table 3 Advantages and Disadvantages of the Zollverein School
Source: Author

6.3 Semi Static Typology

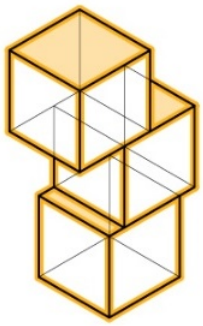

Figure 6-5 Semi Static Typology
Source: Author

New Museum-SANAA

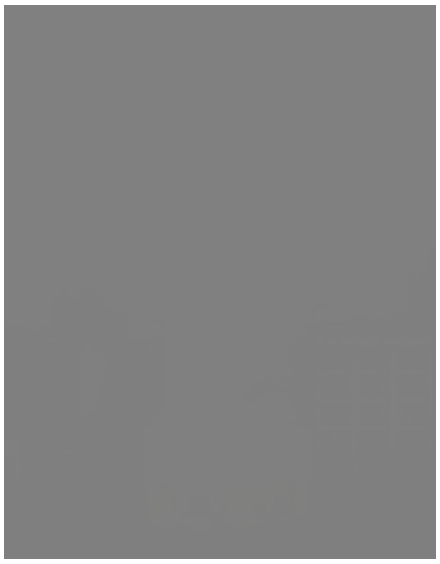

Figure 6-6 Front Elevation
Source: SANAA

Located in Bowery, New York, the New Museum was designed by the architectural firm SANAA. The building is made up of 7 volumes which are staggered and stacked vertically to create urban terraces for museum visitors. When visiting the museum, the visitor takes an elevator to the top and descends to visit the galleries. The staggered volumes create opportunities for light as well as outdoor terraces, as shown in Figure 6-6 Front ElevationThis building utilizes the semi-static volume configuration where the volumes shift in both the X and Y directions.

Circulation

Initially, the visitor enters an elevator to reach the highest floor of the museum. To descend to lower levels and exhibitions staircases take the visitor to the lower level. This is done through the puncturing of the floor as shown in Figure 6-7 Circulatory Stairs

Figure 6-7 Circulatory Stairs
Source: ArchDaily

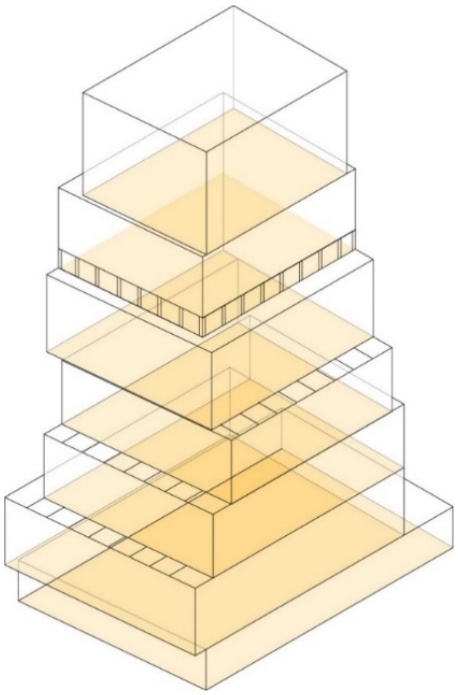

Figure 6-8 Relationship of Floors in the New Museum
Source: Author

Advantages	Disadvantages
Ability to let sunlight in through skylights	Disassociation between floors besides circulation
Indoor/ Outdoor Space	
Volumetric Variation	

Table 4 Advantages and Disadvantages of The New Museum
Source: Author

6.4 Semi Dynamic Typology

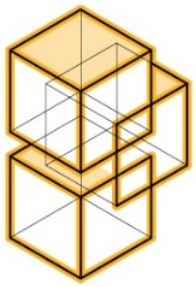

Figure 6-9 Semi Dynamic Typology
Source: Author

Habitat 67- Moshe Safdie

The Habitat 67 is a housing complex located in Montreal, Quebec. Designed by architect Moshe Safdie, this project pushes the boundaries of what a housing project can be. It was "originally intended as an experimental solution for high-quality housing in dense urban environments." Each unit is comprised of one to four of the 600 square foot prefabricated units. The varied configuration of these units makes each unit unique. The varied This project is categorized under the Semi-Dynamic Typology for staggering volumes in the X, Y, and Z direction. Some units, as shown in Figure 6-10, utilize the staggering of the volume above to create a double height space.

Figure 6-10 Section showing the vertical relationships of Habitat 67
Source: McGill University

Circulation

The circulation within the housing units utilizes hallways and staircases that run through the units. According to the Canadian Architecture Collection at McGill University, "the circulation space including streets, sidewalks, 2nd floor terrace and exterior stairs is 110,000 sq. ft. The private space is thus 1.5 times the circulation space."[46]

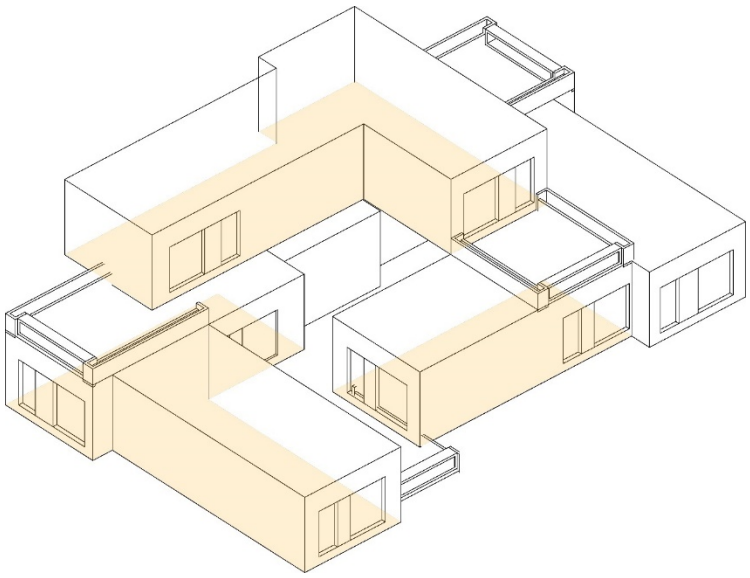

Figure 6-11 Diagram showing the interrelationships of interior spaces at Habitat 67
Source: Author

Advantages	Disadvantages
Ability to create double height spaces	Differentiation of Space
Opportunity to create indoor/ outdoor space	
Outdoor space as building circulation	

Table 5 Advantages and Disadvantages of Habitat 67
Source: Author

[46] McGill University, "Frequently Asked Questions" Accessed January 17, 2017. http://cac.mcgill.ca/moshesafdie/habitat/faqs.htm.

6.5 Dynamic Typology

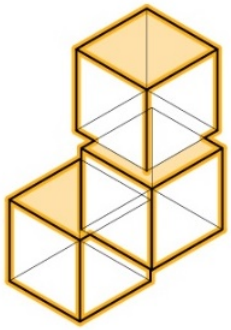

Figure 6-12 Dynamic Typology
Source: Author

Seattle Public Library – OMA + LMN

The Seattle Public library was designed by architecture firm OMA in partnership with LMN. This building questions what a library can be and pushes the boundary of the 21st-century library. Programs within the building are interconnected, regardless of its function. Through visual connections and suspended floors, the library effectively represents the dynamic typology.

Circulation

The library utilizes multiple modes of circulation. The main book stacks are organized from top to bottom and utilize a ramp system that is easy to navigate. Escalators are used in some instances to increase the amount of open space within the building. Catwalks and corridors can also be seen in some areas of the building. These elements serve connect the various functions of the building in an innovative way.

Advantages	Disadvantages
Fluid Space	Minimal Privacy
Ability to create double or triple height spaces	Noise
Visual connection to lower levels	
Flexible outdoor space	

Table 6 Advantages and Disadvantages of The Seattle Public Library
Source: Author

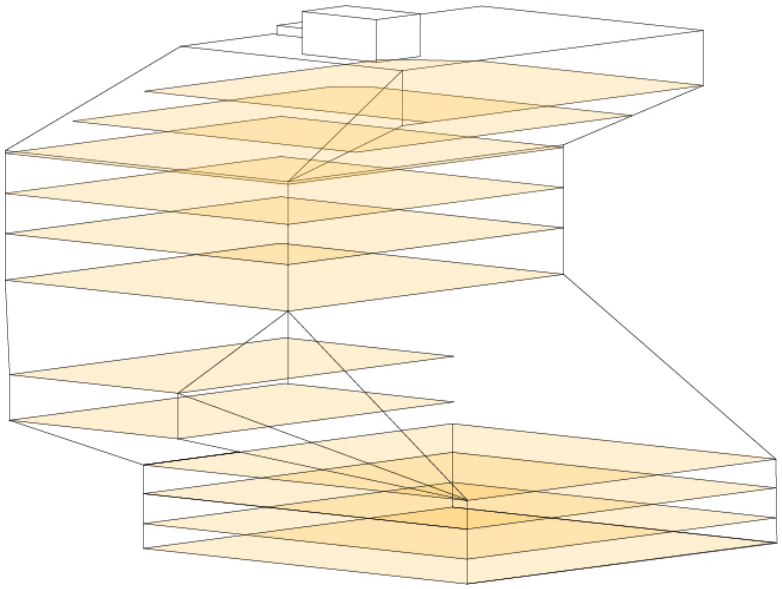

Figure 6-13 Diagram showing the internal relationship of floors at the Seattle Public Library
Source: Author

Conclusion

The challenge of vertical stacking is isolated floor plates and a more dynamic arrangement of spaces creates opportunities for interrelationships and connections and strengthening the community aspect of the building. Through the analysis of the different stack typologies, each typology poses its advantages and disadvantages. The research done on the child's development and educational pedagogy shows that developmental characteristics of a child may directly correlates with the type of vertical typology that benefits the child most. For example, children in the fourth grade may benefit from a more dynamic typology as opposed to a static typology. Similarly, with a more sophisticated vertical relationship of spaces, the circulatory spaces become more dynamic. This spectrum will be used in the final design along with the guidelines to determine the best possible vertical relationship of two floors.

DESIGN FRAMEWORK

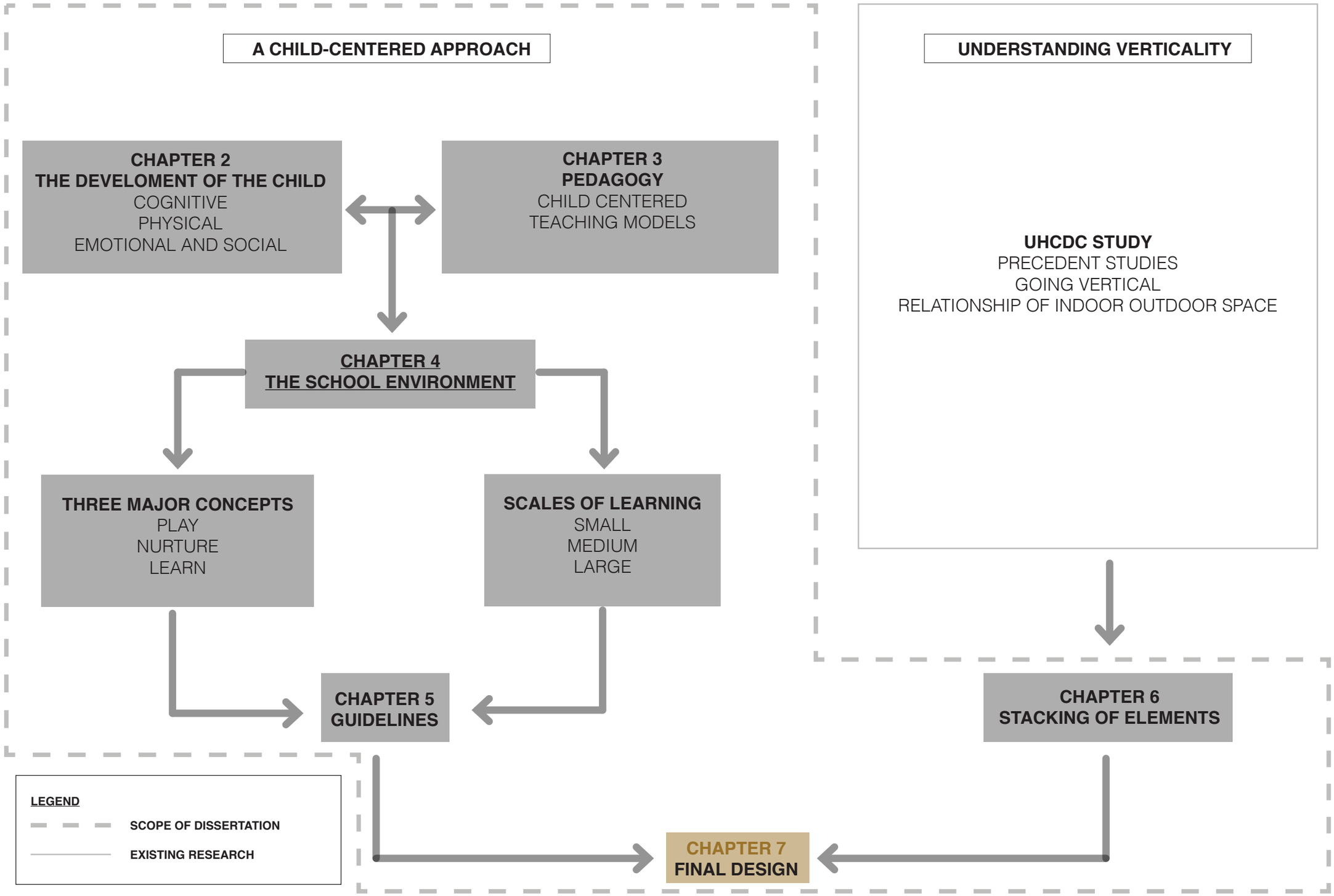

Figure 6-14 Chapter 7 Framework
Source: Author

Chapter 7: Final Design

7.1 Project Context

This section seeks to provide the reader with a brief overview of the site, its context, and the various factors going into the design of the vertical school. Although this dissertations' focus is on the design elements and configuration of spaces in the school, it is important to include a brief analysis of the ever-changing site of Kaka'ako.

7.1.1 Macro Scale Analysis

Defining Kaka'ako

To better understand Kaka'ako it is important to understand its extents. These physical boundaries defined by various sources help to determine the community in which the project sits. Kaka'ako is a developing neighborhood, and by determining the boundaries, it will help the designer determine the extents in which to conduct the site analysis.

Figure 7-1 HiCondos Boundary
Source: Author

Hi Condos
Northern Boundary- Lunalilo Fwy.
Eastern Boundary- Blaisdell Center
Southern Boundary- Kaka'ako Waterfront
Western Boundary- Punchbowl St.

Figure 7-2 City and County of Honolulu Boundary
Source: Author

City and County of Honolulu
Northern Boundary- Lunalilo Fwy.
Eastern Boundary- Blaisdell Center
Southern Boundary- Kaka'ako Waterfront
Western Boundary- Punchbowl St.

Figure 7-3 Google Boundary
Source: Author

Google
Northern Boundary- South Beretania St.
Eastern Boundary- Pensacola St.
Southern Boundary- Kaka'ako Waterfront
Western Boundary- Punchbowl St.

Figure 7-4 ThePlaceName Boundary
Source: Author

ThePlaceName
Northern Boundary- South Beretania St.
Eastern Boundary- Kalakaua St.
Southern Boundary- Kaka'ako Waterfront
Western Boundary- Punchbowl St.

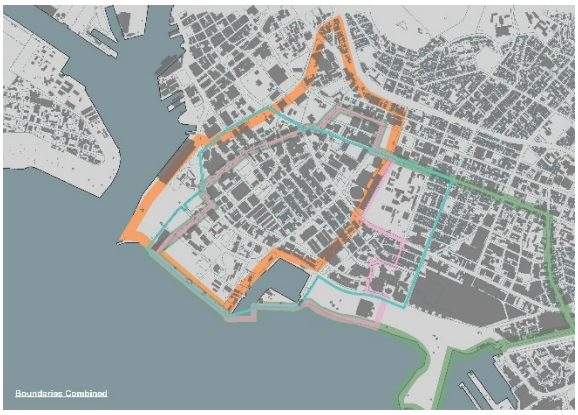

Figure 7-5 Boundaries Combined
Source: Author

After combining the limits into one map and analyzing the results, the consistent area included in all boundaries were the Google and City and County Maps. For this site analysis, the City and County map will be used as it is a more reputable and reliable source of information.

Districts within Kaka'ako

Figure 7-6 Districts within Kaka'ako
Source: Author, Base maps courtesy of UHCDC

The Kaka'ako Community Development District has defined several districts within the community, each having their "own unique character."[47] The project site is in the Pauahi district of Kaka'ako, which is defined by the development district as-

> "a mixed-use 'urban village.' The name of the neighborhood honors the legacy of Princess Bernice Pauahi Bishop, who is the benefactor of Kamehameha Schools- the major landowner in this area. The proposed light metro Civic Center station is located within this neighborhood. The Mauka Area Plan envisions the Pauahi neighborhood as a high-rise area with pedestrian-scaled podiums and active frontages. Several properties on the mauka side of the Ala Moana Boulevard are owned by Kamehameha Schools. The implementation of the Kamehameha School's Master Plan will help to activate the Pauahi neighborhood and potentially areas along busy Ala Moana Boulevard."[48]

[47] Hawai'i Community Development Authority, *Kaka'ako Community Development District: TOD Overlay Plan- Final Draft.* Honolulu.

[48] Ibid.

Proximity to Amenities

Figure 7-7 Proximity Radii
Source: Author, Base maps courtesy of UHCDC

The three distance radii show the proximity of the project to various amenities and major buildings. The quarter-mile radius reaches Ala Moana Boulevard, which is a major artery road that connects Ala Moana to the Downtown Honolulu area. The half-mile radius stretches to Ward Ave. and the Neil S. Blaisdell Center. The mile radium reaches the edge of Ala Moana Center. This shows that the project site is relatively close to the major hubs of Honolulu and is connected to the primary sites which will eventually be connected to the rail transit system.

Transit-Oriented Development (TOD)

Figure 7-8 Proposed TOD Rail Line
Source: Author, Base maps courtesy of UHCDC

The transit-oriented development has been a driving factor in many of the developmental trends surrounding urban Honolulu. With the newly implemented rail, the goal of the city and county is to create an urban setting that is walkable and bicycle friendly. The proposed rail path runs through Kaka'ako towards the Ala Moana district. It is important to note that the proposed rail station in Kaka'ako will be located one block away from the vertical school site. This provides an opportunity to create a school that is geared toward public transportation, and accommodate for a more pedestrian-friendly frontage, as also discussed previously in the guidelines proposed by the Honolulu Community Development Authority.

Moving Families

Kaka'ako is seeing an upward growth in population during the past ten years. In 2010, there were 6,131 housing units. With the increase in condominiums and affordable housing units geared towards local families and individuals, the number of children under the age of 18 has increased over the recent years. Of the 10,034 residents that lived in these Kaka'ako units, 713 were children between the ages of 5-14 years old. For example, the Ke Kilohana, a residential tower under construction, is for "young professionals and new families who work in the area."[49] Of the 424 units, it will house, 375 of these units are reserved for Hawai'i residents.

Need for better facilities

As previously discussed in the introduction of this dissertation, the need for better school facilities in Hawai'i is apparent. The average age of a school facility in Hawai'i is 65 years old.[50] Many of the spaces are not designed to promote child-centered educational models and severely limit how physical space is used to supplement the education of children. Most classrooms are rectilinear spaces filled with desks, designed for a teacher-centered approach to teaching and learning. The challenge of this design project is to create and design spaces that provide opportunities for more active and engaging learning environments in a vertical school that is child-centered and project-based.

Due to the lack of need and zoning regulations, many of the public elementary school facilities in Hawai'i have predominantly been one to two-story structures. Therefore, it can be said that many of the public-school facilities in Hawai'i are primarily horizontal in layout, with structures spread across the parcel. According to the Hawai'i Institute for Public Affairs, "most Hawai'i public schools are built on horizontal designs that are outmoded and not aligned with modern learning environments."[51] They also explain that "complexes on all islands suffer from aging schools, maintenance backlogs, and budget shortfalls."[52] It is predicted that it would take 150 years to repair all the schools in Hawai'i in its current pace of repair and state of school facilities. This validates the fact that new construction in Hawai'i should accommodate for modern learning methods, as well as be flexible to address the needs of the child.

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[49] State of Hawai'i, *Kaka'ako, Urban Core Living*, (Honolulu: Department of Business, Economic Development and Tourism, 2014), 3.

[50] "School Facilities," Hawai'i State Department of Education, accessed December 20, 2017. http://www.hawaiipublicschools.org/ConnectWithUs/Organization/SchoolFacilities/Pages/home.aspx.

[51] Hawai'i Institute for Public Affairs, *Building Better School Facilities*, (Honolulu: Hawai'i Institute for Public Affairs, 2016), 9.

[52] Ibid.

Nearby Schools

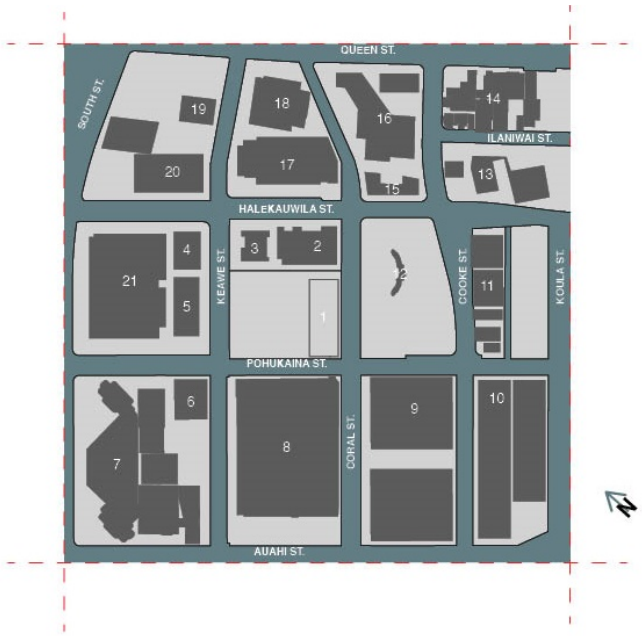
Figure 7-9 Nearby Schools
Source: Author, Base maps courtesy of UHCDC

Elementary Schools in nearby proximity to the site are Royal Elementary School and Queen Kaahumanu Elementary School. With the influx of population and development, it will become necessary to accommodate the influx of elementary age children. The pri mary high school in this district is McKinley High School. Other private schools or daycare facilities includes Rainbow Schools, Stepping Stone Academy, Muriel Preschool, Redemption Academy, and Early Education of Seagull Schools.

7.1.2 Micro Scale Analysis (Site Specifics)

Kaka'ako is a developing site with multiple entities producing different projects. It is essential to understand the project sites that surround the school and accommodate to fit the future development of the site. This section will highlight the current and future developments in the area, and understand the various factors related to zoning.

Existing Site Surroundings



1	Project Site- currently Fisher Hawai'i
2	Parking Structure
3	Halekauwila Place
4	Keahou Place
5	Keahou Lane
6	Native Hawaiian Library
7	One Waterfront Towers
8	Low Rise Commercial Warehouse
9	Low Rise Commercial Warehouse
10	Low Rise Commercial
11	Low Rise Commercial
12	Mother Waldron Park
13	Low Rise Commercial
14	Low Rise Commercial
15	Na Lei Hulu Kupuna (Condominium Complex)
16	Low Rise Commercial
17	Pohukaina Residential Development
18	Elderly Housing Tower
19	Low Rise Commercial
20	Low Rise Commercial

Figure 7-10 Existing Site Surroundings
Source: Author

This map shows the current conditions of the site. The present building on the project site is a stationery store, Fisher Hawai'i. Currently, the portion of Coral Street adjacent to the project site is pedestrian access only and is blocked off to cars and bicycles. The building labeled with the number 2 is a parking structure and is shown in Figure 7-13. Directly adjacent to the parking structure, labeled 3, is the residential tower Halekauwila Place.

Figure 7-11 View of Mother Waldron Park from Project Site
Source: Author

Figure 7-12 Current Project Site
Source: Author

Figure 7-13 Parking Garage Behind Site and Halekauwila Place behind
Source: Author

Figure 7-14 Pohukaina Street
Source: Author

Figure 7-16 SALT Kaka'ako
Source: Author

Figure 7-15 SALT Kaka'ako
Source: Author

Figure 7-17 Residential Development in Kaka'ako
Source: Author

Figure 7-18 View showing Halekauwila Place in the background
Source: Author

Future Developments

1	Future Residential Towers
2	Future Rail Station
3	Potential Multi-Building Development

Figure 7-19 Future Developments near project site
Source: Author

Transit Oriented development is expected to greatly affect Kaka'ako. The future rail station is expected to be located a block away from the project site, which situates the school in a very prime location. With the newly implemented rail system, the community is expected to be more walkable and pedestrian friendly. It is crucial to accommodate the school to understand the different types of ways in which to regulate students in and out of the building daily and account for foot traffic and movement through the site. In the speculative future, if the adjacent lots become high rises at max buildable volume, the adjacent Mother Waldron Park is advantageous as it creates a buffer space in an urban setting. The empty lot can assure that adequate light and air can enter the school.

Regulatory/ Site Restrictions

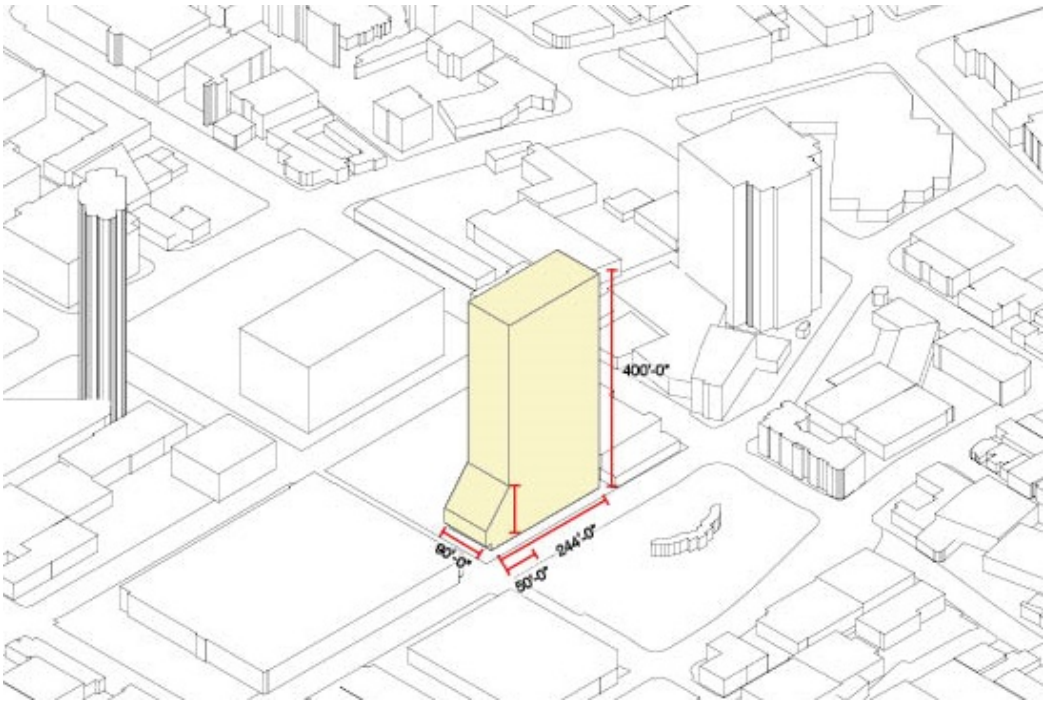


Figure 7-20 Maximum Buildable Volume
Source: Author, Base maps courtesy of UHCDC

Based on zoning codes and regulatory information provided by the Kaka'ako Special Design District, the maximum floor area for the project site is 24,362 ft^2. The setback is 20 ft on all sides, including the Coral St. frontage. The FAR is 3.5, and the Maximum building height is 400'-0". If the maximum floorplate area is utilized, the maximum height of the building is ten stories high. The school must fit the maximum building profile illustrated above.

AREAS BASED ON ED SPEC PROVIDED BY DOE

CLASSROOMS (980 SF EACH)
KINDERGARTEN- 8 CLASSROOMS
SPECIAL EDUCATION- 8 CLASSROOMS
1ST GRADE- 8 CLASSROOMS
2ND GRADE- 7 CLASSROOMS
3RD GRADE- 6 CLASSROOMS
4TH GRADE- 6 CLASSROOMS
5TH GRADE- 6 CLASSROOMS

ADMINISTRATIVE CENTER 8300 SF
LIBRARY MEDIA CENTER 6740 SF
FOOD SERVICE/ KITCHEN 2770 SF
(2) FACULTY CENTER 980 SF
COMPUTER RESOURCE CENTER 1200 SF
CUSTODIAL SERVICE CENTER 580 SF
GRASS PLAYFIELD 16470 SF
KINDERGARTEN PLAYGROUND EQUIPMENT AREA 2000 SF
CAFETORIUM/ MULTIPURPOSE 9735 SF
(3) GRADE 1-5 PLAYGROUND EQUIPMENT AREA 2000 SF
SPED PRE-SCHOOL FENCED PLAY AREA 900 SF
1-5 GRASS PLAYFIELD 98800 SF
GRADE 1-6 PAVED PLAYCOURT 7200 SF
GRADE 1-6 COVERED PLAYCOURT 7200 SF

PLAY

134,570 ft²

NURTURE

19,595 ft²

LEARN

58,730 ft²

Figure 7-21 Department of Education Project Education Specification
Source: Author

Design Approach

Figure 7-21 Department of Education Project Education Specification shows the area requirements provided by the Hawai'i Department of Education Education Specification. This area specification was used as inspiration to determine the final area division of 70% Play, 25% Learn, and 5% Nurture, as shown in Figure 7-22. This is in part due to the loss of open play area when the school is stacked as opposed to laid out on a large plot of land. Through the previous research, it is concluded that the incorporation of play space within the school, as well as the curricula, will be beneficial to the students. Playspaces encourage physical activity, promotes physical wellbeing, and gives the student an opportunity to learn by doing. Play can be directly related to movement, therefore, by incorporating play into the circulation of the building, it allows for movement and play to become entwined into the design of the building.

Figure 7-22 Modification of Area Configuration
Source: Author

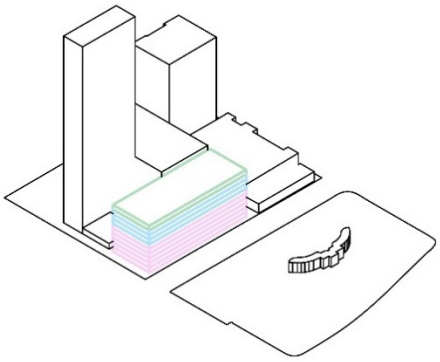


Figure 7-23 Stacked floorplates categorized by Play, Nurture, and Learn
Source: Author

After the maximum building footprint and max height were established, the floors were divided to fit the percentages discussed in the previous section. The pink represents the area dedicated to playing, blue to learn, and green to nurture. Because the circulation of a vertical school takes up a lot of floor area, it is included in the play category.

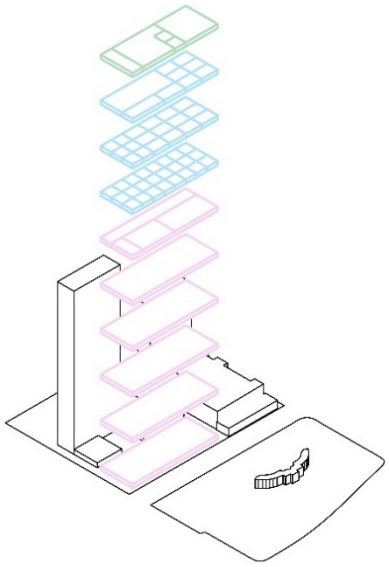


Figure 7-24 Floorplates divided into program spaces
Source: Author

After the areas were allocated to its specific concept, the spaces were divided into separate functions such as play courts, classrooms, etc. A study was then conducted on how to entwine the building with play spaces and use play as circulation to encourage physical activity.

7.2 Conceptual Design

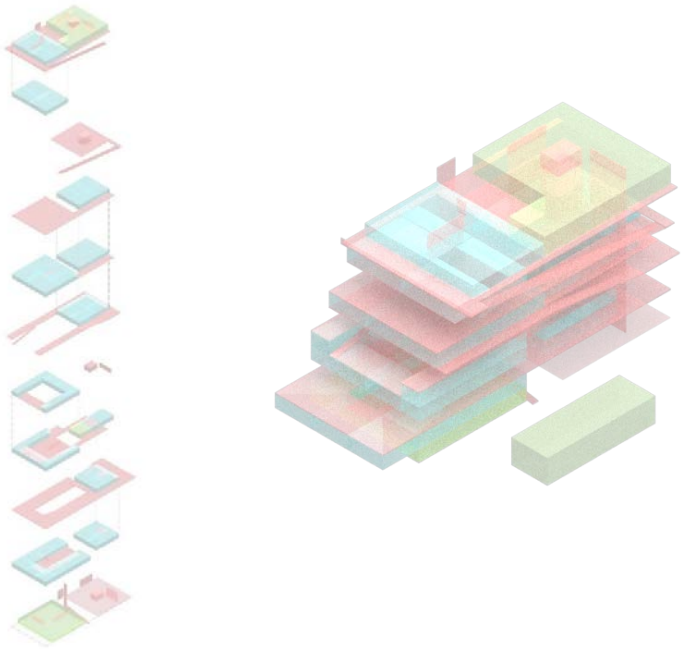


Figure 7-25 Diagram showing organization of spaces relative to concepts of Play, Nurture, and Learn
Source: Author

The concept of the final design for the vertical school is Kaka'ako is centered around the child. After analyzing the child's developmental patterns and innovative pedagogical models about these patterns, it can be concluded that a child's elementary years are complex and multifaceted. The design guidelines extract three central concepts from the research to supplement the child's school experience. These concepts are Play, Nurture, and Learn. These concepts were then related to physical space through a variety of different scales. The smallest scale is the individual, next being the group or class, and finally the school. The guidelines inform the space, and a supplemental study was conducted to determine the effects of "stacking" spaces to create a vertical school. Each floor is designed to fit the need of the student in the respective grades and utilizes methods such as incorporation of play space as circulation, classroom design, and interrelationships of vertical spaces to enhance the learning experience of the child. This dynamic school hopes to serve as a multi-faceted environment to inspire the student.

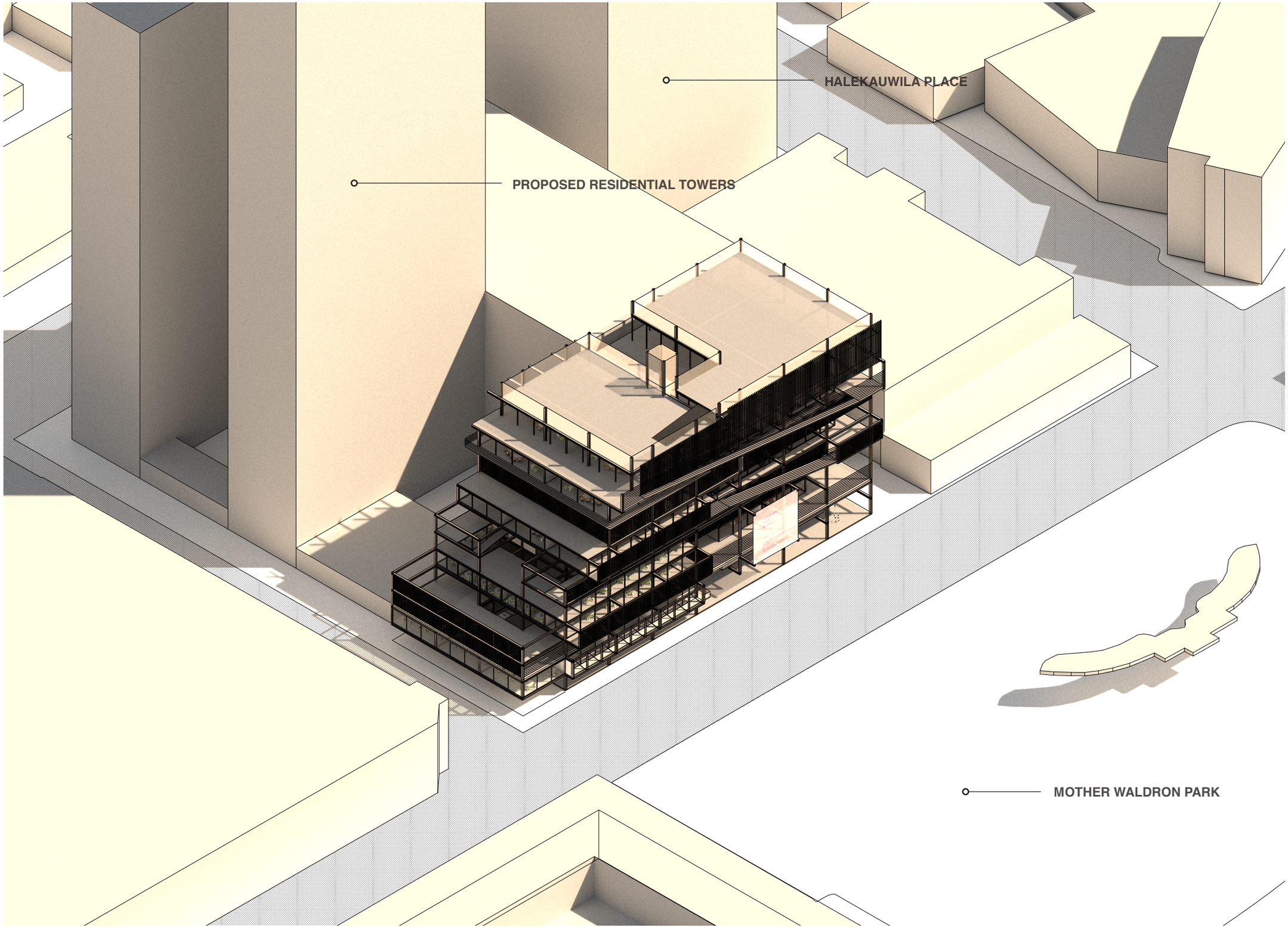


Figure 7-26 Site Isometric showing surrounding context
Source: Author

1st Floor

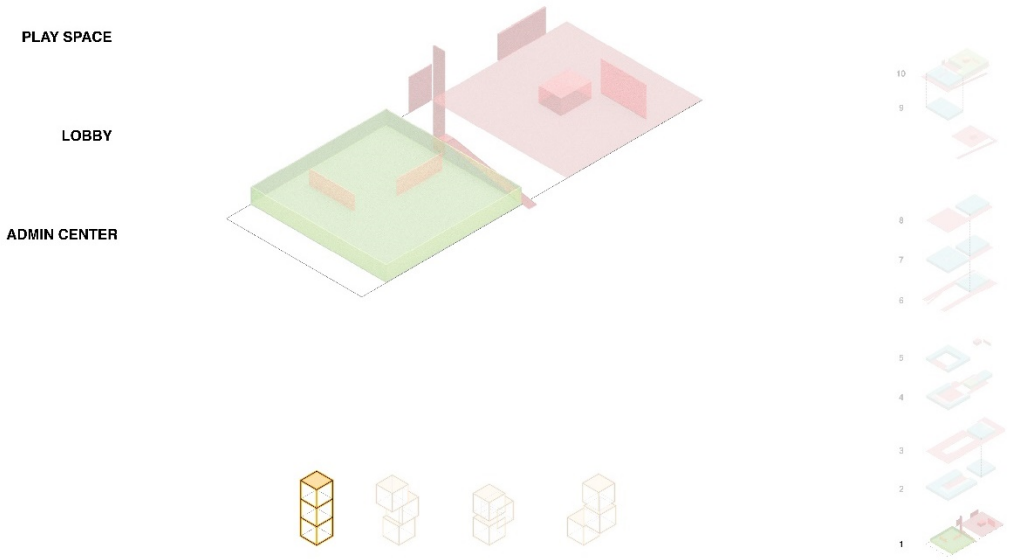


Figure 7-27 First Floor Volumetric Organization
Source: Author

The first floor is the first space in which all users of the school will access at the beginning of the day, so it is especially pertinent to create a space that is tuned to the needs of the child. The playcourt can be utilized as a flex space when foot traffic is expected to be heavy, typically during pick up and drop off times of the school. The guideline components used in this space are Play and Nurture. The play space provides students with a play to engage in physical activities, from playground equipment to multi-functional walls which can be utilized as chalkboards or climbing walls. It is especially important that a play space be located on this level because it provides opportunities for students of different grade levels to interact, which is beneficial to growth and adding to their vocabulary of experiences. The administrative and central office provides students with a place to feel safe and lounge while waiting for their guardians. A ramp against the wall of the admin center leads kindergarteners and first graders to their classrooms on the second floor.

1ST FLOOR

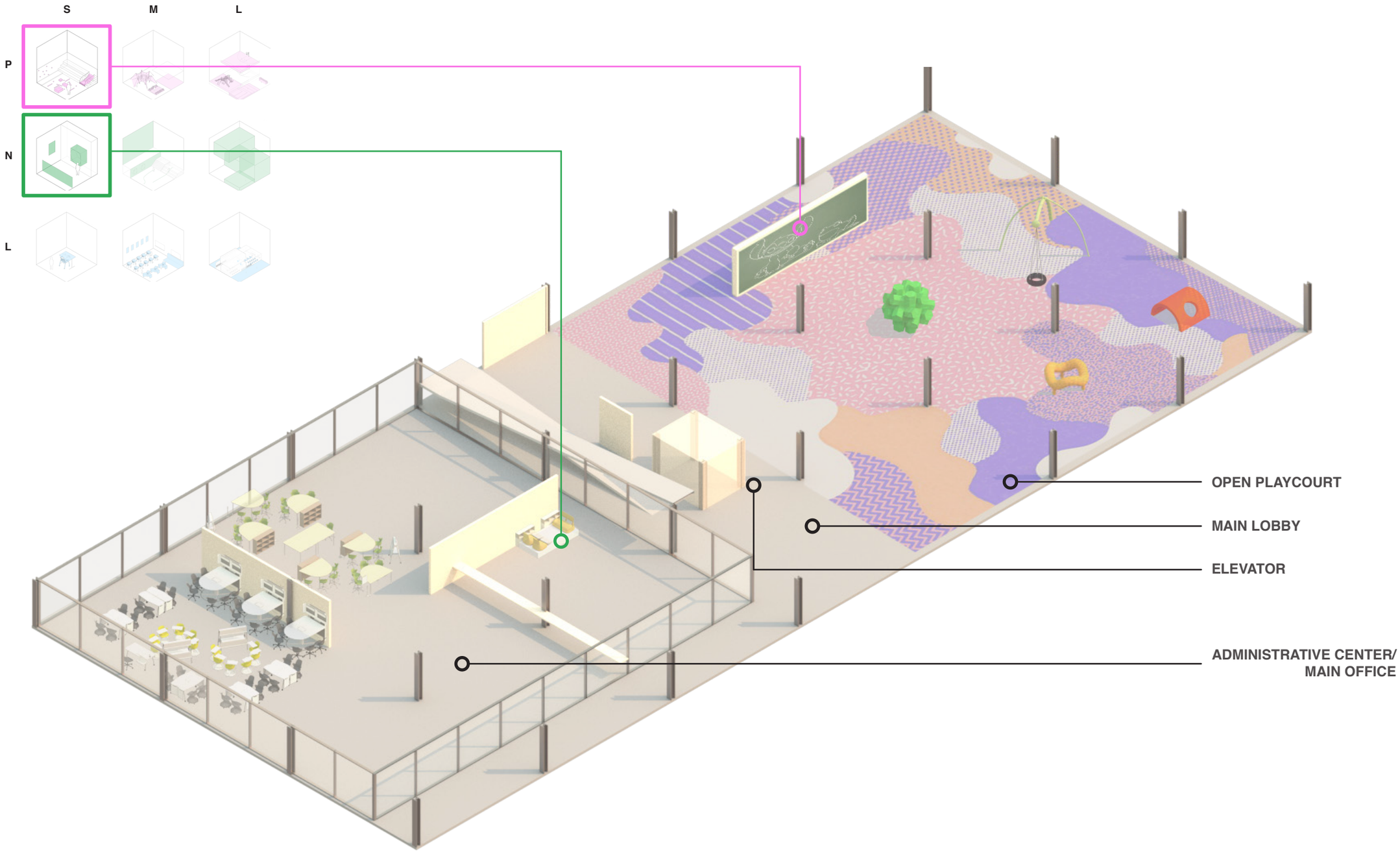


Figure 7-28 First Floor Layout
Source: Author

2nd Floor

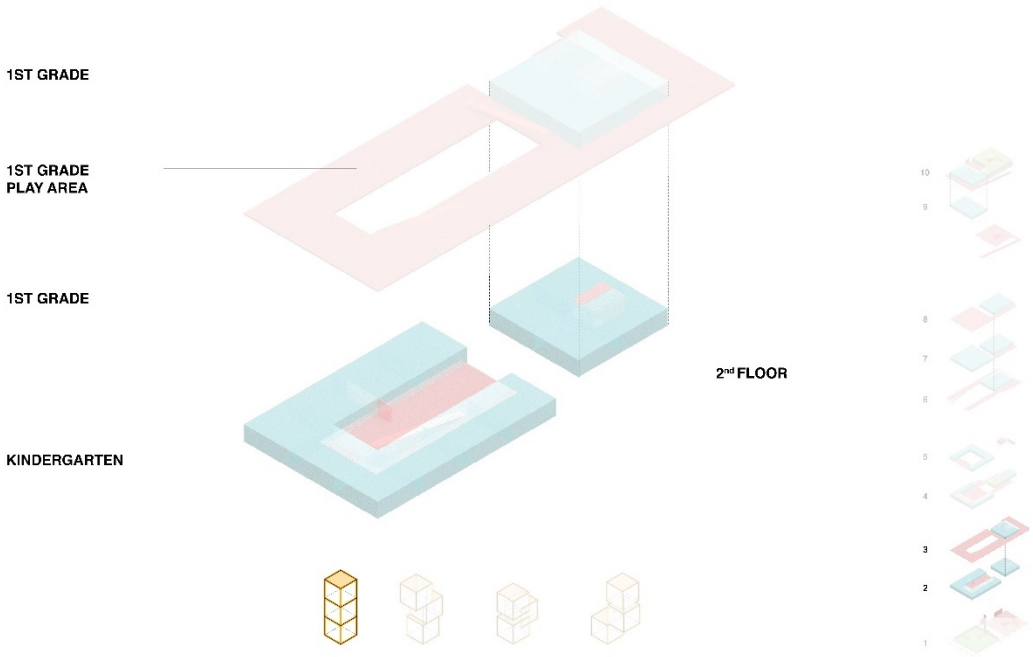


Figure 7-29 Second Floor Volumetric Organization
Source: Author

The second floor categorizes learning and playing into one category. As discussed in chapter two, children in kindergarten and 1st grade are in the preoperational reasoning stage of development, which means that they are still more individualistic in their ideas and ways of interaction. By configuring the kindergarten classrooms in a U-shape configuration, it allows them to interact amongst themselves, and create a community that is familiar to them. This homey play space allows the child to feel like school is their second home, where they are safe and comfortable. The central play space provides the kindergarteners with their individualized play space in which they have the choice to play alone or with other classmates. This is especially beneficial because it provides the students with the ability of choice which is a factor of being more independent.

2ND FLOOR

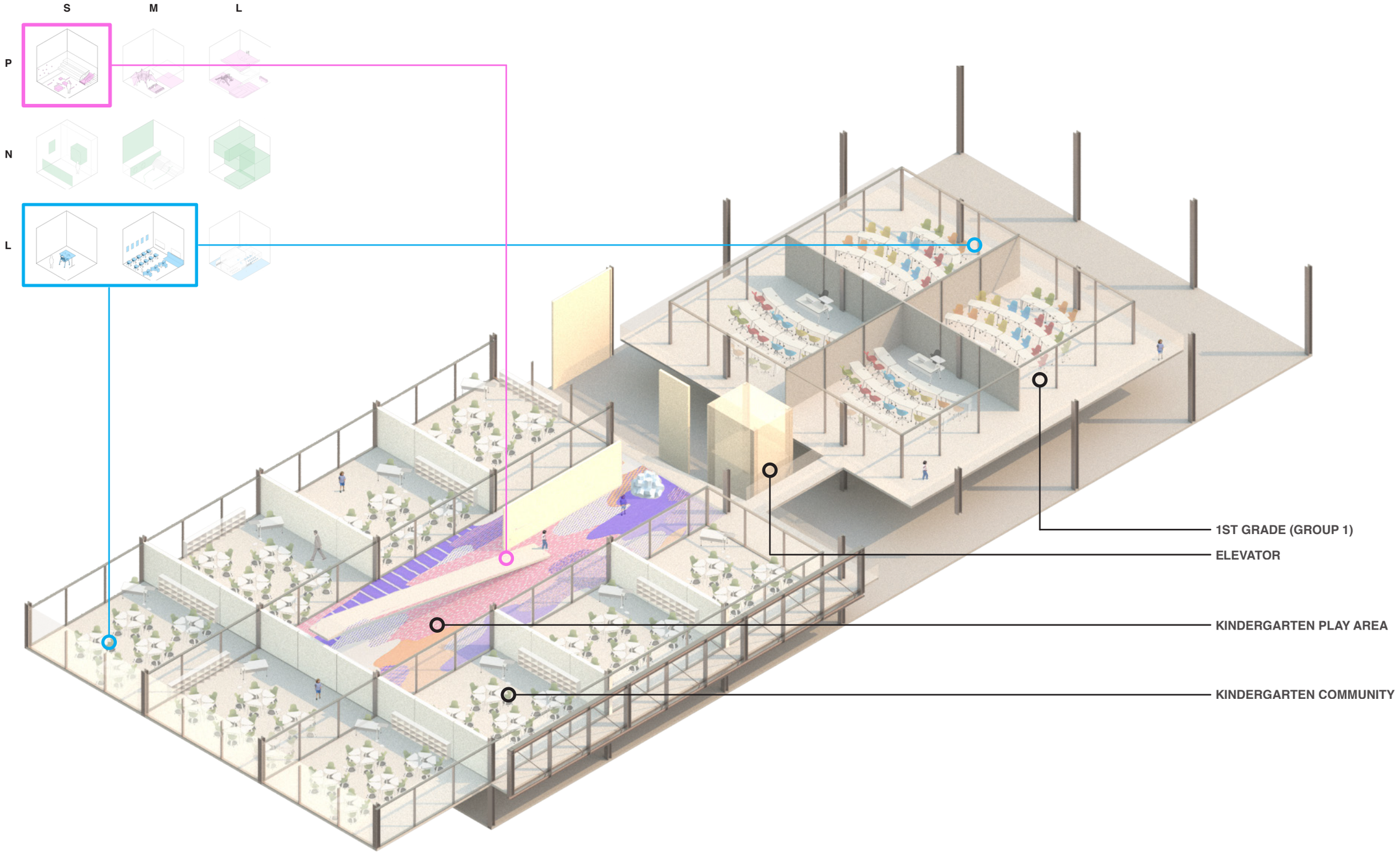


Figure 7-30 Second Floor Layout
Source: Author

3rd Floor

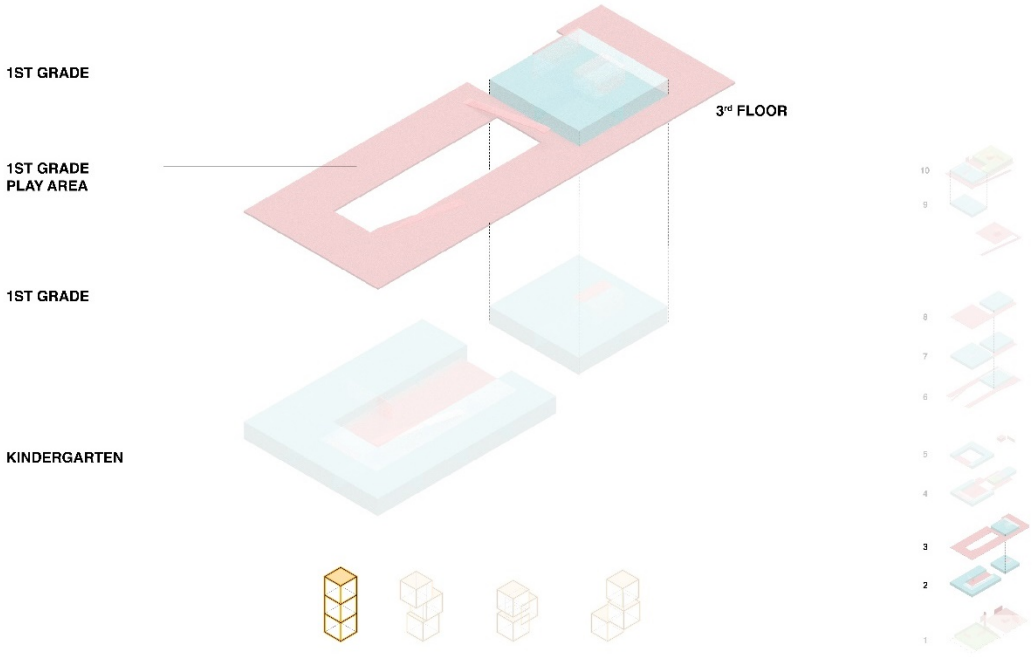


Figure 7-31 Third Floor Volumetric Organization
Source: Author

Approximately sixty percent of the third-floor area is dedicated to playing space. This play area serves as a central play space for grades K-2. The circulation of the floor is also playing space, which encourages movement and the idea of having play perpetually entwined within the design of the building. Coined the “donut play court” this area is designed for interaction between different grade levels. A feature that is especially interesting is the visual connection that students have in the lower kindergarten play area. Similarly, kindergarteners can choose to use the ramp to play at the donut play court which gives them a choice of interacting with students in grades 1 and 2. The ramp is a transformative experience for the student and is symbolic of growth in the child. All three guideline components were used on this floor. Additionally, the 1st-grade classroom layout is comprised of three rows of flexible furniture that can be easily configured to suit the lesson of the day.

3RD FLOOR

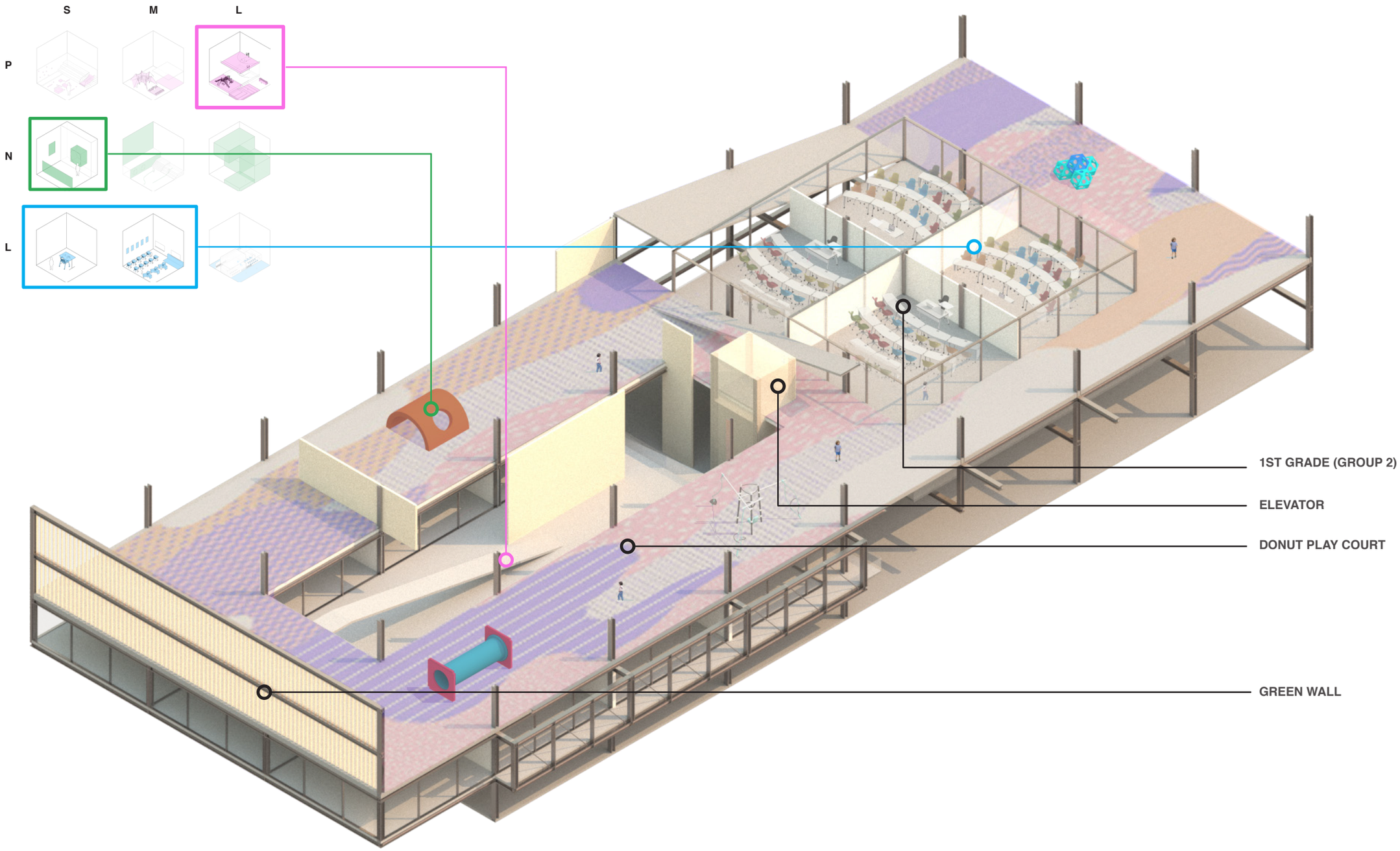


Figure 7-32 Third Floor Layout
Source: Author

4th Floor

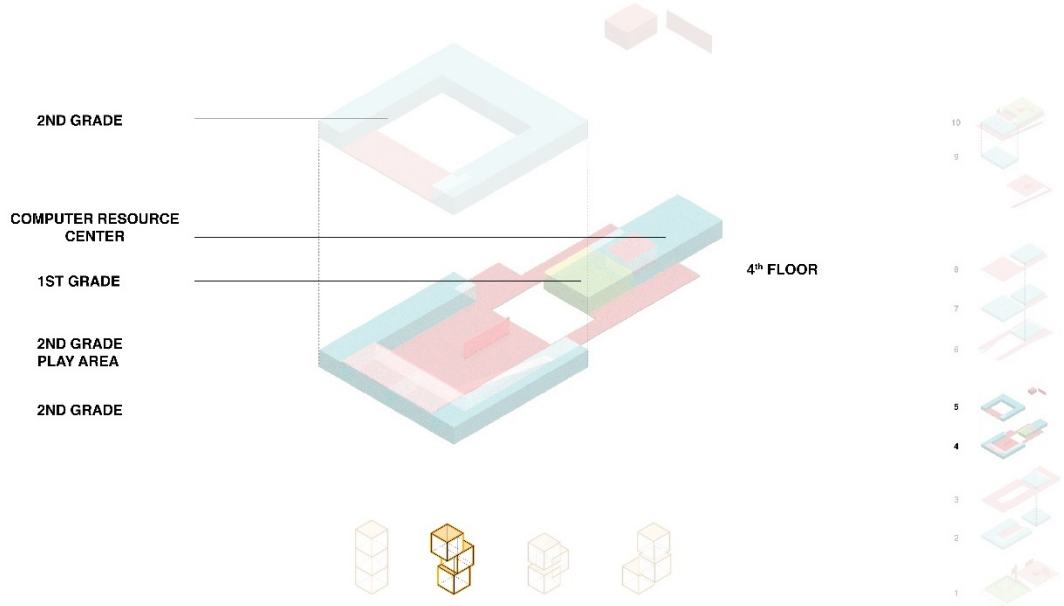


Figure 7-33 Fourth Floor Volumetric Organization
Source: Author

Second grade is split into two separate levels, and each cluster of classes has its designated play space. Similar to students in kindergarten, this allows the students to have the choice of playing in the larger communal play area on the third floor or the more private area on the second floor. This is the first level to begin to include natural elements into the design. The wooden louvers located on the Mother Waldron side of the building serves as a barrier for safety as well as a surface to hang plants and shrubbery. The classrooms are categorized into two types, to provide students with different spaces for various tasks. The elongated rectangular classroom allows the child to work with minimal supervision, while the square type classroom provides the students with more face time with the teacher. This gives the child the ability to be more independent and self-directed in their learning. Similarly, At the age of 7 or 8, second graders are beginning to enter the Concrete Operational Stage of cognitive development, meaning they begin to think logically. By creating a vibrant environment which yields new experiences, it will significantly benefit the child's psychological growth. For this reason, this floor incorporates other elements like the hanging garden and computer resource center.

4TH FLOOR

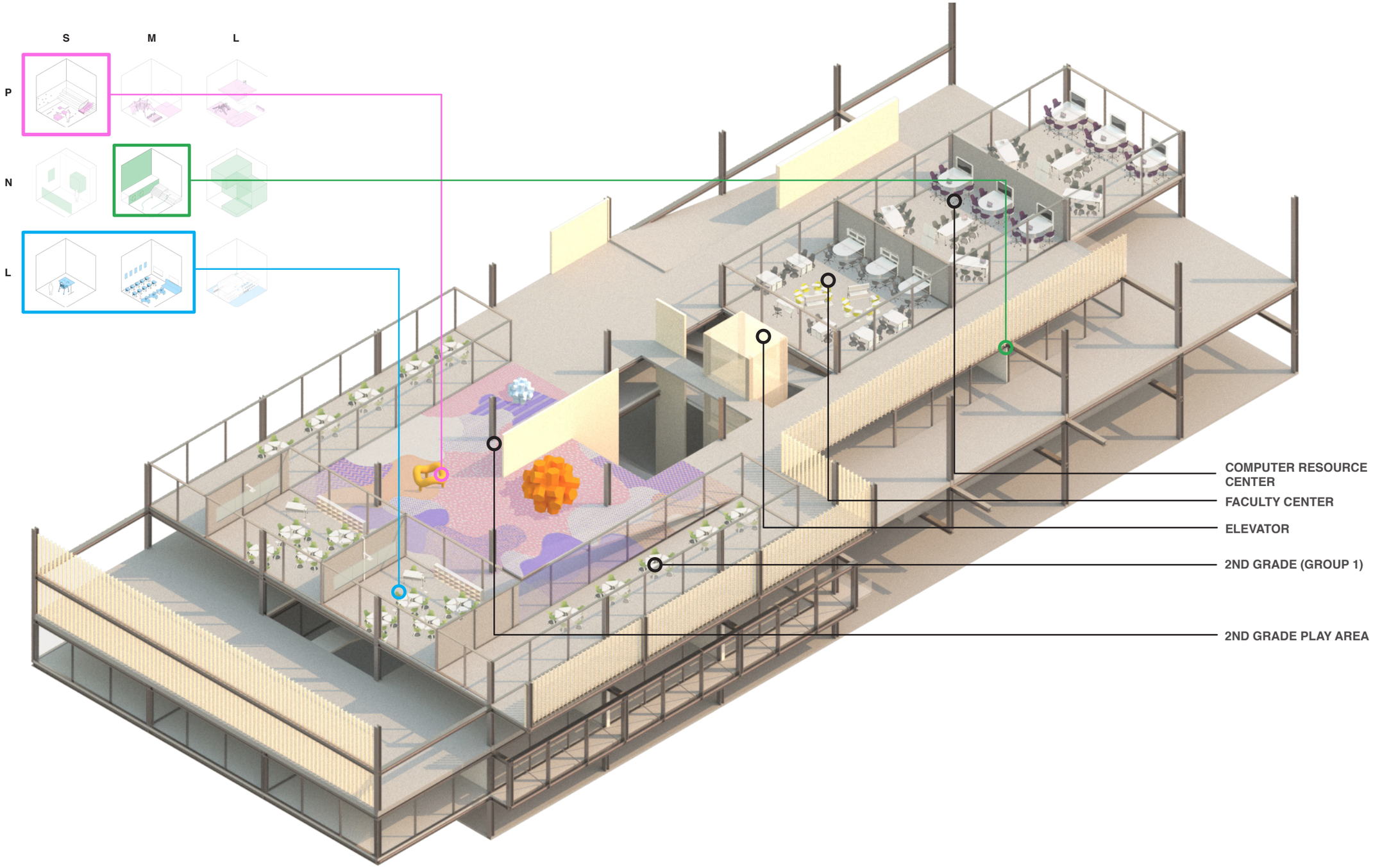


Figure 7-34 Fourth Floor Layout
Source: Author

5th Floor

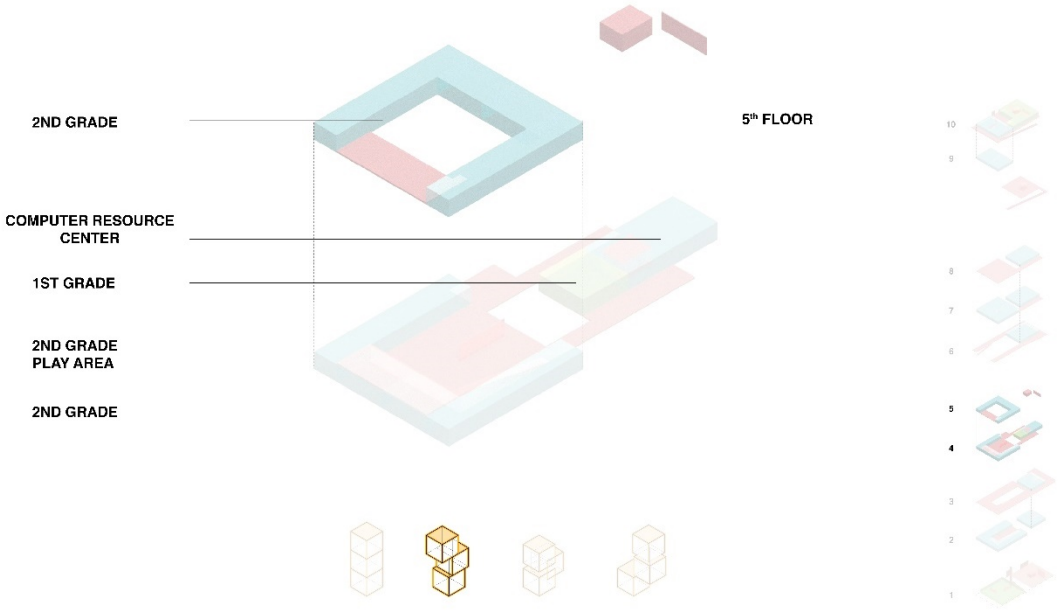


Figure 7-35 Fifth Floor Volumetric Organization
Source: Author

The fifth floor mirrors the classroom layout of the floor below, creating an opening to allow light and ventilation through the play space below. This configuration also allows for interaction between the two floors. The second graders on this level have access to a learning garden, which is taken from the ideas presented by ʻĀina in Schools. Here, students will learn how to grow their plants, conduct science experiments. It is also important to note that the garden area has been designed to allow for adequate daylight for the growing of plants. The play space on this level runs above the computer resource center. Like classrooms on the fourth floor, this classroom configuration allows for multiple activities.

5TH FLOOR

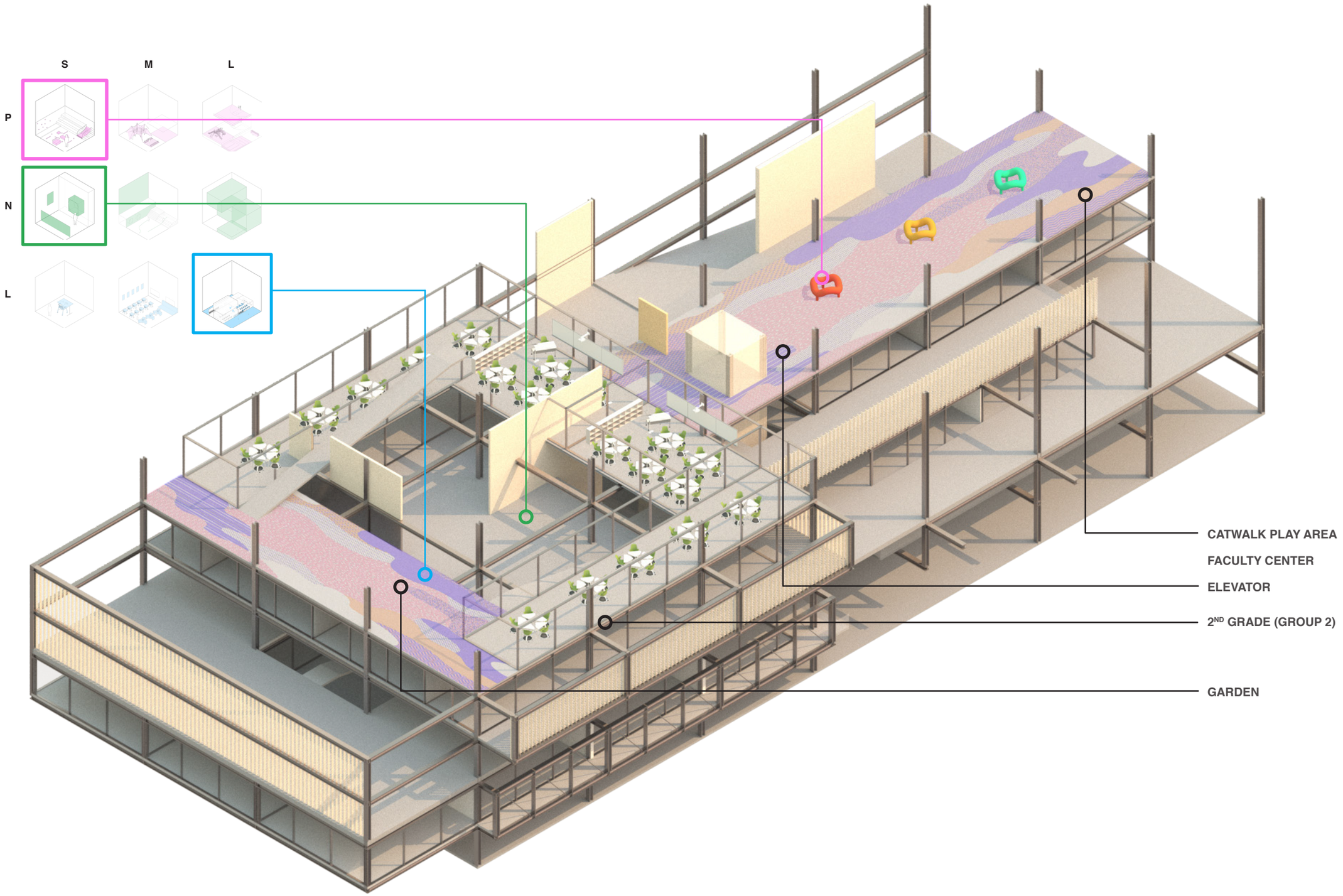


Figure 7-36 Fifth Floor Layout
Source: Author

6th Floor

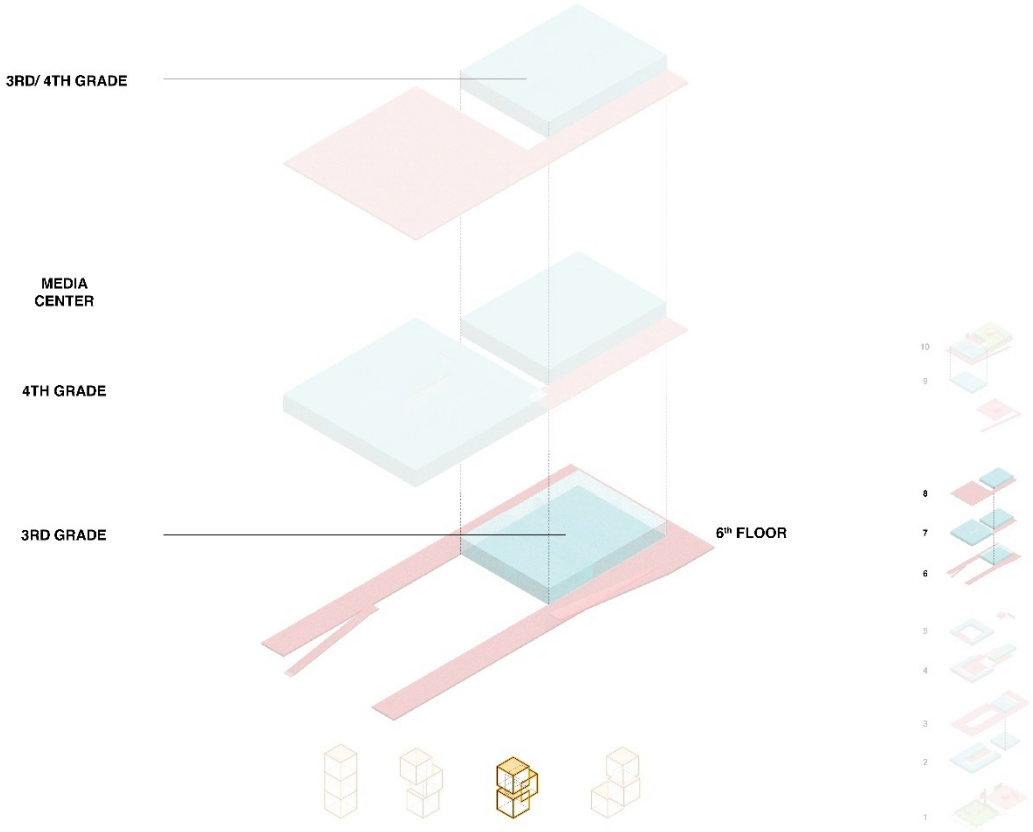


Figure 7-37 Sixth Floor Volumetric Organization
Source: Author

The sixth-floor houses cluster 1 of the third-grade classrooms which are also the first floor of a three-story structure. The three-story structure is comprised of two third grade clusters with a media center in the middle. The play spaces on this level are long corridors which provide visual access to the floors below and around the site. The corridor on the Mother Waldron Park side of the building is an exciting hybrid space as it joins the hanging garden idea into the place space. A ramp on the Mother Waldron side of the building allows for students to travel to the 7th floor.

6TH FLOOR

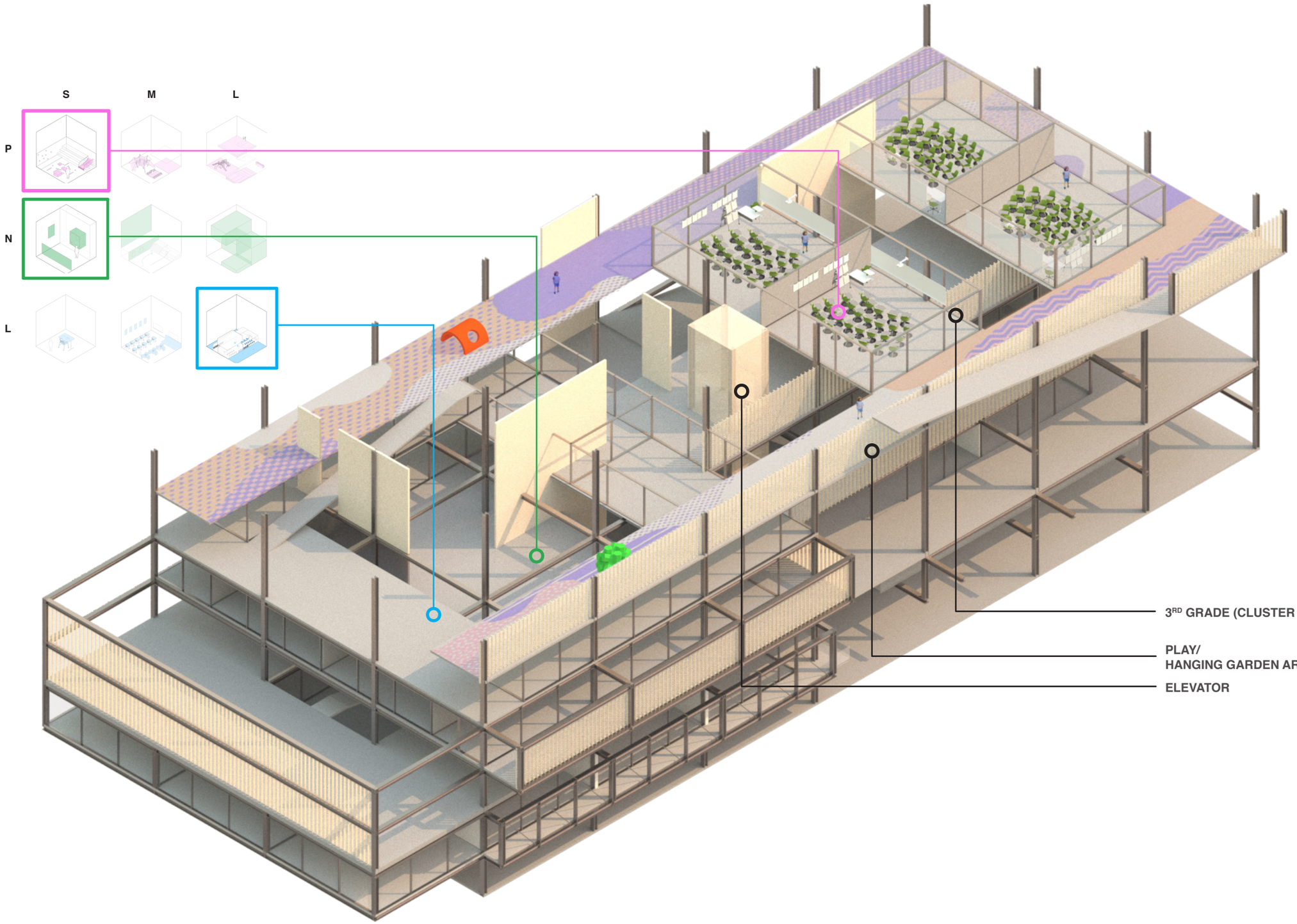


Figure 7-38 Sixth Floor Layout
Source: Author

7th Floor

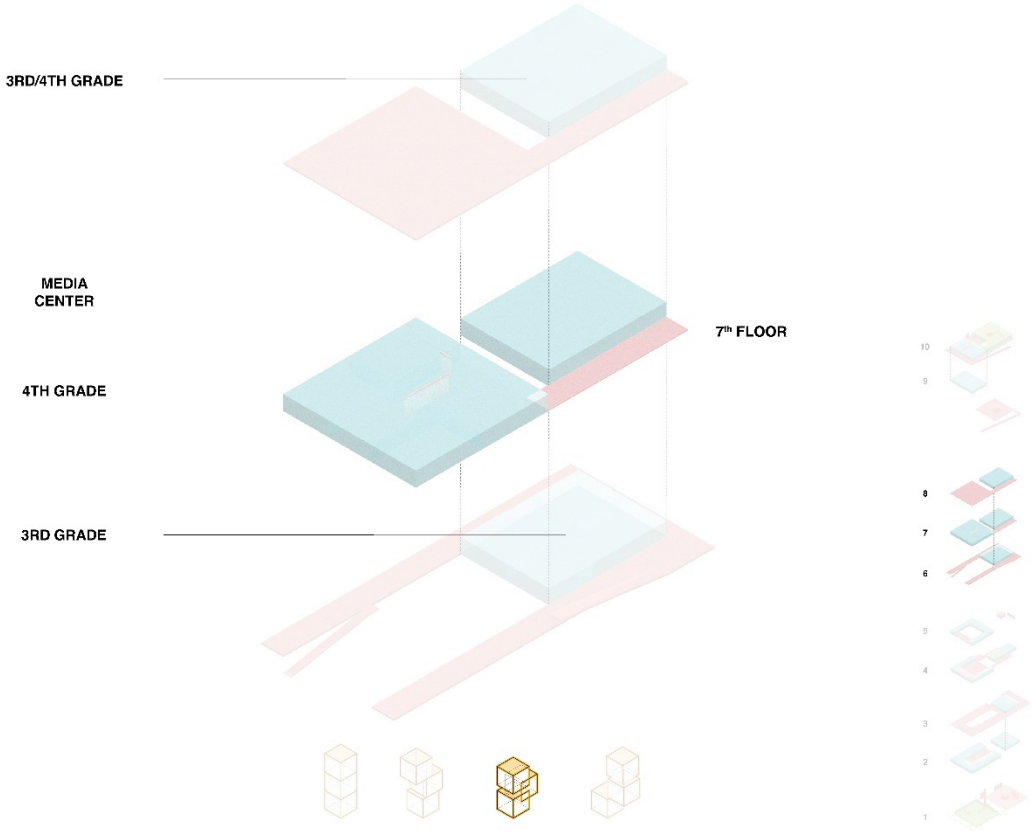


Figure 7-39 Seventh Floor Volumetric Organization
Source: Author

The 7th floor houses the media center with the 4th-grade classrooms. The fourth graders are connected to the media center/ library by floor, while the third graders are connected vertically. This creates an interrelationship between the two grades by use and function. By the fourth grade, students begin to understand complex concepts and ideas, and by allowing them access to the media center at all times it allows them to push their creativity.

7TH FLOOR

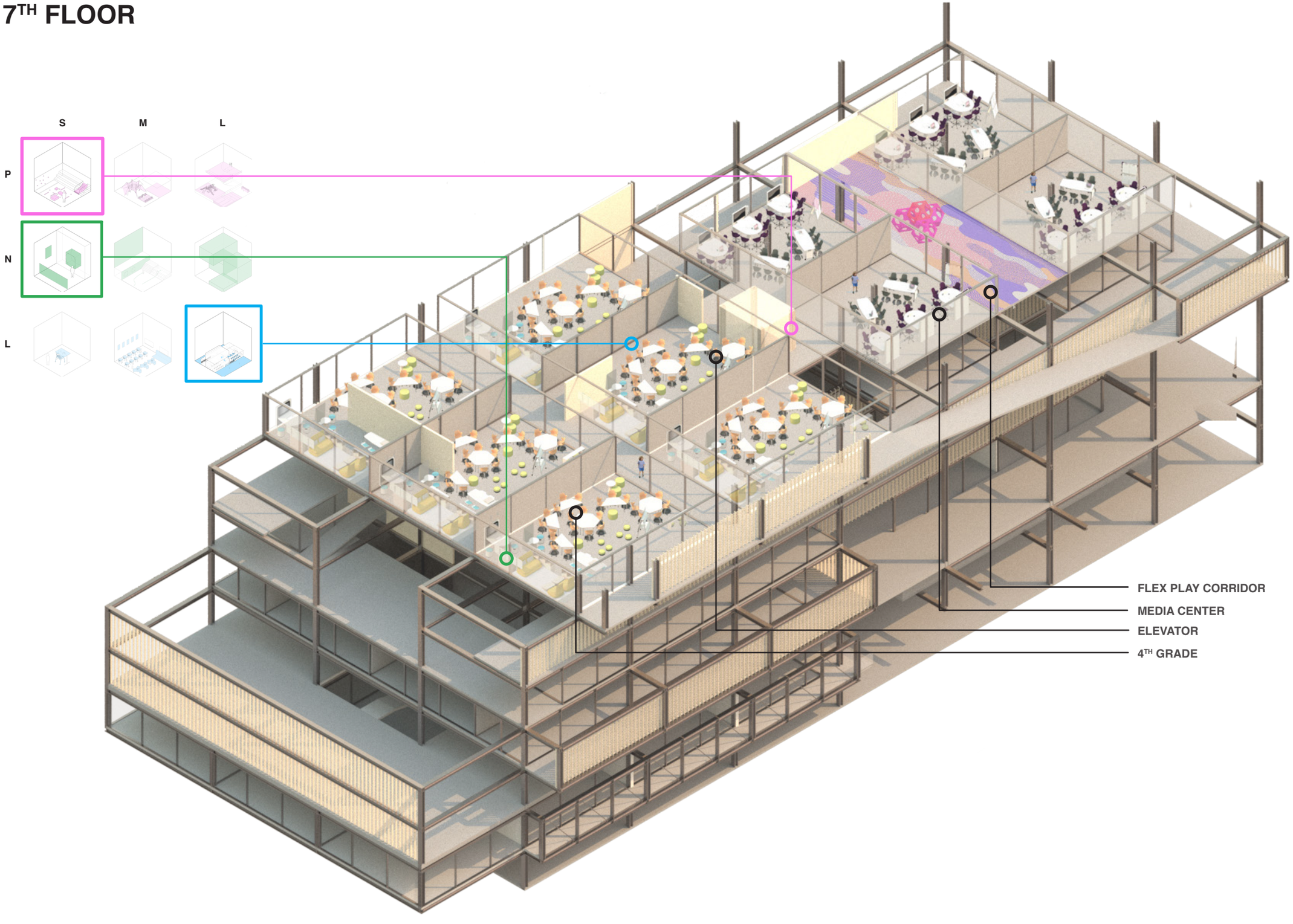


Figure 7-40 Seventh Floor Layout
Source: Author

8th Floor

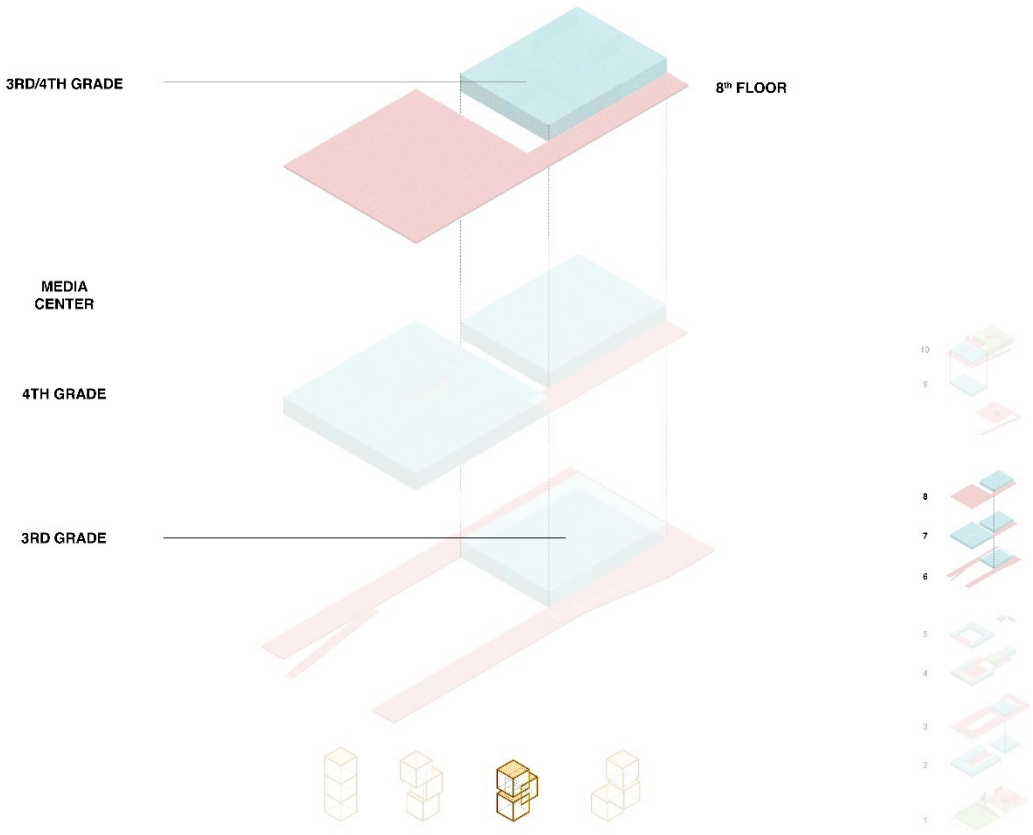


Figure 7-41 Eighth Floor Volumetric Organization
Source: Author

The eighth floor holds third and fourth-grade hybrid classes. This allows the third graders to interact with fourth graders. The main component of this level is the learning garden. Similar to the garden on the fifth floor, this garden specializes in creating food for use in the kitchen. The idea behind this is to create a collaborative environment between grade levels. The third and fourth graders produce the food, and the fifth graders prepare the food for the entire school to consume. This creates a sense of comradery and teamwork. The play area on this level is designated for grades 3-5.

8TH FLOOR

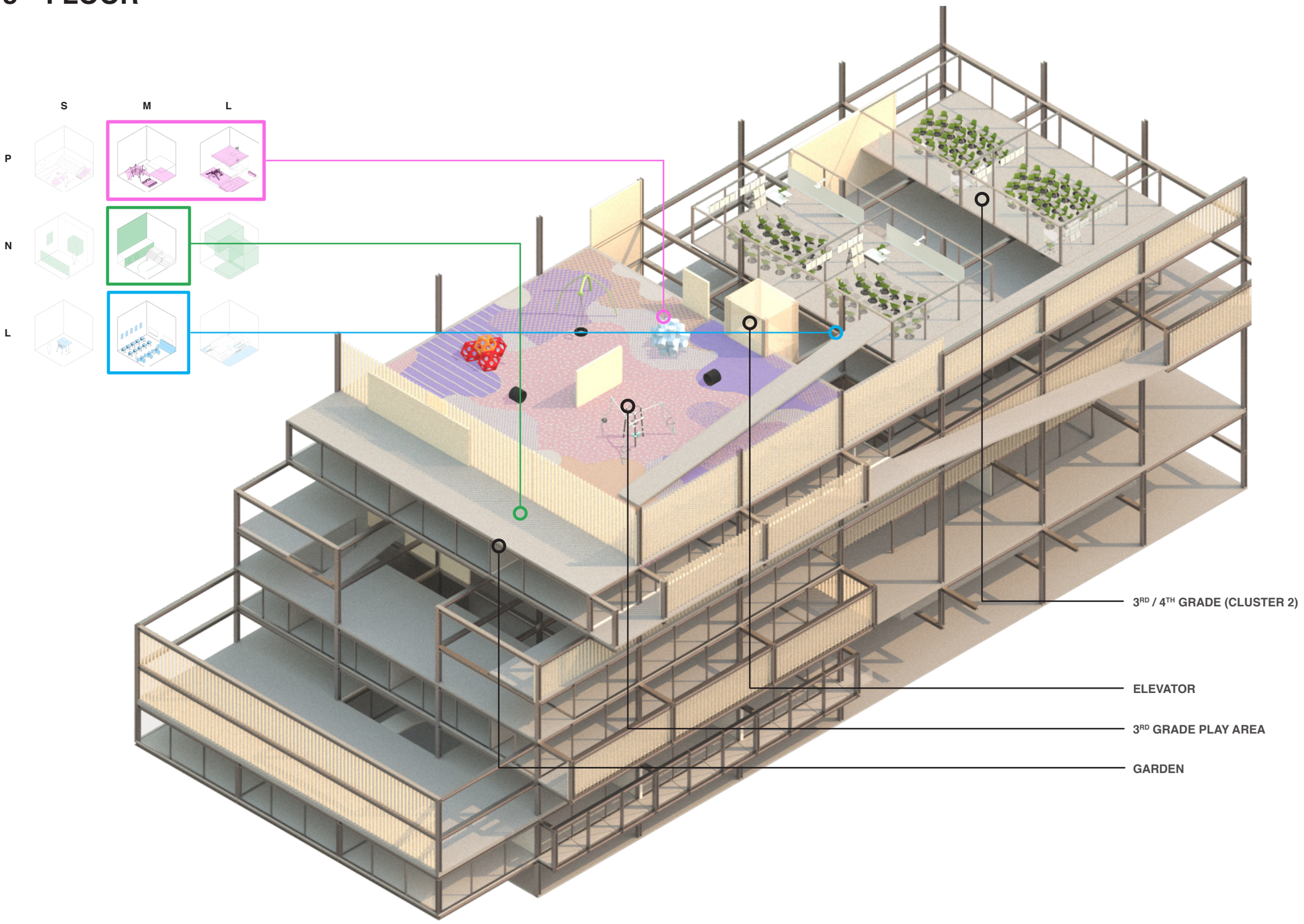


Figure 7-42 Eighth Floor Layout
Source: Author

9th Floor

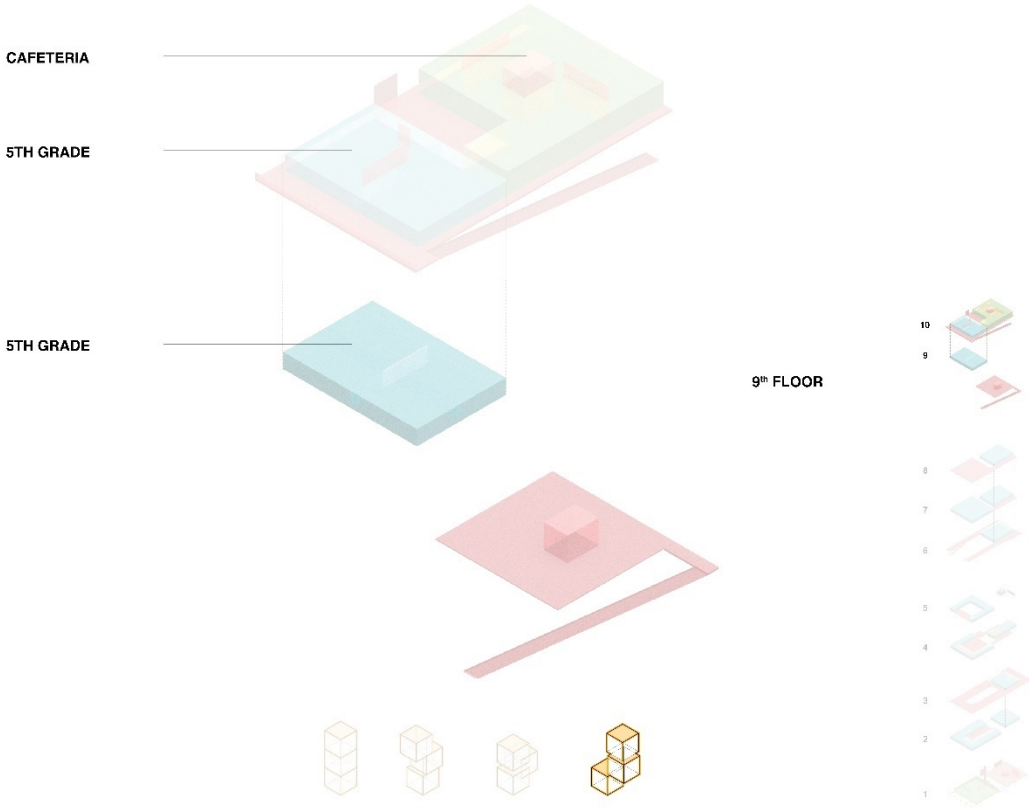


Figure 7-43 Ninth Floor Volumetric Organization
Source: Author

The ninth floor comprises of fifth grade classes and a designated play area. A ramp connects the play area from the floor below for collaborative play. Together with the fourth graders below, this cluster of fifth graders focuses on growing crops and food for the fifth graders above who will be preparing and cooking the food for school lunches. The overall area of the fifth-grade classroom is more significant and accommodates for the different types of lesson plans. The furniture is more flexible and a variety of different desk heights are provided for students to freely use during the lesson plan. From the desk, a student is able to see out into the play space.

9TH FLOOR

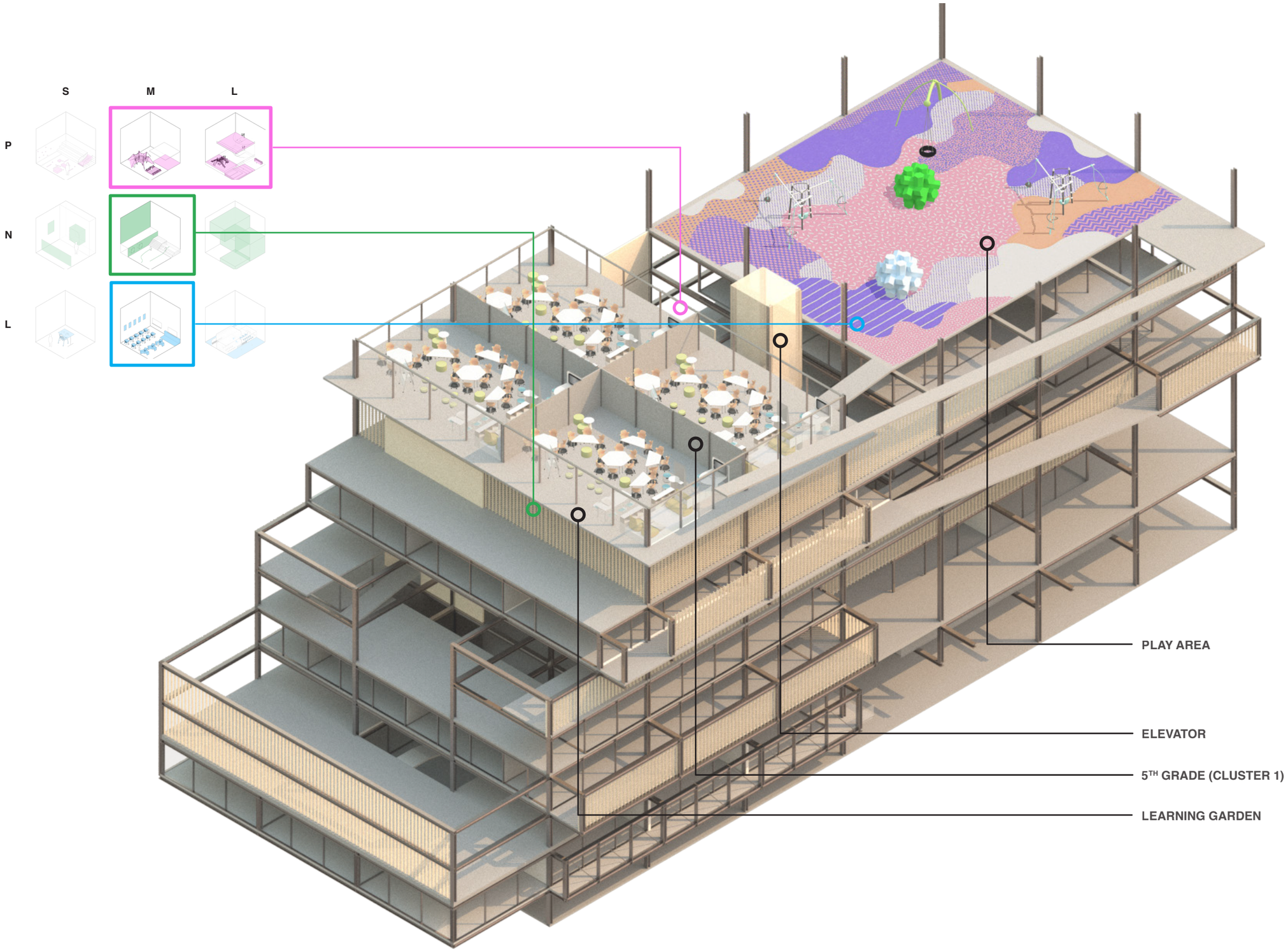


Figure 7-44 Ninth Floor Layout
Source: Author

10th Floor

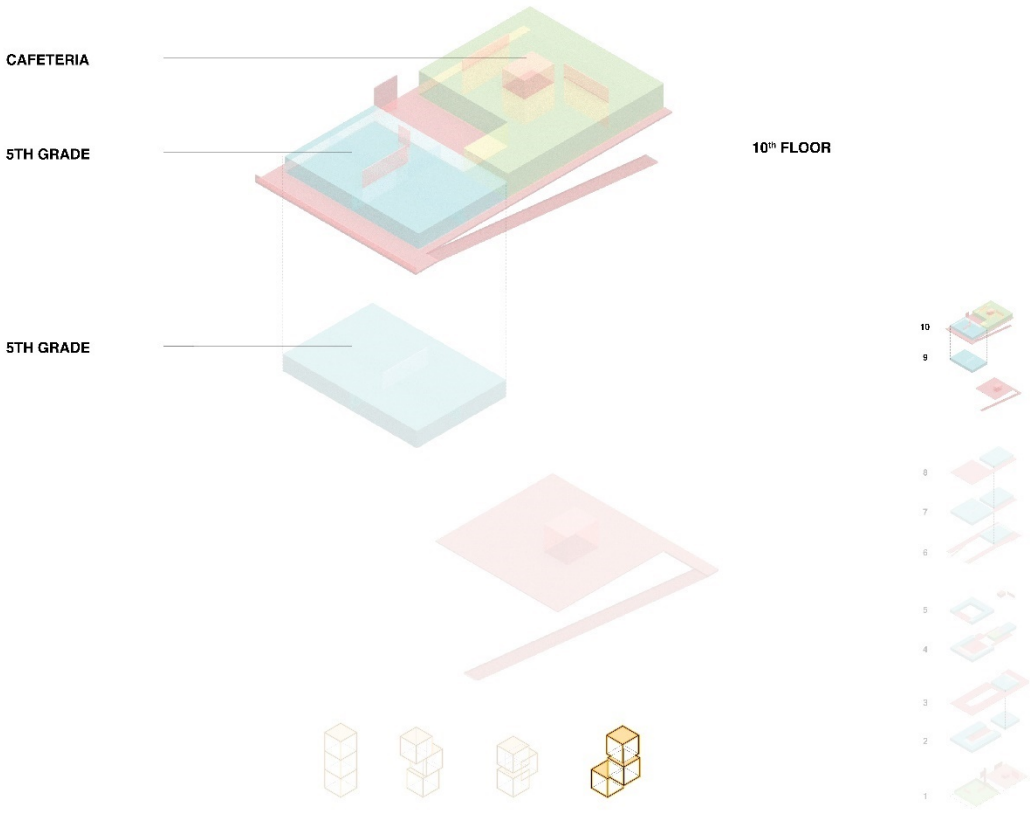


Figure 7-45 Tenth Floor Volumetric Organization
Source: Author

The tenth floor comprises of the second cluster of fifth graders and the cafeteria. The classroom is directly adjacent to the kitchen, where meals will be prepared. This collaborative way of learning is especially beneficial to kids at this age because they are about to enter intermediate school, and this provides them with the ability to interact with adults and employees of the cafeteria. The primary duties of this class inform the way the space is laid out and facilitate the necessary spatial qualities to take the students outside of the classroom. Having a collective area such as the cafeteria at the uppermost floor signifies the importance of communal space, and allows for maximum natural daylighting and views during lunch hours.

10TH FLOOR

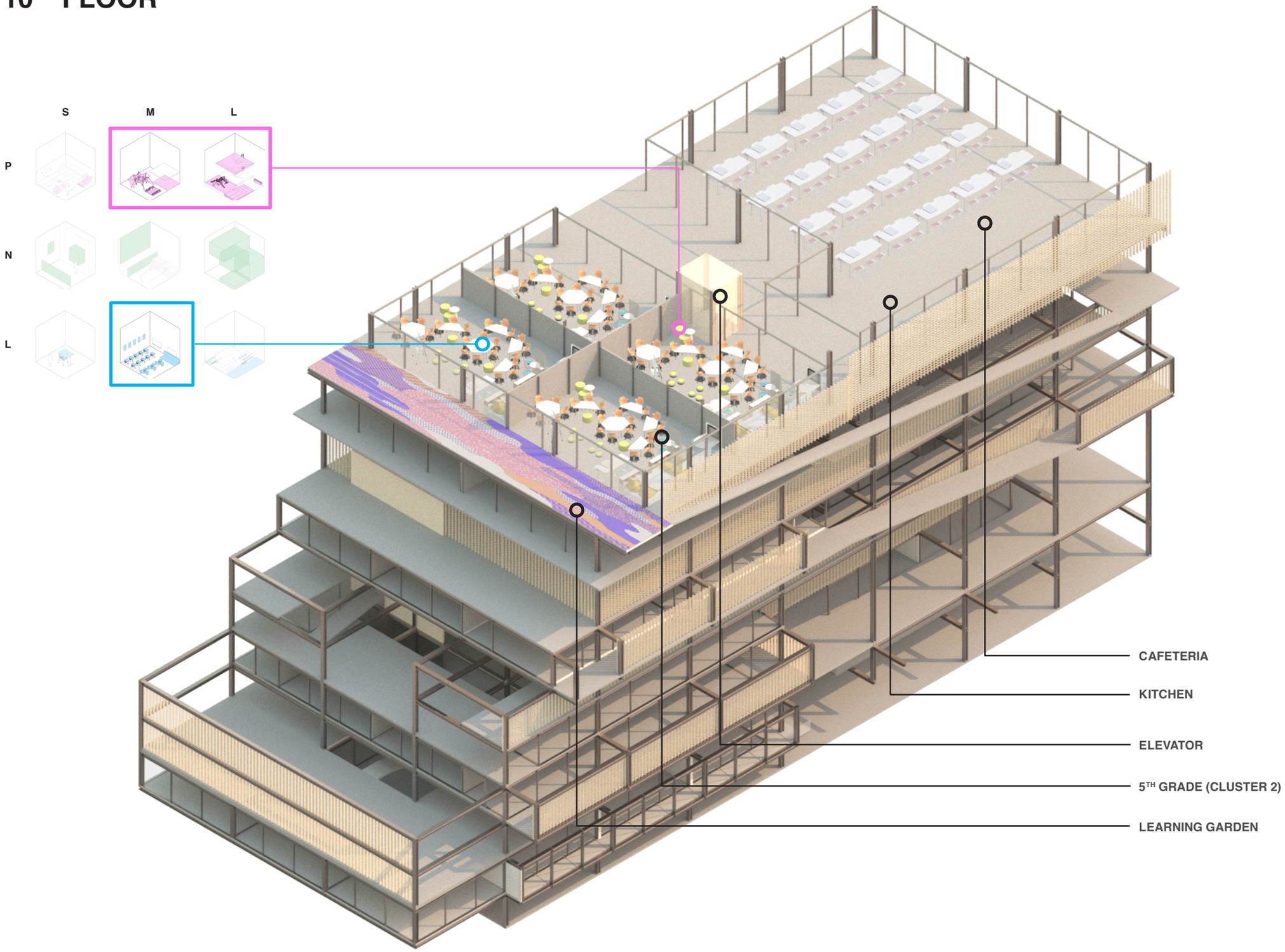


Figure 7-46 Tenth Floor Layout
Source: Author

11th Floor

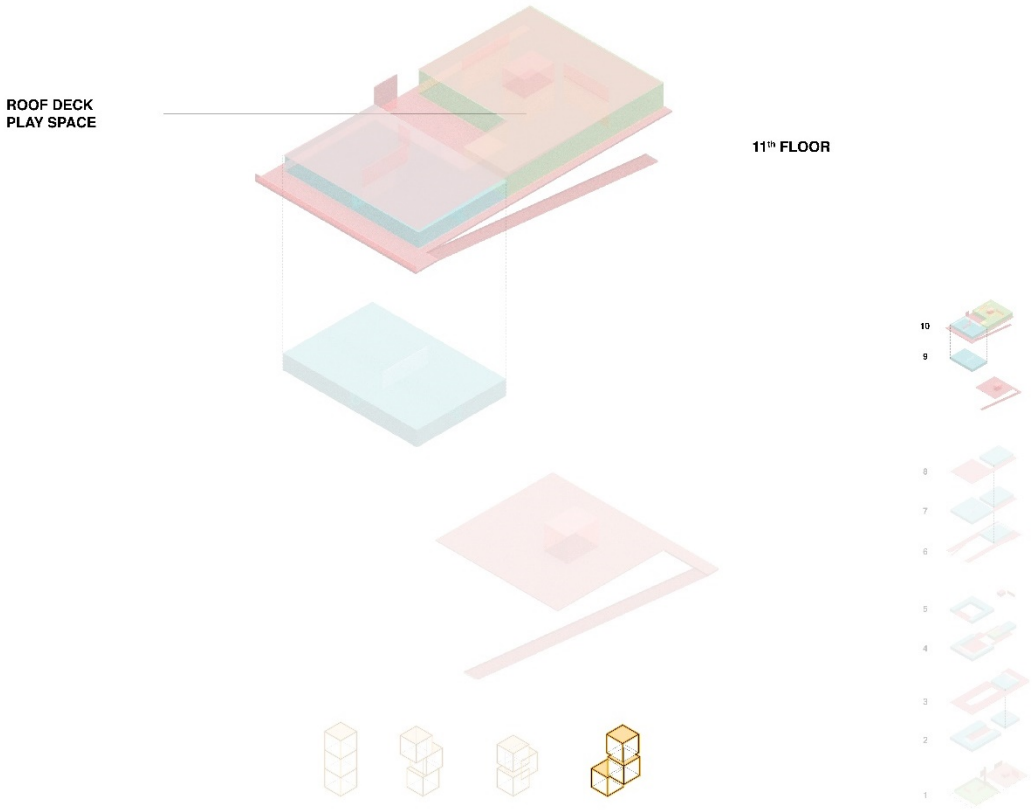
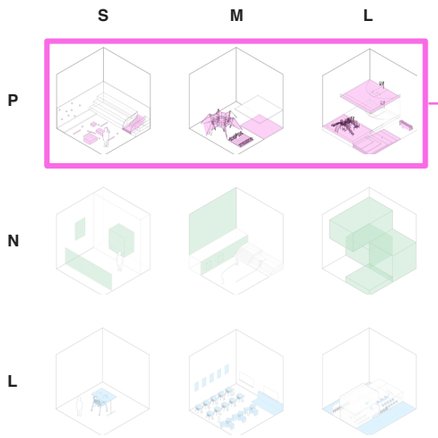


Figure 7-47 Eleventh Floor Volumetric Organization
Source: Author

The top floor/ observatory desk provides the students with the ability to overlook the neighborhood of Kaka'ako and familiarize themselves with the different landmarks around the area. The play space is open to students of all grades, and is the main play area for lunch recess. Being able to have a completely open space allows the children to be healthy, and play freely in an increasingly dense urban neighborhood. Being on the top floor allows the students to have a view from the mountain to the ocean. This can also be used as a tool to educate students on the urban setting of Kaka'ako.

11TH FLOOR



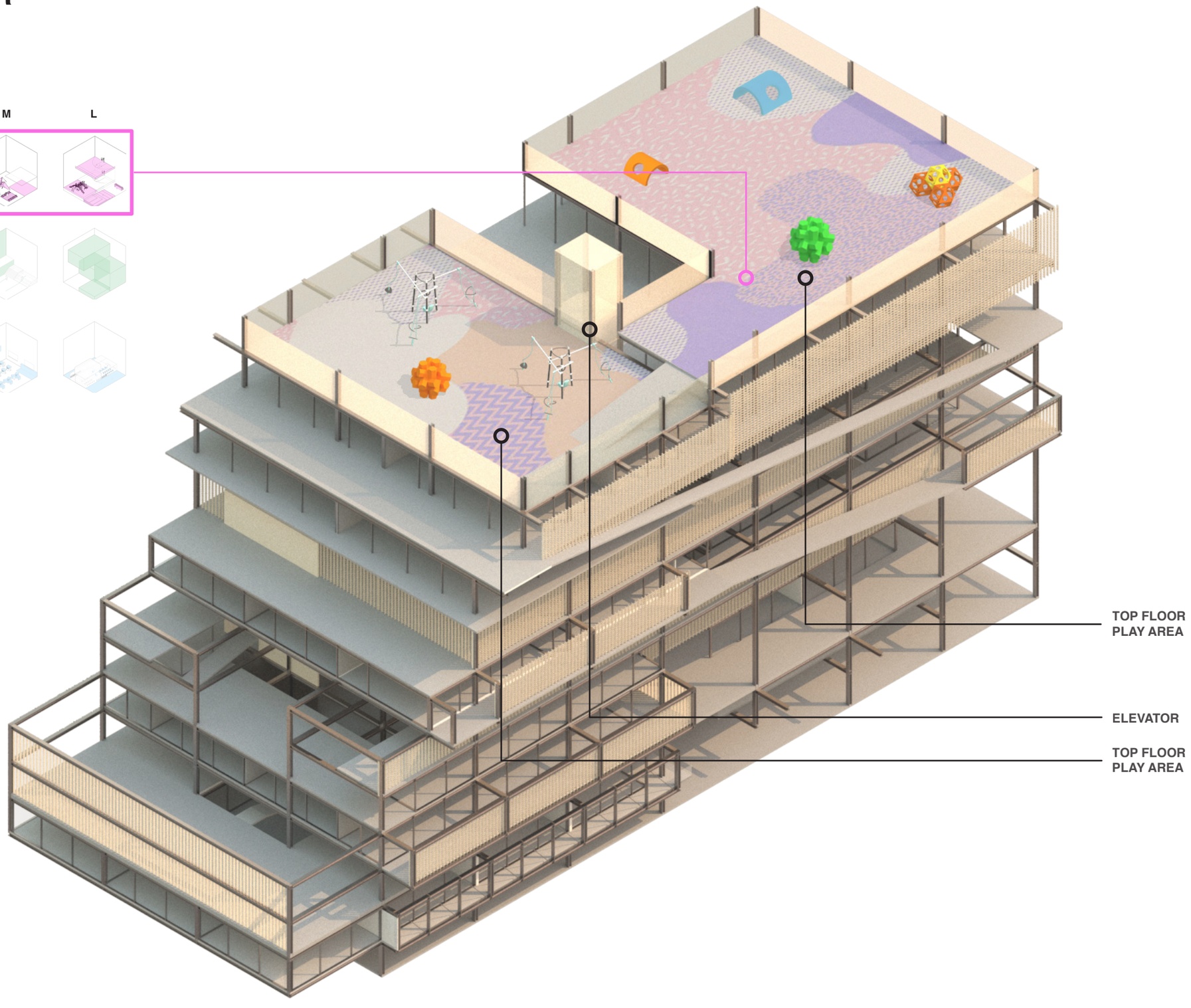


Figure 7-48 Eleventh Floor Layout
Source: Author

Conclusion

Aligning the design framework with a child-centered approach is vital when designing elementary school facilities. Younger children may not have the ability to articulate what works and what doesn't, so it is the designer's responsibility to be attuned to the child's needs and design spaces relative to the individual.

By incorporating play as a major element in the conceptual design of this vertical school, it provides students with a fun and engaging learning environment. Creating a setting that children love will create a stronger bond between students, and essentially tie the school together. Each floor of this design is based on the age group and grade on that level and centers around the child's experiences with other individuals. A nurturing environment ties back to the child's emotional and social wellbeing and should be included in every school design. The learning environments or classrooms within the school should be highly functional and adapt to the lesson of the teacher. The final conceptual design translates ideas presented by great minds such as Dewey, Piaget, and Montessori into architecture.

Another aspect that is crucial during the design process is interdisciplinary collaboration. Educators, designers, architects, and students should work together to determine what works for the students and how those ideas will come into fruition.

It is necessary that steps such as a conceptual design be taken in school design, to test a hypothesis and yield results, whether negative or positive. Research and analysis will only take the designer so far, and by synthesizing an idea into a design it will add to the designers' vocabulary. This dissertation hopes to serve as a study to benefit future designers of vertical schools and school facilities in Hawai‘i. It also hopes to serve as a springboard for designers to use in actual designs, and create schools centered around the ideas of Play, Nurture, and Learn.

Figure 7-49 Coral Street Frontage
Source: Author

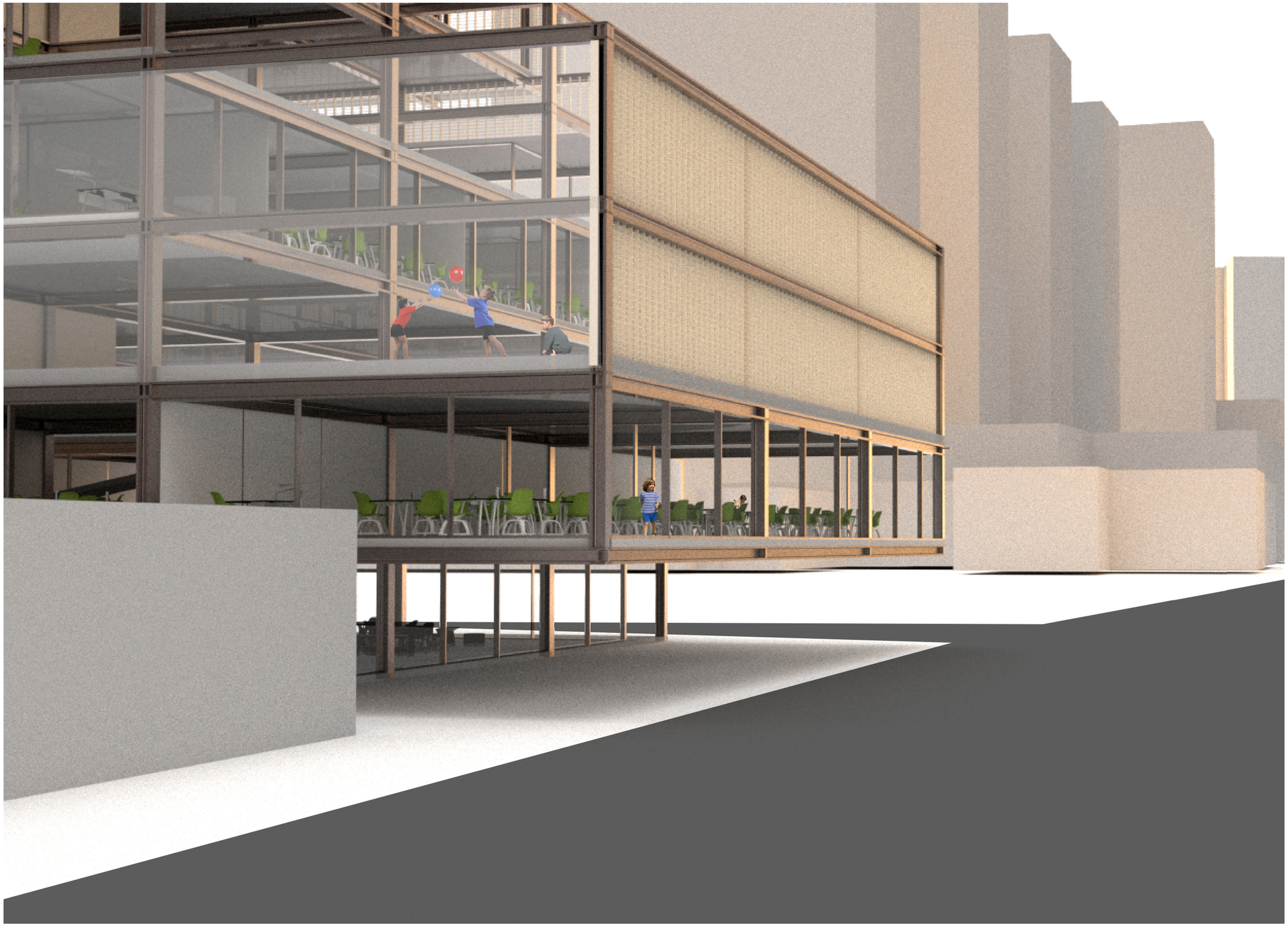


Figure 7-50 View from Pohukaina Street
Source: Author

Figure 7-51 Interior Atrium showing activities
Source: Author

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