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Epistemology: It’s Elementary! An Architectonically Constructivist Elementary School in Syracuse, NY-- Part 1

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Epistemology: It’s Elementary!

An Architectonically Constructivist Elementary School in Syracuse, NY

play + observe + understand + experiment

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“Give the pupils something to do, not something to learn; and the doing is of such a nature as to demand thinking; learning naturally results.”

John Dewey
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Abstract

The Constructivist framework is an epistemology which posits that "knowledge is a compilation of human-made constructions"¹ not the "neutral discovery of an objective truth."² As a fairly broad concept that theorizes how knowledge is acquired, constructivism illustrates our conception of what knowledge is. This paradigm objectifies knowledge by positioning it within the experience of the learner, rather than through the classical framework of infallible truth. Hence, the individual learner is responsible for actively building their own knowledge base through a continuity of experience and experimentation, rather than receiving this knowledge through some external compulsion.

Constructivism, as theorized by educational philosophers like Dewey, Piaget, Lewin, and Kolb, is the experiential process through which one acquires knowledge. This theory is applicable in any situation, and its application is certainly not limited to designated *learning environments*. Thus, any environment can be a *learning environment*, provided some form of experience which the learner can cognitively reflect upon takes place within that environment. The multiplicity of environments within which constructivism naturally occurs is indeed infinite. This is one of the more salient aspects of our research of constructivism, that its applications are nonspecific to program and context.

However, our contention seeks to expound on constructivism as an architectural construct. Thus, constructivist methodology can have physical applications, through which an environment takes specific advantage of incorporating *teachable moments* into its realm of influence. These moments vary in topic, scale, and type of learning experience; although, specifically these moments could be described in three terms: moments that highlight observable *natural phenomena*, designed *instruments* which control interior and exterior articulation of space, and instances which foster *freedom of association*. These architectural mechanisms will be intrinsically expressive (materially and operationally) and directly observable in terms of how they work, as well as the mode of effect they have on a given environment.

*Architecturalized* constructivism can be explored in the context of a learning environment, particularly for the elementary school age range of 5 to 10 (K-5). Not only are these years some of the most formative in one’s life, but this age range would likely benefit most from these simple and didactic design moments as a foundation for understanding more complex ideas. While the most obvious application is in a classroom, we also entertain the vast array of possibilities this design proposal could have on the interstitial school spaces that are not typically referred to as *learning environments*. Through these constructivist learning environments, we envision space which emboldens children to actively participate in changing the space they learn and socialize in. Our effort can only become fully realized when the school itself is an exploratory learning tool, a vehicle of learning experience, and an adaptable learning space suited to the needs of the learner.
Glossary of Selected Terms

**Architectonics**
The science or study of architecture and its physical form.

**Constructivism**
A theory epistemology which holds that knowledge is continuously constructed by each individual as a product of his or her experiences.

**Didactic Materials**
Objects designed to teach a particular concept.

**Epistemology**
The study of how knowledge is formed.

**Experiential Learning**
The process of learning from direct experience, usually including reflection and analysis.

**Learning Environment**
All aspects which facilitate learning, namely: students, teachers, tools, monitors, curricula, and space.

**Nature**
The collective phenomena of the physical world; features of the earth which are not of human creation.

**Places of Learning**
All places designed to facilitate learning, including but not limited to: schools, libraries, and museums.

**Proprioception**
Relating to one’s discerning of movement and orientation relative to his or her surroundings and self.

**Senses**
Relating to the human interpretations of feel, appearance, taste, smell, and sound.

**Teachable Moment**
A situation, planned or spontaneous, utilized to illustrate a principle through example.

**Traditional**
Refers to lecture form instruction where students are taught by reading, listening, and taking notes.

**Worldview**
An individual’s personal philosophy and understanding of his or herself and the world around them.
Philosophy

The fundamental concept behind the *Places of Learning* thesis research studio is that the ability for children to learn may be enhanced by reconsidering the architectural aspects of a learning environment. One approach to this concept is to propose a marriage between the architectonics of a learning environment and the constructivist theory of education. This approach recognizes the potential to improve the experience of inhabiting the built environment by allowing learners to interact more directly and literally with the architecture. The anticipated result of this philosophy is an interactive work of architecture, able to be continuously transformed by the inhabitants to reconfigure the properties of both internal and external spaces, as well as the relationships between them. Applied to the design of an elementary school, the ability to reinterpret and change elements of the architecture will benefit children's cognitive and social development by enhancing their ability to organize and construct knowledge through experience.

The constructivist theory of education is applicable to both curricula and architecture. Designing a school within a constructivist framework will generate an interactive learning environment. The design of a constructivist school enables children to continuously transform their spaces by interacting with a composition of interpretable and operable components. By allowing children to reinterpret the built environment in a multiplicity of ways, the construction of knowledge can be facilitated through experience.

Learning Environment

In order to reconsider the architectural elements of a learning environment, it is necessary to understand the concept as a simultaneously conceptual and physical condition. Although it is difficult to concisely define, a learning environment may be understood as an educational theory and practice which collectively refers to everything that facilitates a given individual's or group's learning process. This phrase is interpreted differently by different professionals: educators understand it to be synonymous with curriculum, technicians understand it to refer to knowledge delivery and/or management systems, philosophers understand it to refer to the metaphysical aspects of the learning process, and theorists understand it to refer to the conceptual space of learning and the didactic materials within. Architecturally, a learning environment is understood as the physical space of learning, consisting of architecture, furniture, and the realm between. From the shared perspective of a theorist and an architect, a learning environment is the system of learning which consists of several components, namely: students, teachers, tools, monitors, curricula, and space. The spatial component of the learning environment not only provides a physical setting for a school as an institution, but more importantly it facilitates the experience of events and activities of a school as a construct of social and cognitive development.

Constructivist Theory in Education

The constructivist theory in education advocates for the self-creation of knowledge, holding that individuals learn through experience. From this position, students are defined as unique learners, among other learners of different strengths and weaknesses and alternative worldviews. The teacher serves as a facilitator of learning, promoting the learner's construction of knowledge. The tools are all the extensions of the
learner’s search, creation, and expression of knowledge. The monitor serves as the means for the learner to demonstrate his or her acquisition of knowledge to the teacher, other learners, and themselves. The monitor illustrates personal success as well as the ability of a given learning environment to achieve its pedagogical goals. Conventionally, the monitor consists of some form of standardized testing in order to compare students and schools. (A formal monitor may not be present below the third grade).

In a traditional framework, the components of curriculum and space both serve to define a school structurally. The curriculum organizes the other components, as well as the pedagogical goals of the learning environment; this constitutes the conceptual structure of a ‘school’. The spatial component serves to physically facilitate the other components, which comprises the material structure of a ‘school’ as a building. There is a lost opportunity in this traditional model of an elementary school for direct interaction with the architecture.

Traditional Learning Environment

In order to assess this lost opportunity, it is necessary to understand the history and characteristics of the traditional elementary learning environment. The field of education in the United States is generally resistant to change; new theories and methods are hesitantly considered, and seldom altered or rejected once established. This is demonstrated by the fact that popular forms of alternative elementary education in the United States, such as the Montessori Method and the Reggio Emilia approach, were generated elsewhere. In terms of architecture, perhaps the most prolific example of this rigidity is the archetype of the traditional classroom. This is especially true of public elementary education in the Northeastern United States. The form of the classroom has essentially been handed down since the 1700s and exists with only modest development three hundred years later in the vast majority of modern public schools.

Traditional elementary classrooms, not unlike many high school and college classrooms, tend to be simple and static. They typically consist of a rough carpet or linoleum floor, four hard walls, a dropped ceiling, and florescent lighting. These rooms contain rigid rows of student desks facing a blackboard and teacher’s desk. Such spaces do not allow for interaction between the learner and the classroom. This rejects the learner’s intrinsic desire to explore the space in which they live and learn, and fails to constitute a learning environment that encourages or satisfies that desire. Many educational theorists address this aspect of the shortcomings of traditional school systems. In his work, Experiential Learning: Experience as the Source of Learning and Development, David Kolb states:

“It is the notion of constant, fixed elements of thought that has had such a profound effect on prevailing approaches to learning and education, resulting in a tendency to define learning in terms of its outcomes, whether these be knowledge in an accumulated storehouse of facts or habits representing behavioral responses to specific stimulus conditions. If ideas are seen to be fixed and immutable, then it seems possible to measure how much someone has learned by the amount of these fixed ideas the person has accumulated.”
Alternative Learning Environment

A new form of learning environment which directly parallels the principles of constructivism will allow individuals to teach themselves through all components of the learning environment. This philosophy is particularly beneficial for elementary education because it allows the learner to more readily and independently discover, apply, and benefit from personal strategies. This diverges from the belief that elementary school is the phase of education wherein one learns how to learn, as opposed to secondary education wherein the focus shifts to the ability to retain and apply knowledge. Although highly related through the features of active learning and an abundance of didactic materials, the pure constructivist school differs from the Montessori Method and the Reggio Emilia approach.

The practice of the Montessori Method is based on a comprehensive collection of didactic materials which form a ‘prepared environment’, providing the individual with experiences from which to learn. While conceptually identical, the Montessori Method differs from the constructivist school in the specificity of the didactic materials provided. Such materials are each designed to be used for a singular purpose and demonstrated by a teacher prior to handling by the learner. This process illustrates isolated concepts within a predetermined structure, not unlike the scientific method. This rigidity inhibits the pure self-creation and association of knowledge in that information is given and reinforced by the teacher rather than discovered by the learner. In this way, the Montessori Method potentially limits creativity and expression. In her work, Education for a New World, Maria Montessori speaks to the prepared environment:

"Scientific observation has established that education is not what the teacher gives; education is a natural process spontaneously carried out by the human individual, and is acquired not by listening to words but by the experiences upon the environment. The task of the teacher becomes that of preparing a series of motives of cultural activity, spread over a specially prepared environment, and then refraining from intrusive interference."

Alternatively, The Reggio Emilia approach promotes creativity and individual expression as a core tenet of its philosophy. The concept that children possess ‘one hundred languages,’ refers to the endless opportunities and means of the learners’ self-expression and self-creation of knowledge. This demonstrates the act of doing as learning, inspired by Dewey. The practice of the Reggio Emilia approach is primarily concerned with active learning and a collection of didactic materials which are constantly reinterpreted by the learners and teachers as a community. Throughout the process of active learning, the learner freely interacts with the teacher, other students, and the tools of his or her learning environment to develop experiences from which to learn. In his work A Bill of Three Rights, Loris Malaguzzi describes the rights and relationships of children necessary to succeed:

"Children have the right to be recognized as the bearers of important rights: individual, social and legal. They both carry and construct their own culture and are therefore active participants in the organization of their own identity, their autonomy and their capabilities. The construction of this organization takes place through relationships and interactions with peers, adults, ideas and objects, as well as both real and imaginary events of a communicative world."
The Reggio Emilia approach also offers the concept of the ‘third teacher,’ which refers to the child’s ability to learn not only from teachers and his or herself, but from the environment. Unlike the prepared environment of the Montessori Method, this concept may extend past shelves of didactic materials to include architectural space as a facilitator of learning. As opposed to utilizing existing aspects of a given space, the constructivist school will consider the concept of the ‘third teacher’ to its fullest potential from the inception of its design.

Constructivist Learning Environment

The constructivist school will advance the role of architectural space to serve not only as a place in which to learn, but as a tool from which to learn. The architectural manifestation of this strategy will define and facilitate the requirements and relationships of the learning environment so as to incite constructivist learning in every regard. A learner’s ability to transform and adapt his or her own environment not only fulfills his or her inclination towards exploration, but it also generates a feedback loop by which the learner constructs knowledge from genuine experience. In his work, *Experience and Education*, John Dewey, the most progressive constructivist of his day, illustrates the need for experiential learning:

“A purpose differs from an original impulse and desire through its translation into a plan and method of action based upon foresight of the consequences of action under given observed conditions in a certain way. … The crucial education problem is that of procuring the postponement of immediate action upon desire until observation and judgment have intervened. … More foresight, even if it takes the form of accurate prediction, is not, of course, enough. The intellectual anticipation, the idea of consequences, must blend with desire and impulse to acquire moving force. It then gives direction to what otherwise is blind, while desire gives ideas impetus and momentum.”

Designed cause and effect interactions with architecture, furniture, and the realm between, will produce teachable moments that may be used to demonstrate given principles and allow the learner to freely discover phenomena and create fantasy. At the scale of the overall structure and spatial framework, clarity in the relationships and forms of architectural components will produce a heightened ability for the child to learn from the assembly and mechanics of building systems, which is often lost as an opportunity for learning. At the scale of furnishings, interpretable instances and relationships will produce an environment which anticipates and facilitates the observation, interpretation, and modification of the environment. This enhances and celebrates variety in work strategies, learning style discovery and development, and individual and collective dynamics. Lastly, integrated throughout the architecture at the component scale will be apparatuses for altering: the amount, position, pattern, and color of light, the framing, opacity, and filtering of view, and the sizes, proportions, and configurations of interior and exterior space, among many other possibilities.
History of Education in the U.S.

In the 1600s, education in America began with the adaptation of the English method by the colonists, and instruction was issued by elder family members, religious leaders and trade masters. By actively participating on a daily basis in one’s own household, community church, or in a specific trade, people learned to be successful contributors to their society. Schools did exist at this time but were few in number and unlike the array of topics taught by schools today, early schools focused on socialization, ‘the means by which social and cultural continuity are attained.’17 Such education was specifically administered to prepare a select few men for lives in ministry, law, business, or government. The 1700s featured the establishment of the common school system, recognized today for the one-room schoolhouse. These schools are defined by a relationship of one teacher to a class in a single room building with a general curriculum focused on the three “R”s (reading, writing, and arithmetic). Schools were often established as business ventures and were usually in session for only a third of the year or less, based on harvest times and weather. Although publically maintained at the town level, they were exclusive in that they usually required tuition and were dominantly of male attendance. By the mid 1750s in the Northeast, around three quarters of males and three fifths of females were literate, using the bible as their main tool.18

The 1820s marked the establishment of first public high schools and defined requirements for the training of teachers. By the mid 1800s, primary schools were maintained at the state level and, in most all cases, constituted one’s primary source of education19 as they do today. By 1870, elementary schools were publically accessible without tuition and common in all states in urban centers.20 Prior to the early 1900s, education for the vast majority of Americans culminated with the contemporary equivalent of the 7th or 8th Grade. This is due to the rural nature of the country preceding the citification effected by the industrial revolution and the WWI baby boom. 1918 marked both America’s ceasefire with Germany and the enactment of the compulsory laws which require the completion of elementary school or the equivalent.21 By 1900, public secondary education surpassed that of private secondary education22 and states began to require that children attend some form of school until at least 14 years of age.23 By this time, the format of the one room schoolhouse had been aggregated such that newer schools consisted of halls of multiple classrooms with the same rows of desks facing the teacher’s desk and board.

Education through the 1900s bore witness to inequality for women, African Americans, veterans, and persons with mental and physical disabilities, as well as the numerous acts attempting to rectify such issues. Through the Progressive Era (1890 - 1930), the fields of developmental and epistemological theory and philosophy flourished with the emergence of many alternative teaching forms and great educational thinkers and reformers such as: John Dewey with his work on education reform, Jean Piaget with the study of cognitive constructivism, Kurt Lewin with his findings on group dynamics, Loris Malaguzzi with the development of the Reggio Emilia approach, and Maria Montessori with the Montessori Method and prepared environment.

Also of note during the Progressive Era is the Gary Plan, so named for its development in Gary, Indiana by educator William Wirt. Wirt focused on vocational training, calisthenics, character building, self-reliance, and efficient use of time and infrastructure. The Gary Plan involved two halves of a student body
rotating between classroom instruction and vocational, natural, and athletic studies. Wirt advocated for the ‘total development’ of children which he believed requires instilling rural values threatened by urbanization. The Gary Plan ultimately failed not because it was unsuccessful but because it proved to be unprofitable for schools. Historian Ronald Cohen refers to Wirt’s efforts through the Gary Plan schools in his work The Paradox of Progressive Education: The Gary Plan and Urban Schooling: “…they were free, exciting, creative environments, assisting and enriching the lives of rich and poor, black and white, native and immigrant children. For many, they surely promoted opportunity.”

In 1983, reform escalated following the publication of ‘A Nation at Risk’ by the National Commission on Excellence in Education: an analysis of academic performance in relation to funds spent per student, showing unfavorable results. This report prompted conservatives to advocate for more and longer school days and higher testing standards. This led to the Accountability movement of the 1990s wherein states were held to mandatory minimums on standardized tests. Underperforming and failing students were faced with a top-down, 19th century approach to a 20th century issue, as educators were obligated to further specify requirements, enhance productivity, capitalize on investment, increase quality control, and maximize efficiency. In 2002, the No Child Left Behind Act administered federal funding essentially in exchange for measured progress toward established goals in mathematics and language arts in the form of standardized testing. Such goals, however, proved unrealistic and were set lower and unattained. Currently most states have been waived from, or otherwise withdrawn from the act and have adopted the Common Core State Standards which is currently receiving similar criticism.

The recent lack of development in the architecture of education is understandable due to the number of considerations and parties involved. Theoreticians and philosophers of development, epistemology, and intelligence, educators and administrators, architects and designers, students and their guardians, state and federal government agencies, and the general public all affect the architecture of education. Also, apart from the difficulty of collaboration from such large and varied parties, experimentation in the field of education has a direct result on the success of young individuals. It is impossible to humanely justify the potential that negative effects could have on the child’s education, which necessitates that change consist of a slow progression of small alterations to accepted theories and methods. Constructivism is therefore essential to enacting change because it provides learners with the facility to make their own discoveries and decisions about the learning process to their own benefit and self-education.

The traditional classroom form was developed and intended for ‘formal authority’ type instruction wherein learning consists of following along with the teacher’s instructions to pass examination. Although this format inhibits the self-creation of knowledge, it exists with such consistency because it generally works for the average student given the values of our society: do well in elementary school in order to prepare for high school, do well in high school in order to prepare for college, do well in college in order to prepare for a career, do well in your career to lead a successful life. It also produces higher average test scores, which allows schools under the No Child Left Behind Act and Common Core Standards to be eligible to receive more funding.
The values of this system, and the standards of examination which allow one to progress through it, focus on intelligence, or select aspects thereof. Although there are empirically proven methods for teaching that are successful for the majority of students, it is critical to consider that intelligence is relative, multivalent, and not easily quantified. The ability to succeed in life is more accurately defined not by this or any system, but by an individual’s ability to provide a service of worth to his or her society, as proposed by Howard Gardner. Gardner demonstrates that individuals possess and excel in different mental abilities from one another, and from different forms of learning. By embracing such differences in a way which assists all students without harming students who learn best by traditional methods, a new and more successful form of learning environment may be generated.

Figure 1: A well equipped 1700s rural one-room school house with typical shed construction and few windows.

The furniture and layout of early American schools descended from the church. The original purpose of such schools was to teach literacy in order to recall and understand the scriptures.

Figure 2: A contemporary classroom in Syracuse, NY.

Not much has changed about elementary level education in America in the last three hundred years; classrooms tend to have more windows and better proportioned furniture, but are still largely square and organized in rows for efficiency.

Figure 3: Graphic of current variations of American Education by grade and age

Adapted from the Institute of Education Sciences, U.S. Department of Education
Schools in Syracuse specifically are known for their poor performance: nine out of ten of the elementary schools of the Syracuse City School District were ranked in the bottom 10th percentile in language arts and mathematics in New York (2012-2013). The SCSD (Syracuse City School District) has developed the “Great Expectations” strategic plan for improving its schools. The mission of the plan is: “To build, support, and sustain school communities that provide all students with a high-quality education that prepares them to graduate as responsible, active citizens ready for success in college and careers and prepared to compete in a global economy.” The Plan points out that Syracuse schools were geared towards preparing people for a manufacturing economy, and there has since been a shift in economy in the last twenty years towards health science and education, which require higher education.

The plan also cites statistics to show that the Syracuse city school population is 72% colored, 84% low income, and speaks over seventy languages. Attributing to this diversity is a total of more than six thousand immigrants and refugees. The Plan also discusses the issues of the current school system citing that over 70% of 3rd - 8th graders are performing below the New York State proficiency standards (2011). The plan appears unfortunately similar to No Child Left Behind Act, with goals like creating “An educational community that graduates every student as a responsible, active citizen prepared for success in college, careers, and the global economy.” The plan contains other vague and seemingly over-ambitious and hopeful language, such as: “If Syracuse is to thrive, we need to prepare all our students for success in a 21st Century economy and for a life of active citizenship.” The plan does however call for advocating and providing for tutoring, AP and SAT prep, and mentoring services, as well as incentivizing students who excel in high school with free college through the Say Yes to Education Foundation.

Performance Assessment Test Scores by NY State, SYR District, and School (Dr. Weeks)
Epistemologies & Manifestations
John Dewey
(1859 - 1952)
Philosopher | Psychologist | Educational reformer | Constructivist

John Dewey was one of America’s foremost philosophers in the 20th century and a founder of the philosophical movement known as pragmatism. Dewey was also a major contributor in the fields of functional psychology and a preeminent leader of the progressive movement in education in the U.S. Dewey’s contributions to educational practice are as relevant today as they were a century ago when he was advancing them.

It is key to understand John Dewey’s philosophy of learning as a natural process, not a confined one. To illustrate this, consider the dichotomy of learning as a result of special schooling, social class, leisure, wealth, or divine inspiration, versus learning as a psychological need embedded in the biology of a person. Dewey staunchly defends the latter. As such, people are always in motion, persisting and initiating thought as a forward thinking process. This natural process is what Dewey refers to as constructions and criticisms, describing the way that we summon information from past experience and use it in a thorough study of the present, reflecting upon and testing both. Dewey’s learners, it follows, are never passive, disinterested, unengaged, idle collectors of sensations. Rather, they are constantly grappling with “tradition and practice, emotion and reason, doing and thinking.”

Inasmuch as education is a means to an end, Dewey emphasizes the learning process above all else. Dewey believed that knowledge is not a set of own-able attributes, but instead an emotionally charged process by which the learner shapes new continuities and interactions with the curriculum. In Experience and Education Dewey writes:

“The two principles of continuity and interaction are not separate from each other. They intercept and unite. They are, so to speak, the longitudinal and lateral aspects of experience. Different situations succeed one another. But because of the principle of continuity something is carried over from the earlier to the later ones...What he has learned in the way of knowledge and skill in one situation becomes an instrument of understanding and dealing effectively with the situations which follow.”

In Democracy and Education, Dewey writes that teachers cannot hand ideas to students as if they were bricks. In John Dewey and the Challenge of Classroom Practice, Fishman writes that we are tempted to isolate ideas because they are able to be decontextualized, like bricks. Fishman extends Dewey’s analogy by stating that we should strive to help the learner understand the brick as part of a larger system. The learner must see the brick as part of the building they clad, connected in a purposeful and didactic way to other building components like timber and steel. He also writes that we must have purpose and personal investment in the brick, the need to use it. Only then can we appreciate the brick as a needed unit to realize the larger desire of having a building. The extended analogy works for Dewey’s educational philosophy as it relates to learning, and its relationship to use, manipulation, need, and discovery.
Our contention is distilled by one of Dewey’s primary beliefs, which he spoke and wrote about for most of his life. He delineates his thoughts most clearly in *Experience and Education*, where he distinguishes his pedagogy of education from what he calls “traditional” education. For the latter, Dewey argues that problems are applied from the outside, rather than the problems arising from conditions found in present experience. In dealing with these intrinsic problems, Dewey writes: “New facts and new ideas thus obtained become the ground for further experiences in which new problems are presented. The process is a continuous spiral.”[^42] Our proposal seeks to dovetail the same logic of an experiential *continuities and interaction* curriculum with the physical architecture of the school, for an enriched learning experience.

![Continuities and Interaction](image1)

**Figure 10**: Dewey’s Continuity and Interaction curve.

![Decontextualized Ideas](image2)

**Figure 11**: Decontextualized, abstract concepts versus contextualized building blocks, epitomizing Dewey’s philosophy of helping the child organize constructed thoughts of scaffolded information.
In his writings about education theory, John Dewey architecturalized some of his ideas related to school program, program relationships, and other keys physical aspects of the ideal constructivist built environment. During his fruitful time at the University of Chicago, Dewey and his colleagues were formulating a philosophy of education extrapolating an instrumentalist view of pragmatism. In conjunction with this functionalist theory, Dewey was developing an approach for an educational setting that was consistent with his own ideas on learning.\textsuperscript{43}

The Laboratory School was an idea developed by Dewey to pursue investigations on his conceptual-theoretical work, which by nature emphasized an interplay with real-world environments and a removal from the less concrete world of theory. The ultimate goal of the school was to create a clear dialogue between life in school and the outside world. The Laboratory School would be a place of workshops, gardens, textile shops, kitchens, laboratories, and art and drama facilities. Through these programs, the school would deliver an authentic educational experience to the child, materializing Dewey’s strong constructivist ideals for a learning environment.\textsuperscript{44}

Dewey makes a couple of relevant points and distinctions of use to us in the chapter “Waste in Education” in his book \textit{The School and Society}. Paramount in this idea of waste is isolation, epitomized in his statement that “All waste is due to isolation.”\textsuperscript{45} Dewey characterizes this isolation physically and intellectually, positing that if the child cannot use experience from outside of school in a school environment, or use what they have learned in the school environment outside of school, then their education has been a waste. On the contrary: “When the child lives in a varied but concrete and active relationship to this common world, his studies are naturally unified.”\textsuperscript{46}

Therein lies a critical notion of how the built environment of a school and the constructivist ideal can be manifested in school curriculum and design. Building elements, at varying scales and degrees of use, can become critically integrated into wall partitions, shading devices, and movable furniture. All of these can be necessarily engaged by the learner as part of an active learning experience. This experience is not only built upon previous knowledge of a particular building element, object, or idea, but necessitates the continued process of learning through active input. These design elements are particular to learning more about the world at large, so the child has experiences that are undertaken in the school environment, but apply in the broader context of a home or larger community. Taken literally, design elements can didactically engage a learner by inciting social situations through the configuration of shared elements like water fountains, desks, and courtyards. All of these concepts strip away the notion of isolation, both intellectually and physically.

Dewey provides us with a general programmatic scheme of a school plan which lends to this constructivist attitude. These diagrams (next page) illustrate both internal and external relationships. It would be an injustice to describe these in any other way than in Dewey’s own words: “It is not our architect’s plan for the school building that we hope to have; but it is a diagrammatic representation of the idea which we want embodied in the school building.”\textsuperscript{47}

Key to understanding the arrangement of program is to understand the relationships Dewey was interested in. In particular, Dewey saw the center of the organization scheme as the library, or the manner in which
all the program come together. On the two lower corners are the dining room and kitchen, and above those are the shop and textile industries. The library in the center represents the collection of intellectual resources of every kind, and the corners are practical activity. The interior is theory, and the perimeter is practice. The library, therefore, is

"where the children bring the experiences, the problems, the questions, the particular facts which they have found, and discuss them so that new light from the experience of others, the accumulated wisdom of the world - symbolized in the library. Here is the organic relation of theory and practice, the child not simply doing things, but getting also the idea of what he does; getting from the start some intellectual conception that enters into his practice and enriches it; while every idea finds, directly or indirectly, some application in experience and has some effect upon life."

Dewey’s Learning Lab is applicable to how we’re thinking about the designed learning environment because it integrates two critical aspects of social and cognitive development: experimentation and reflection. The feedback loop between these two aspects embody constructivist thought, and relates back to this fundamental part of our contention, which anticipates an active learner that observes, modifies, and interprets their learning environment. The idea that peripheral but overlapping ‘practice’ space is situated next to the space for reflection is one that, like Dewey’s Learning Lab, can operate at the scale of the entire school, but can also be reduced to the scale of the classroom or furniture piece.

Figure 12: Kindergarten Transportation Project in one of Dewey’s Labratory Schools. The room in which the children are working operated as a kind of hands-on workshop for the learner to become fully engaged in.
Figure 13: Elementary Geography class in Dewey's Laboratory School.

Figure 14: Social gatherings on Lee Hall porch at Black Mountain College, one of Dewey’s Experimental Schools.
Figure 15: Dewey’s idealized dialogue between the school curriculum and community places. The diagram illustrates how lessons constructed in schools can engage with outside programs like businesses, home, and other community spaces.

Figure 16: The programmatic relationships between spaces of work and display. Dewey illustrates how research and art can converge in a collective, display-oriented space like a museum.

Figure 17: School program plan illustrating the overlapping of practical work space and theoretical reflection space, and the feedback loop between those and other community spaces.
Kurt Lewin
(1890 - 1947)
German - American Psychologist

Kurt Lewin is recognized today as a seminal theorist who laid the groundwork for much of our current understanding of group psychology, experiential learning, and action research. His research is useful to our contention because it reinforces many of Dewey’s ideas on constructive learning. Also, he posited a number of theories that describe how individuals in a group operate, and how those individuals contribute towards a common desired outcome. This addresses the social aspect of our contention; that a dynamic architecture can advance the social blossoming of the child during this most critical stage of his or her development.

In the summer of 1946, Lewin and a number of his colleagues at the Research Center for Group Dynamics (a centre he established two years prior at MIT) implemented a two week program for the Connecticut State Interracial Commission. In this program, participants and staff worked together on various activities and treated each other as mutual peers. The motivation of the event was to study the activities and discussions of the participants, and trainers and researchers collected detailed observations and recordings of the group activities. Later, those organizing the event collaborated to share their data. These later meetings were initially designed to involve only the staff, however as time progressed, participants requested to be included in the discussions. Lewin, intrigued by the possibilities of including a subject in the staff’s discussion of participants’ group work, of course allowed three participants (all of whom requested to be involved in the later discussions) to meet with the staff.

As the meeting progressed, one participant in particular disagreed with one of the staff observers on their interpretation of her behavior earlier that day. Another participant agreed with the woman who spoke up, and a lively debate ensued about the staff’s interpretations of their behaviors during the group activities. Word spread quickly, and the following night more than half of the 60 total participants began attending the feedback sessions. Soon, these feedback sessions which were originally designed to be selectively inclusive to the trainers and researchers became the focus of the conference altogether. Lewin joined in with the researchers and participants in the active interpretation of the observed events of the day, a moment which has become a landmark event in what Lewin called ‘T’ (or training) groups. David Kolb later pointed out the significance of the event:

“Thus the discovery was made that learning is best facilitated in an environment where there is a dialectic tension and conflict between immediate, concrete experience and analytic detachment. By bringing together the immediate experiences of the trainees and the conceptual models of the staff in an open atmosphere where inputs from each perspective could challenge and stimulate the other, a learning environment occurred with remarkable vitality and creativity.”
Subsequent landmark events, now under the National Training Laboratory in Group Development, took Lewin’s T-group theory and applied it to the laboratory method. This method created task groups for participants, and selected a “change agent” who would facilitate feedback to group participants. This individual was the paragon, responsible for recognizing a need for change, diagnosing problems, planning for change, implementing plans, and evaluating results. In order to incite change in these task groups, it was realized that an understanding of group dynamics was needed. The innovation was Lewin’s identification of four key elements to the T-group: 53

1. Feedback - Lewin used this term, borrowed from the field of electrical engineering, to describe the realized adjustment of a process based on the result or effect of a given situation. Lewin observed that feedback was a key element because it reported here-and-now observations in the most accurate way possible, unskewed by perceptual distortions. As it relates to our contention, feedback can be most vividly created through a hands-on understanding of the topic at hand, rather than an abstract passing down of ideas.

2. Unfreezing - Refers to Lewin’s change theory, describing the dethroning of an existing system of belief. In the T-group setting, Lewin sought to create an environment that incited learners to challenge and re-examine their existing conceptions. Our contention posits that the built environment can act as a motivator to interest the child in becoming involved in a process that will indeed change their understanding of the space around them, as well as the physical processes and materials that compose them. This process of unfreezing must be an active learning experience.

3. Participant observation - Or simply, observation. In Lewin’s T-group, participants were expected to participate emotionally and observe their own behavior objectively. Most important here is the relationship between the concrete, emotionally charged experience and analytical detachment. In terms of an educational experience, observation of an event or process and well as the observation of oneself taking part in the event is critical in the active learning process.

4. Cognitive aids - In Lewin’s T-groups, brief lectures, handouts, film clips, readings, and theory sessions provided that the basic allegiance of participants was their interest in learning, not the consulting room. In our case, the cognitive aid analogy can be extended to describe the tool by which all of the former take place. Taken literally, these aids would be the physical manifestation of the school design, implemented at a variety of scales and instances and serving to augment the curriculum-directed learning process. 54

Also useful to the contention is Lewin’s Action Research theory. Shown below, the Action Research loop identifies four key issues for the learner. The first involves the identification of a problem, the issue requiring further investigation. This leads to the act of investigation, to learn more about the situation at hand. Next is the action stage, in which the work is performed. Finally and probably most critically is a reflection and evaluation stage. 55 Applied in a learning situation, action research is a practical way to assess one’s own work and self-reflect as a framework for constructivist learning. This is similar to Dewey’s constructivist framework, and is a key aspect in pinpointing how constructivist architecture can inform a process of active learning in the physical environment.
Lewin’s Action Research Theory

Figures 15-16: Kurt Lewin’s Action-Research Loop, describing a series of interactions that occur as part of the experiential learning process. This illustration below attempts to visually represent this feedback loop.
Jean Piaget
(1896 - 1980)
Swiss developmental psychologist | Philosopher | Biologist

Jean Piaget is known today for the framework he developed in the early and mid-twentieth century known as “cognitive constructivism”. He is often considered the “grandfather of constructivism”, and formulated the basis by which numerous subsequent studies based in developmental theory would expound upon. Discussion of his role is not only central to our continued discussion of constructivist theory and practice, but also to our design ideas for a school architecture rooted in constructivist ideals.

Piaget began his psychological studies in 1920 by developing tests to measure the child’s intelligence and find connections between their level of understanding and their age. In these tests, Piaget was interested in discovering how children learn. Such tests showed, as expected, that when younger children are confronted with the same questions or issues presented to older children, the younger children were more likely to answer incorrectly. These tests were designed to be too cognitively advanced for the younger children. Yet in allowing the younger children to explain the logic of their incorrect answers, Piaget realized that the children’s power of reasoning was not flawed at all. In the areas where the younger children lacked the knowledge to understand the task at hand, they used imagination to compensate. This is simply because the younger children did not have the life experience as a departure point for understanding the task. Piaget concluded that knowledge, or the accumulation of fact, cannot be equated with intelligence. The younger children were not dumb; in fact they were quite advanced in using (although incorrectly) imagination to fill in for the experience they have not yet had.56

Piaget’s work showed that children think in strikingly different ways than adults, and are not merely less competent thinkers. Children are born with a genetically inherited mental structure. Although basic, this mental structure is the foundation by which new and subsequent experiences shape new knowledge.57 Piaget developed his theory of cognitive constructivism using two avenues: the first component predicts what children can and cannot comprehend at different ages and stages of development, and the second describes the learning process by which children develop their cognitive abilities. The essence of Piaget’s theory can be most succinctly characterized such that humans can not and should not be given information that becomes of immediate use to them. Instead, knowledge is a constructed entity, becoming a genuine aspect of the learner’s experience. This means that true knowledge and understanding must be built up as a product of experience.58

These experiences, Piaget argues, allow learners to create schemas that symbolize and organize some aspect of what they are learning and experiencing. These schemas now have a personal, relatable connection to the learner’s experience. Consequently, the new synaptic connection is stronger because the artifact was generated in a personal, genuine way.59 In order to frame his discoveries, Piaget identified successive stages of development, which he referred to as “Schema.”60
One useful way to consider a Schema is to look at it as a stored pattern of behavior. For example, a schema about buying a meal in a restaurant includes looking at the menu, ordering, eating, paying the bill, and tipping. This is what Piaget would call a “script”. Whenever we find ourselves in a restaurant, we replay this script in our memory and use it to play out the current situation as a way to structure behavior in that situation. This example would be too complex for a child in the early stages of development, but the analogy applies because it demonstrates how, as the child matures, they develop a multiplicity of schemas that are more elaborate.61

While Piaget never proposed his thoughts could be the foundation for a system of education, his studies have been especially influential in the UK. In 1966, a review of primary education undertaken by the UK government was based strongly in his theory. Discovery learning, the idea that children learn best through hands-on learning and active participation, was central to the transformation of the curriculum. Some of the recurring themes in the curriculum include: play as part of the child’s learning, adaptability of the curriculum, learning through discovery, and most importantly to us, the use of the environment.62

While the application of Piaget’s ideas to school curriculum has permeated internationally, we seek a didactically physical application of Piaget’s ideas, one which anticipates active learning in the design of a learning environment. Rooted in the successive stages of development posed by Piaget, our design proposal would incorporate unique, age related activities embedded within the architecture itself. These embedded design moves would change the respective landscape of the child’s learning environment, evoking a cause and effect relationship between moving parts that can be directly manipulated and observed by the child.

<table>
<thead>
<tr>
<th>Stage</th>
<th>Characterized By</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sensori-motor (Birth-2 years)</td>
<td>Differentiates self from objects</td>
</tr>
<tr>
<td></td>
<td>Recognizes self as agent of action and begins to act intentionally: e.g. pulls a string to set a mobile in motion or shakes a rattle to make a noise</td>
</tr>
<tr>
<td></td>
<td>Achieves object permanence: realizes that things continue to exist even when no longer present to the sense</td>
</tr>
<tr>
<td>Pre-operational (2-7 years)</td>
<td>Learns to use language and to represent objects by images and words</td>
</tr>
<tr>
<td></td>
<td>Thinking is still egocentric: has difficulty taking the viewpoint of others</td>
</tr>
<tr>
<td></td>
<td>Classifies objects by a single feature: e.g. groups together all the red blocks regardless of shape or all the square blocks regardless of color</td>
</tr>
<tr>
<td>Concrete Operational (7-11 years)</td>
<td>Can think logically about objects and events</td>
</tr>
<tr>
<td></td>
<td>Achieves conservation of number (age 6), mass (age 7), and weight (age 9)</td>
</tr>
<tr>
<td></td>
<td>Classifies objects according to several features and can order them in series along a single dimension such as size</td>
</tr>
<tr>
<td>Formal Operational (11 years and up)</td>
<td>Can think logically about abstract propositions and test hypotheses systematically</td>
</tr>
<tr>
<td></td>
<td>Becomes concerned with the hypothetical, the future, and ideological problems</td>
</tr>
</tbody>
</table>

Figure 18: Piaget’s Stages of Cognitive Development. Piaget’s work reflected his studies of child behavior, and show how the child progresses through a series of four stages. Each stage reflects characteristic attributes about changes in how the child views the world around them. Piaget was clear that intellectual development in the child is not measurable through quantitative means and would not reflect the simple accumulation of knowledge over time. Rather, Piaget’s categories reflect qualitative changes about how the developing child processes information.
Figure 19: Chart describing Piaget’s view that development in the child takes place as a series of internal maturations through which the child’s interaction with their environment is assimilated with the child’s existing mental schema. Piaget’s learner influences and is influenced by those elements called out to the right, suggesting that a dialogue exists between learner and environment which is critical for the construction of knowledge.

Figure 20: The situation to the left shows an attempt at teaching plant development through an abstract, instructional method. Below is the opposite method, in which the child plants the seed, and observes the growth and development of the plant firsthand. This comparison illustrates the difference between traditional instruction and active learning.
Maria Montessori
(1870 - 1952)
Italian Philosopher | Physician | Educator

Maria Montessori is most famous for the method of education and scientific pedagogy that bears her name. Her ideas are still widely used today, implemented in Montessori schools in the United States and around the world. Prior to Maria’s international prominence as an educator, she was an extremely respected and highly awarded physician in Italy and worked her own successful practice. By the start of the twentieth century, however, Montessori began to extend her studies into the realms of philosophy and psychology, and began conducting observations and experimental research in Italian elementary schools. She focused mostly on developing methods and materials to use on mentally disabled children.63

In 1906, Maria Montessori moved to the San Lorenzo district in Rome, in order to oversee and care for a group of children who were not cognitively disabled. She was, however, more interested in testing some of the methods she was using on disabled children. The Casa dei Bambini, as it came to be known, would become the location in which Montessori developed the foundations for her educational method. In the classroom, Montessori observed the behavior of the young children, noting episodes of attention, interest, concentration, repetition, and sensitivity to her methods and the environment. Given the ability to choose their own activities, the children showed interest in the activities and materials that she provided. She noticed an emerging self-discipline that was not motivated by candy or external reward, but instead by the child’s own intrinsic interest in learning.64

Montessori began by implementing a number of practices that are now the standard in Montessori education. She replaced the heavy wooden furniture with light furniture and child-size tables, which were designed such that the child easily move. The shelves upon which she placed toys and materials were scaled to the child, making her learning tools accessible. The curriculum included a variety of exercises related to the personal upkeep of the child and the child’s environment, including cooking, hand-washing, dishware cleaning, taking care of plants and animals, and gymnastics. Additionally, she allowed the children a relatively free range of movement throughout the classroom, encouraging them to explore the areas they want and come and go to different lessons in the classroom.65

Central to Maria’s understanding of the development of the child’s mind is her belief in treating each child as an individual, believing that the independent child could reach new levels of autonomy, become self-motivated, and fulfill their potential as a learner. Children have the freedom to act freely in an environment arranged for their needs, and can work at their own pace and inclination. Montessori observed that after some time, the child began to care for and order their environment, straightening tables, chairs, and ordering materials on the shelf. She called the child’s tendency to concentrate on chosen activities and care for their environment “spontaneous discipline”.66
As Maria Montessori developed her methods, she prepared her classroom environments in a very specific and controlled way. As Orem writes in *Montessori Today*: "Every task that the child performs has, in effect, roots in the past and seeds for the future, having been thoroughly prepared for and serving, in turn, as preparation for yet another more involved activity." Preparation is not only intended to help order the child’s capabilities in their own mind, but to also create a stimulating environment by which the child can master certain prepared tasks designed to advance their cognitive development.

This final and crucial aspect to Montessori’s approach is the most salient aspect of her pedagogy. As it relates to our contention, we see the Montessori approach as one that complements nicely the idea of an environment that is observed, modified, and evaluated by the learner. The smaller-scale aspects of the Montessori learning environment seem particularly relevant. In much the same way Maria was observing a genuine interest by the child in manipulating the prepared materials she provided, so do we expect to create an engaging learning environment centered on elements that anticipate and encourage the child’s active involvement. Inasmuch as these designed elements are prepared for the learner, they would be as varied in their response to the child’s input as each child.

Needless to say, a responsive environment would inspire the free play of the learner, in much the same way Montessori allowed her children to act freely. Yet our proposal supposes that this kind of interpretation and modification can occur at all scales in a learning environment, not just at the scale of an object or piece of furniture. Yet the Montessori Method provides us with a solid theoretical and practical foundation by which we can approach a school design project. Specifically, we can examine elements at all scales that induce the child’s own input in reinterpreting and changing the space they occupy.

Figure 11: Maria Montessori visiting one of her classrooms. Visible in the background are some of her specially developed and prepared instruments for learning.
Figure 12: Maria Montessori working with children using her newly developed method.

Figure 13: Children handling and touching textured letters (top). Children using cardboard script to spell (bottom).
Figure 14: Central to Maria Montessori’s ideas include her thoughts on the child mind. As shown the in diagram to the left, she divided the mind into 3 parts: the conscious, subconscious, and unconscious. Montessori posited that one of the most sensitive times for the child is when their unconscious mind is most dominant. When the child develops a new skill or ability, the essential components of that ability become rooted in the unconscious and have far-reaching effects on the child’s continued development.

Montessori’s Idea of the Human Mind

Ordered Work

Progress Stage

Superior Stage

Figure 15: Montessori’s model describing the ups and downs of traditional teaching methods.

Figure 16: Montessori’s model describing a relatively progressive model allowing children a limited range for choosing their daily learning activities.

Figure 17: Montessori’s model describing her own method of teaching, creating a sustained level of thinking throughout the child’s day resulting in a layered and continually rising intellectual bar. This staging is only attainable by allowing free and total range of daily activities on the part of the child.
Figure 18: The Pink Tower, representing the decimal system ascending scale, volume, and other geometric concepts.

Figure 19: The Cylinder Blocks, a classic Montessori learning tool through which the child learns to distinguish diameter, shape, and depth, through a series of holes and pins.
Figures 20, 21: The trinomial and binomial cubes, which concretize the mathematical concept of 3 dimensional binomial and trinomial relationships.
Loris Malaguzzi
(1920 – 1994)
Educator | Child Psychologist | Educational Philosopher

Loris Malaguzzi is known as the founding director of the education network of Reggio Emilia, Italy. Along with a dedicated community of parents and other educators, Malaguzzi was the primary figure in developing the resulting Reggio Emilia approach to early childhood education. The creation of the Reggio Emilia approach is a product of societal beliefs and needs following World War II. Malaguzzi viewed education in terms of the development of children as members of society. The postwar rebuilding of the area’s educational infrastructure provided an atmosphere which Malaguzzi, along with other community leaders, utilized as an opportunity to focus education on addressing the civic sensibilities of respect, responsibility, and community through activity and communication.

The Reggio Emilia approach may be understood as a collection of various existing educational theories and practices; however, there are fundamental tenets which define and distinguish the Reggio Emilia philosophy. These include creativity, collaboration, and communication. Children are believed to be capable members of society, possessing the natural tendency to form and demonstrate genuine interest. Such interest must be encouraged to develop, resulting in the self-construction of knowledge through creativity. The archoblanco puzzle is an example of this open creativity. Unlike Montessori materials which each isolate one concept, children experiment with the material to “nest the asymmetrical arches into a round tray; solve structural problems as they build an inverted cone or a double tunnel; and tap their imaginations to create bridges, domes, towers, spiral houses, tigers with red tails, and fascinating forms.” As capable members of society, children are encouraged to interact with each other in small groups, as well as with teachers and parents. Such collaboration is essential in fostering children’s civic skills. Collaboration is achieved primarily through group work with countless active media. The act of freely exploring dancing, acting, writing, drawing, painting, sculpting, building, making and so on, fosters children’s creativity and communication.

Communication in the Reggio Emilia approach refers not only to verbal and written skills, but all possible form of expression, including the arts. This concept is referred to as the Hundred Languages of Children. In his work of the same name; Malaguzzi describes the importance of the active learning approach in relation to traditional teaching methods: "What children learn does not follow as an automatic result from what is taught. Rather, it is in large due to the children’s own doing...” It is the combined emphasis on the inseparable tenets of creativity, collaboration, and communication which allows for innovation in the construction of knowledge. As stated by Jean Piaget, “Are we forming children who are capable of learning what is already known? Or should we try to develop creative and innovative minds capable of discovery from the preschool age on, throughout life?”
Such acts of doing have innate architectural implications, arguably an aspect of the learning environment which is underutilized in other education models, and could be utilized even further. The physical space of a Reggio Emilia school is temporal, interactional, and multivalent; it provides for the simultaneous interactions of students, doing of activities, use of materials, and making and display of creations. The ‘emergent curriculum’ is the method by which Reggio Emilia educators plan lessons based on a combination of general set objectives and the perceived interests of the children. This process is at the discretion of the community of children and teachers and promotes children’s sense of discovery and self- construction of knowledge.

In the Reggio Emilia approach, the construction of knowledge is defined as the unison of Communication, Creativity, and Collaboration. Each element requires the other two in order to exist and without any one of these three elements, the construction of knowledge is not possible.

The elements of the Reggio Emilia approach are best achieved by active and artistic work in small cooperative groups. Spatial implications of this approach include subdivisions of plan and areas of relative center as opposed to the linear fashion of a traditional classroom.

Didactic materials of the Reggio Emilia approach allow for a multitude of interpretations to learn a variety of lessons in the pursuit of fostering the self-construction of knowledge through experience.
The Diana School
1970
Reggio Emilia Preschool | Italy

The Diana School is a municipal preschool in Reggio Emilia, Italy which has gained international recognition for its landmark approach to the Reggio Emilia method. The Diana School has a maximum capacity of about 75 students, consisting of 3-5 year-olds. A 1991 story by Newsweek picked the Diana School and other Reggio Emilia schools in Italy’s Emilia Romagna region as an example of a grass-roots project which has since become a model for international use.

The Newsweek article quite vividly illustrates the atmosphere of the school:

“The glass-walled Diana School in the northern Italian city of Reggio Emilia looks more like a cheerful greenhouse than a public kindergarten. Children’s art is everywhere – on walls, painted on windows, hanging on the ceilings, spread across tables. There are ceramic tiles of sea horses, a mobile of human profiles made of wire and beads, and clay figurines of trees and leaves. Two dressing areas offer costumes for children who might want to disguise themselves for the day.”

The Diana School encourages a strong connection between the child’s home and school life by allowing parents to work alongside teachers as volunteers in the classroom. Daily classwork is not organized under a curriculum. In fact, the work is organized around themes which allow the learner to develop a variety of skillsets which are aimed at helping the child understand the world around them. For example, science and math concepts are presented through an art project, allowing the child to develop visual and motor skills. In one case, 4-year-olds worked on plant projects at different stations set up around the classroom. At one table, learners outlined the form and structure of leaves using wire. At another table, a student used real leaves in his painting of a tree, allowing him to feel the texture, see the color, and distinguish the front from the back of the leaf.
The program structure includes an infancy program, *asilo nido* (nest) for learners younger than 3. Next is *scuola materna* (maternal school), for 3-5 year olds. Here, learners are assigned to classes of 24, and stay together with the same 2 teachers for all 3 years. While centered around the bright classrooms, children are allowed to wander to an adjoining small-group room, or go to the kitchen to have a snack.\(^{79}\)

While limited in its description of specific architectural elements, the article highlights the open, light, and transparent plan of the building. Strong visual connections between social programs can be established, as well as distinctively private spaces where the child can spend alone time. Also evident is the Reggio spirit of fostering the child’s natural inclination to decorate their own learning environment. This speaks to the environment’s critical role in fostering the child’s cognitive and social development, and the emphasis that the Reggio Emilia method places on the environment as “the third teacher.”

One of the primary ways the Reggio Emilia education differs from traditional education or other alternative methods of education is that the child is free to make his or her own choices. Consequently, the child’s activity is not limited by curriculum or lesson plans, and their individual choice of activity is supported by the teacher. With their own goals in mind, Reggio learners can operate at varying scales of interaction, from individual activities, to small groups, to classroom projects:

“Small groups of children work simultaneously and can be found all around the school setting, organized so as to facilitate social, cognitive, verbal, and symbolic constructions. Our children in fact have many choices: they have places where they can be alone, in a small number, in a large group, with the teachers or without them, in the *atelier*, in the *mini-atelier*, in the large *piazza*, or, if the weather is good, in the outside courtyard, rich with small and large play structures. Because of that, the classroom is transformed into one large space with market stalls, each one with its own children and its own projects and activities. This arrangement permits good observations and organically developing research about cooperative learning as well as about the bartering and marketing of ideas.”\(^{80}\)

Malaguzzi’s description of the Diana School classroom and the auxiliary programs that coexist alongside it illustrate the importance of the designed environment in the construction of knowledge. Through the years, this emphasis on the physical environment has only become more apparent as children, parents, educators, and community members continue to pool their efforts towards political action to obtain public funding for early childhood education. Participants realized early on the significance of the built environment in their community schools. To quote Carlina Rinaldi: “Children must feel that the whole school, including the space, materials and projects, values and sustains their interaction and communication.”\(^{81}\) At the core of this is the basic philosophy that children’s centers should be integral parts of the urban plan, since the education of children is a community-based concern for those living in Reggio Emilia, Italy. The ultimate goal of the school’s urban situation was to make it a focal point in the community.
where it would be placed in the public’s full view and enjoy a community of interaction, rather than isolated interaction within the school.82

For every Reggio building, whether completely new or adapted from existing space, pedagogists, educators, and parents meet with the architect to plan out the school. Those using the building daily should have input in every design decision; “a wall too high or the lack of a partition could modify the possibility or the quality of interaction in an educational approach where partnership and interaction are paramount.”83 Furthermore, Tiziana Filippini points out “educators in Reggio Emilia speak of space as a ‘container’ that favors social interaction, exploration, and learning, but they also see space as having educational ‘content,’ that is, as containing educational messages and being charged with stimuli toward interactive experience and constructive learning.”84 Hence, the Reggio Emilia system induces a continually evolving interior structure.85

Intrinsic to our contention, as well as Reggio Emilia pedagogy, is the importance of social space, which is an essential component of developing and maturing in a learning environment. Social development and cognitive development go hand in hand, and the space in a constructivist learning environment must adapt and facilitate encounters, interactions, and dialogue among the children. Thus, the learning environment must foster the needs of the individual as well as the group.86

The Diana School’s main common space is called the same as the term for any city square in Italy, piazza. Not only is this a unique connection to Italian culture, but reaffirms the importance of shared space by placing it in the direct center of the plan. The school’s piazza is visually open to everything else around it. Also in the Diana School (as well as other Reggio schools) are large ateliers, a library, an archive, and a storage room. The large atelier was implemented as studio or workshop space for the children, and can be shared by students and adults throughout the school day. In Malaguzzi’s own words:
“The atelier, in our approach, is an additional space within the school where to explore with our hands and our minds, where to refine our sight through the practice of visual arts, where to work on projects connected with the activities planned in the classroom, where to explore and combine new and well-known tools, techniques, and materials.”

Each age level (3-5) has its own large classroom, as well as a mini-atelier which operates for the specific age group it serves. Simultaneously, the Diana School houses a kitchen, dining room, a room with sinks for washing or project-making, and bathrooms. Truly, the program of the Diana School operates much like a community of learners who must operate and live with one another in a cooperative and mutually benefitting way. The arrangement of this space and the activities that occur among and between them is critical. As Malaguzzi said:

“The continuous activity is the most important thing for us and represents that which can contribute the most to keeping fresh our interest and the continuous mobility of our thought and action. I believe that our schools show the attempt that has been made to integrate..."
Malaguzzi brings architecture to the forefront, insinuating that the organization of space underlies the goals of the Reggio education. This architecture is not only functional as living and learning space, but as one that encourages "continuous mobility" of "thought and action." Malaguzzi also draws connections to Dewey, who emphasized the "continuous experience" as the true vehicle for learning. Reggio Emilia proposes that the learning environment can become a stimulating and meaningful center of activity, which is fundamental to our contention.

Another landmark feature of the Reggio classroom is the ability of the space to document and display the work of the child. Malaguzzi said: "The walls of our preprimary schools speak and document. The walls are used as spaces for temporary and permanent exhibits of what the children and the adults make come to life." This situation is shown quite vividly in images of the Diana School, where most of the wall space is tiled with colorful student work. Architecturally, this may not seem quite as interesting because it doesn't necessitate involvement that is intrinsic to the architecture, but rather a sort of superficial application to architectural surface. But the lesson here is that the Reggio method values the work and ideas of the child so that it begins to influence the environment. Thus, the child's talents are documented, displayed, and celebrated to the point where the child's work becomes an aspect of the space itself. While our proposal does aim for an interactive environment that is more intrinsic to the architecture, the Diana School demonstrates the value of the child's work in shaping the environment.

Also, the Reggio method recognizes the temporality of a learning environment. Thus, the classroom truly is "a living, changing system." Gandini writes that the Reggio physical environment is shaped according to the needs and rhythms of the child, at the child's own pace. This clearly suggests that the ideal Reggio environment is not fixed, but instead supports a level of adaptability that parallels the cognitive and social development of the learner. In fact, referring to the classroom as a "system" suggests a moving arrangement of parts, which indeed respond in some way to varying forms of input by the child. While this is less apparent architecturally in the Diana School, the notion is central to our contention.

The most potent aspect of the Reggio education to the development of our thesis is the theory that the physical environment acts as "the third teacher." Along with a team of two teachers, the environment also has the capability of educating the child. Gandini writes that in order for this to happen, the physical environment must be flexible, an attribute described earlier:

"It must undergo frequent modification by the children and the teachers in order to remain up to date and responsive to their needs to be protagonists in constructing their knowledge. All the things that surround the people in the school and which they use - the objects, the materials, and the structures - are not seen as passive elements, but on the contrary are seen as elements that condition and are conditioned by the actions of children and adults who are active in it."
The above quote epitomizes the essence of what our contention is attempting to expound upon. It speaks to the responsiveness of the learning environment, as well as its pivotal role in enabling the child to construct knowledge. It speaks to the range of scales our contention address, from the object, to furniture, to entire wall and structural systems. Also, it distinguishes the Reggio environment as one that is very much active in the learning process, rather than serving merely as background. The environment as a space that conditions the learner, and is conditioned by the learner highlights our own thoughts for the potential of a feedback loop to exist between the environment and the learner. Clearly the Reggio curriculum (or lack thereof) provides the most useful parallel for how our contention would manifest itself within a system of education.

Yet our ideas would allow for a much greater intrinsic manifestation of adaptable, interactive, and truly constructivist design from an architectural standpoint. The existing Reggio model exhibits to a lesser degree some of the environmental design moves that would become much more of a design theme in our constructivist school, rather than a superficial application of those ideas seen at the Diana School. These concepts would be concretized through a series of operable moments, able to be handled by the child, which would have varying scales of spatial influence upon the learner’s environment. Thus, the child can reinterpret an altered environment as a way of constructing knowledge through experience.

Figure 47: A child immersed in a light projection on the wall at the Diana School.
David Kolb provides us with useful theoretical foundations by which we can pose our unique theory of experiential learning through architecture. In Chapter 2 of his book *Experiential learning: experience as the source of learning and development*, Kolb describes the current theory of experiential learning, and how it diverges from other learning-based epistemologies. Kolb cites two reasons for calling his perspective on learning “experiential”; first because it directly relates to previous work by Dewey, Piaget, and Lewin (all of whom developed intellectual origins for experiential learning), and second, to clearly dovetail the critical role that experience has in the learning process and ultimately the creation of knowledge. As Kolb describes, this position is clearly different from behavioral theories of learning, or more implicit methods that are based on the rational idealist epistemology. While we will avoid going into great detail describing these other cognitive theories, it is useful to know that they place primary emphasis on the acquisition, manipulation, and recall of abstract symbols. The behaviorist model, in direct contrast to the experiential model, denies any direct role that the conscious and subjective experience has in the acquisition of knowledge, and the process of learning.\(^{93}\)

Yet Kolb states outright that his theory of experiential learning is not meant to be simply another alternative to cognitive and behavioral theories, but rather is an integrative attempt to pose a holistic approach towards learning that “combines experience, perception, cognition, and behavior.”\(^{94}\) In order to properly position his own Experiential Learning Model, Kolb summarizes the three models that are most influential in the development of his own.

Kolb first discusses the Lewinian Model, guided by the techniques of action research and the laboratory method. Kolb states that this model proposes that learning, change, and growth occur most readily through an integrated process that begins with “here-and-now experience followed by collection of data and observations about that experience.”\(^{95}\) The data can be subsequently analyzed and organized into conclusions, which are then fed back to the actors so that they can learn and modify their behavior. As can be seen on the opposite page, the immediate experience is the basis for observation and reflection, and these observations become integrated into a new “theory” for which a new line of action can be distilled and undertaken.

The two most salient aspects for Kolb, and also for our contention, are the critical roles that the “here-and-now” experience play, as well as the feedback process facilitated during a social learning and problem-solving situation that provides a continuous process of goal-oriented action. One of the primary goals of our contention is to develop an architecture that is informed by and adaptable to the needs and whims of the child. By empowering the child to take ownership of their space, they have gained an experience characterized by life, texture, sensation, understanding, and the colorful subjective
personal learning process from which they can constructively build upon. This is in direct contrast to the often distilled and out-of-touch learning curriculum imposed upon children in our modern education system. Kolb rightfully points out that there is much to be gained through an action research method in a continuous and goal oriented feedback process, which can undoubtedly be provided through physical means in a constructivist school building.

Dewey’s Learning model is the next one that Kolb draws upon for inspiration. While it is indeed similar to the Lewinian model, the Dewey model places greater emphasis upon the developmental nature of the feedback process. From here, we can distinguish how learning changes from mere impulse to higher-order thinking. Kolb notes that Dewey and Lewin stress learning as a dialec process which merges experience, observation, and informed action. The experience itself gives way to an idea which has momentum, which almost immediately is translated into impulse. Yet in order to properly take action, the learner
must postpone impulse and observe their feedback to make an informed move. And of course, the action is necessary to achieve the desired goal. When the goal is not attained, a period of reflection is needed before the undertaking of a subsequent experience.\textsuperscript{97}

Kolb also incorporates Piaget’s model of learning, which identifies stages of cognitive development throughout the learner’s lifetime. Piaget theorized that the learning process is constituted by a cycle of interaction between the individual and the environment. This is quintessential to the contention, which poses that the physical environment is under the umbrella term “environment” which is so often included in constructivist theoretical framework. As Kolb summarizes, Piaget viewed the interaction between \textit{accommodation} and \textit{assimilation} as key to the experiential learning process. “Intelligent adaptation”, as Piaget calls it, results from the mutual balance of these two processes. \textit{Accommodation} occurs when one molds themselves to their environmental constraints. \textit{Assimilation} occurs when one imposes their own concepts and images without reference to environmental realities.\textsuperscript{98}

Piaget, as Kolb summarizes, believed the process of cognitive growth arises from the interplay of concrete to abstract and from active to reflective. This results in a continuous loop between assimilation and accommodation, occurring in alternating stages.\textsuperscript{99} The feedback loop, which has a clear connection to the previously mentioned constructivist models, involves the critical

\begin{figure}[h]
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\includegraphics[width=\textwidth]{piaget_cycle.png}
\caption{Piaget’s cycle of interaction, and four stages of cognitive development.}
\end{figure}
interface with the learner’s environment. While typically the “environment” is conceived more broadly as “curriculum”, our contention assumes that the environment is the physical environment. When taken as such, the architecture of a learning environment becomes a critical part of any learning environment. Kolb unites these three landmark theories by dealing with the obvious similarities between them. First, learning is a process, and cannot be dealt with as a means to achieve a set of desired outcomes. Kolb notes that the idealist approach to traditional education conceives ideas as fixed and immutable, and so the tendency is to define learning in terms of outcomes. Knowledge, then, is an accumulated storehouse of facts. Experiential learning theory, Kolb writes, argues that ideas are not fixed, but are rather “formed and re-formed through experience”. Each of the previously discussed learning models conceives learning as a process that is continuously modified by experience. Therefore, the creation of knowledge is somewhat of a moving target since no two experiences are the same, and because this knowledge is based on a continuous construction process that varies for the individual learner. Second, Kolb points out that in all three theories, learning is a continuous process grounded in experience. Dewey says it most clearly:

“...the principle of continuity of experience means that every experience both takes up something from those which come after....As an individual passes from one situation to another, his world, his environment, expands or contracts. He does not find himself living in another world but in a different part or aspect of one and the same world. What he has learned in the way of knowledge and skill in one situation becomes an instrument of understanding and dealing effectively with the situations which follow. The process goes on as long as life and learning continue.”

Consequently, our educators should not think of learners as ‘blank slates’ in terms of the ideas they intend to teach. Rather, educators must assume that each learner enters the course with more or less accurate or inaccurate articulations about the topic. So the job of the educator is to implant new ideas and dispose of or modify old ones. This also refers to Piaget’s ideas on assimilation and accommodation, where the learner must balance their sense of both in order to advance learning.

Third, Kolb discusses how each theory suggests learning as a process filled with tension. Lewin talked about the dialectically opposed relationship of concrete experience and abstract concepts. Dewey phrases the dichotomy as the impulse that gives “moving force” to ideas, and reason which gives desire its action. Piaget describes these twin processes as accommodation and assimilation. By calling out these opposed modes of adaptation, Kolb introduces his own Experiential Learning Model (ELM):

“Learners, if they are to be effective, need four different kinds of abilities - concrete experience abilities (CE), reflective observation abilities (RO), abstract conceptualization abilities (AC), and active experimentation (AE) abilities. That is, they must be able to involve themselves fully, openly, and without bias in new experiences (CE). They must be able to reflect on and observe their experiences from many perspectives (RO). They must be able to create concepts that integrate their observations into logically sound theories (AC), and they must be able to use these theories to make decisions and solve problems (AE).”
This progression, as Kolb presents it, is a continual loop composed of four ideas in two opposing sets. The concrete experience aspect directly opposes the abstract conceptualization, and the active experimentation is opposed to the reflective observation on the other. Thus, Kolb writes, "in the process of learning, one will move in varying degrees from actor to observer, and from specific involvement to general analytic detachment." 106

Kolb’s ELM provides us with a strong foundational theory for the logic with which the built school environment could be designed, as well as the school’s curriculum. A school environment can and should encourage the child to engage in active experimentation with the physical architecture. These varied forms of interaction can allow the child to shape or control the features of their space, and the mechanical features that enable their movement can be apparent so as to enable clear observation on the part of the child. Not only does the environment become an active teacher, but the experience becomes the reference point upon which the learner builds upon to further their understanding of the world.

Kolb explores this same idea, calling it the “transaction between the person and the environment”. 107 Kolb writes, "The casual observer of the traditional educational process would undoubtedly conclude that learning was primarily a personal, internal process requiring only the limited environment of books, teacher, and classroom. Indeed, the wider “real world” environment at times seems to be actively rejected by educational systems at all levels”. 108 The outcome of this thought is “a tendency to perceive the person-environment relationship as one way, placing great emphasis on how environment shapes behavior with little regard for how behavior shapes the environment.” 109

In a sense, Kolb is asking in the same way that we are; why is architecture simply a background? While clearly Kolb isn’t limiting his critique to architecture, we’re interested specifically in architecture as a social construct. How do classroom group settings implicate a learning space, and vice versa? How can a classroom adapt to individual, secluded learning? How can a learner understand broader subjects like physics, structure, and mechanics through a build environment? How can empowering the student to impose upon their environment give them the learning experience that they can apply in a broader context? How can the environment impose spatial and social constrictions or opportunities for the child to learn from? These questions, among many others, are those which our contention aspires to address specifically through the designed school environment.
Figure 52: Kolb's Experiential Learning Model.
Herman Hertzberger
(1932 - )
Architect | Emeritus Professor

Herman Hertzberger, alum and emeritus professor of the Delft University of Technology, is a Dutch Structuralist and humanist architect. Humanism is a philosophy which applies to many of the arts and humanities and refers to emphasizing the value of the human being and the preference for individual evidence and thought over established doctrine. In his work Lessons, Hertzberger can also be taken as a proprietor of constructivist education:

“Everything that is absorbed and registered in your mind adds to the collection of ideas stored in the memory: a sort of library you can consult whenever a problem arises. So essentially, the more you have seen, experienced and absorbed, the more points of reference you will have to help you decide which direction to take: your frame of reference expands.”

Throughout his work, Hertzberger demonstrates these philosophies by focusing on the concepts of individuality, collectivity, and how these relate to one another. Hertzberger places specific emphasis on the perception and occupation of space by individuals and groups. The Dutch Structuralist movement in architecture may be interpreted essentially as an extension of this belief, maintaining that the role of the architect is not to provide a complete solution to a given isolated problem, but rather to provide a scaffold or framework to be occupied, utilized, and modified by individuals. This operates within a larger cultural structure, thereby allowing for a multitude of solutions to any number of problems through time. Structuralism also maintains that architecture must be designed to adapt, to expand or contract, and to allow for reprogramming.

For the design of individual spaces, Hertzberger believes that people possess the ability to discover and form their own space, or sense of space, relative to the scale of their body in order to best suit their approach to the task at hand. Hertzberger achieves this in his work by the articulation of corners and niches in plan, level change in section, and a designed transformability (both interpretive and literal) of the furniture elements of the physical environment. For the design of collective spaces, Hertzberger believes that people also possess the ability to function and collaborate collectively in spaces at the group or community scale. Hertzberger achieves these effects in his architecture by designing large, open, porous, and contiguous spaces populated by multivalent spaces of meeting to promote interaction, inspire activity and productivity, and allow for tasks to be approached at the cooperative level.
Individual and collective activity
Creative project based work
Instructed lesson based work
Individual intellectual work

Figure 54: Plan diagrams depicting multiply of center by articulating space
Redrawn from Herman Hertzberger’s *The schools of Herman Hertzberger*, 11

Figure 55: Plan diagram depicting activity in space by scale and form
Redrawn from Herman Hertzberger’s *Space and learning: lessons in architecture* 3, 7
Montessori School in Delft
(1960 - 1066)
Delft, Netherlands | Herman Hertzberger

Completed in several phases from 1960 to 1981, Herman Hertzberger’s school in Delft was designed to offer a primary school environment for 300 students learning under the Montessori teaching philosophy. It remains today as an archetypal example in this regard. As stated in the Harvard Educational Review: “A Montessori school (is one which) exploits the infinite variety of relationships of child to child, child to work, and child to teacher. Everybody makes his or her own choice of what kind of work to do and as a result, the system is characterized by many different activities occurring simultaneously.”

The school has undergone several additions to accommodate more students and different programs. Although the expansion has exceeded initial expectations, the nature of the plan allowed for this expansion without disrupting from the original goals of the project or conflicting with the context. The school itself is situated outside of the local historical district adjacent to urban housing blocks and immediately immersed in natural landscaping which has also been developed over time. A building, such as a school, may function like a city; with classrooms opening onto the hallway as buildings opening onto the street, and with different programs and degrees of opacity accessed by contiguous spaces for circulation, occupation, and interaction.

Operable aspects of the built environment allow for physical transformability limited by the number and modularity of the parts. Such features invite the creation of both individual and collective spaces and permit one to tailor or design the physical aspects of the environment to best suit the nature and approach to the task at hand. Fixed aspects of the built environment may alternatively allow for transformability limited only by the freedom of association of the occupants. Such features also invite the creation of both individual and collective spaces, and providing the varied scaffolding in the environment to become programmed space.

The library area of the school is not defined by its own walls, but rather occupies an area of the hallway. A pair of columns below a skylight central to this space supports a work surface and storage areas, promoting interaction with the materials of the library when occupying the space or passing through it. The landscaping that has sprung up around the school establishes a buffer zone, and gives a dominant presence to nature. This is important in Montessori education: the growing of plants likened to that of the child.

The L-Shape plan at the scale of the classroom questions the traditional classroom environment by displacing and multiplying the concept of center, allowing the space to be more readily reconfigured in a multitude of ways. The idea of space making in scale and form are present throughout the playground area for the same reasons for which they are present throughout the building proper. This is critical in Montessori education, which emphasizes the connection of work and play, the outdoors, and self structured social engagement.
The primary school classrooms have an ‘L’ shaped plan with changes in floor level to further divide the space, while still allowing for a teacher to maintain sight of the entire space. (From top to bottom) each classroom includes: an exterior garden space and patio, a built in seating and multi-height work space, an open plan, an internal sky lit vestibule, and a space for wet work and cleaning.

Figure 56: Plan diagram of the development
Redrawn from Herman Hertzberger’s Space and learning: lessons in architecture 3, 116.

Figure 57: Plan of a typical primary school classroom.
Figure 58: Plan of the Delft School.

1/16" = 1'
14 Entrances
15 Kindergarten Hall
5 Kindergarten Class
4 Primary Hall
5 Primary Class
6 Secondary Hall
7 Secondary Class
8 Platform-Block
9 Library Space
10 Hearth
11 Project Space
12 Art Space
13 Play Space
14 Gardens
15 Playground

Figure 64: Garden Space
Figure 65: The Platform-Block
Figure 66: Mat Storage
Figure 67: Entry Court
Figure 68: Natural Elements
A prime example of an architectural feature that embodies Hertzberger’s philosophies is the conversation pit of the Montessori School in Delft. The conversation pit consists of a literal pit centered in the communal space of the kindergarten area of the school. The depth of the pit is equal to the comfortable maximum height of a child’s seating surface, which is about twice the comfortable minimum height. The pit is a rectangular volume, with a width four times its height. These proportions accommodate sixteen identical wooden boxes of equal height, width, and depth shaped like a ‘C’ or a ‘U’ with a square piece in the middle. When removed from their flush position with the floor, the boxes may serve as chairs, tables, building materials, vehicles, or anything the child needs or imagines them to be. From a collective standpoint, the open nature of this system allows children to gather together in groups of various number and configuration for different activities. The modularity of this system allows for the children to act as individuals, each interpreting the elements based on their own physical needs and personal ideas. This space serves as a flexible work and play space wherein the transformability allows for infinite arrangements.

Figure 69: (Clockwise from top left) elevations, axonometric, and sectional isometric of the conversation pit
Figure 70: Activation of the Delft conversation pit, known as the 'hollow'

Figure 71: Section of the potential for accommodating various sizes and configurations of people

Figure 72: Sequence model assembly of the components of the boxes
The Rietveld Schröder House was designed by Dutch architect Gerrit Rietveld with and for Truus Schröder-Schräder and her three children. The resulting house, located at the end of a block of rowhouses on the outskirts of Utrecht, Netherlands, is undoubtedly unique. Truus Schröder utilized the passing of her husband to enroll her children in a Montessori school and relocate, "to turn her dream into reality and to organize her life spatially according to her personal insights." The design of the house was very much a cooperative venture between owner and architect; Truus Schröder was inspired by the spatial qualities of a large open attic she had once baby-sat in, and Rietveld was inspired by the principles of the De Stijl movement, later citing his own red blue chair.

The driving design goals were for the house to have an absence of walls and an ambiguity of interior and exterior thresholds. The resulting building is a series of planar elements which slide both visually and literally to create an open space for living, and an atmosphere that spills outside of the building proper. In order to satisfy building code, the layout of the ground floor is divided in a fairly typical fashion: a quadrant scheme with an entrance hall leading to a reading room, studio, servant’s quarters, and kitchen, all situated around a central core consisting of a stair and chimney. It is the first floor which exhibits the true nature of the design. This space, which was labeled an attic to satisfy building code, employs a series of pivoting and sliding panels to freely subdivide an otherwise continuous space for resting, working, dining, and living.

The aesthetic quality of the house relies on the principles of the De Stijl movement: complete abstraction by the reduction of form and color to simple Cartesian geometries and primary colors and values. The elements which compose the house are planer and rectangular in section, rendered in red, blue, yellow, black, gray, and white. There is an apparent logic in the way spaces and objects were formed, not on a technical level of material properties and joinery techniques, but on a conceptual level of compositions built up of individual planer components. The house visually continues to the exterior with its sliding aesthetic and consistent palette. The house physically continues with doors to the garden in every room, and balconies on all sides on the first level.

Tectonically, the façade is comprised of large thin planes with gaps between them, revealing the internal spaces of the house through areas of glazing. The exterior and interior both feature operable fenestration and built-in furniture. The many external doors and windows literally open up the house. Elements such as the bench on the south corner of the house obscure the boundary of the envelope. Many of the windows have deep sills which can be used as tables. Niches throughout the house are subdivided for open storage, such as the closet in the entry hall and the shelving in the studio. Sliding panels divide spaces that would be too wide for conventional doors, or where the space is unable to accommodate the would-be door-swing, as seen on the ground floor stair landing. Ahead of its time, the Rietveld Schröder House exists today as a museum to the only truly realized work of De Stijl architecture.
Although the entire design process took only two weeks, the drawings are so detailed as to demonstrate the importance of the built-in furnishings.

The eastern corner of the first floor demonstrates the copious use of operable windows throughout the house, which visually extend the interior space.

The first floor of the house may be portioned off in various combinations with the movable partitions which pivot and slide on tracks to subdivide the otherwise continuous space. All this to create space that is best suited to the nature of the occupancy and program of the space at the moment.
Ground Floor
3/16" = 1'

Figures 76 and 83: Plans of the Schroder House.
Operable Partitions

First Floor, Closed

Ground Floor, Closed

Figures 88  
1/8" = 1'
First Floor, Open

Ground Floor, Open
Maison de Verre
(1928 - 1932)
Paris, France | Pierre Chareau

The Maison de Verre (House of Glass) was constructed in Paris, France for Dr. Dalsace, his wife, and their children. Although primarily attributed to avant-garde architect and designer Pierre Chareau, the design was a mutual work; Chareau served in company with architect Bernard Bijvoet and metal craftsman Louis Dalbet. The unique character of the house resulted in part from the combined program requirements of a doctor’s office, and a townhouse style personal residence on a small infill site. The resulting work is known for its variation of opacity, structural and material honesty, and juxtaposition of traditional and industrial elements.

The front façade and namesake of the building is comprised of a solid soldier-stacked wall of industrial glass lens blocks, the opacity of which permits light and denies view. This contrasts highly with the rear façade, which is articulated with a balcony and bays punctured by transparent operable apertures inspired by the rotating transoms of factories and the sliding windows of trains. This juxtaposition aids one’s orientation and understanding of public and private zones, which was important for visiting patients. Between these two conditions is a collection of perforated metal meshes and slats of shelving, which allow for a simultaneous openness and seclusion of the private spaces.

The structure of the house consists of steel beams and columns in a free plan arrangement. The floor plates are suspended from a series of columns which also bear the load of the masonry construction apartment above. This allows for an absence of load-bearing walls and for the interior volume of the house to be divided instead by a series of independently located partitions and floor level changes. The waiting room, for example, is designed to deliberately exhibit the steel structural members of the building. Throughout the house, the exposed steel girders are displayed, clad in red paint and black slate panels to emphasize their presence and form.

Figure 90: Industrial language employed throughout the building.

The doctor’s office becomes a wall rather than a locked door (left), the maid’s broom closet becomes a cubist sculptural element (middle), and the ventilation louvers fall away from visual presence, allowing the façade to maintain aesthetic dominance (right). Such moves evoke an element of transparency by allowing the user to conceal or show space.
The industrial elements throughout the building allow the inhabitant to directly alter certain aspects of their environment. The mechanical factory louvers in the corner of the drawing room allow for ventilation without intruding on the continuity of the glass lens blocks. Oversized doors connect and disconnect the bedroom from the interior terrace. Sliding metal walls unite and divide spaces such as the drawing room and office. A telescoping ladder links the master bedroom and boudoir. Rotating elements conceal and reveal spaces such as the broom closet which appears as a sculpture when closed. Rendered in metal, glass, and wood, articulated furnishings including work surfaces, closets, and cabinets allow for a unique level of transformation at the scale of the individual.

Figure 91: Steel girders support the existing second floor apartment, the stair of which was left in place.

Figure 92: The structure is exposed and celebrated on the interior, clad in red paint and black slate panels.

Figure 93: Articulating furnishings.

Throughout the building, end tables, game tables, phone stands, and desks pivot to allow for direct personal interaction. Such elements may be readily reconfigured for the need of the moment, and likewise utilized or hidden away for social or other events.
Figure 94: (Left) Axonometric drawing of the master bathroom. This is perhaps the pinnacle of the industrial and articulated nature of the design of the house. This is apparent in the materials and movements specified below. Aluminum, steel, brass, chrome, glass, teak, and rubber comprise the material pallet, which comprises numerous pivoting and sliding mechanisms that are inseparable from the architecture of the space.

<table>
<thead>
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<th>No.</th>
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<th>Material</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
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<td>Aluminum</td>
</tr>
<tr>
<td>2</td>
<td>Door stop</td>
<td>Rubber</td>
</tr>
<tr>
<td>3</td>
<td>Clothing hook</td>
<td>Forged steel</td>
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<td>4</td>
<td>Curtain gate</td>
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<td>5</td>
<td>Pivoting drying racks</td>
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<td>Tracked screen</td>
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<td>7</td>
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<tr>
<td>14</td>
<td>Over sink shelf</td>
<td>Steel sheet</td>
</tr>
<tr>
<td>15</td>
<td>Soap dish</td>
<td>Steel sheet</td>
</tr>
<tr>
<td>16</td>
<td>Tile shower wall</td>
<td>Mosaic tile</td>
</tr>
<tr>
<td>17</td>
<td>Storage draw</td>
<td>Perforated metal</td>
</tr>
<tr>
<td>18</td>
<td>Storage unit</td>
<td>Aluminum</td>
</tr>
<tr>
<td>19</td>
<td>Rotating drawers</td>
<td>Aluminum</td>
</tr>
<tr>
<td>20</td>
<td>Pivoting drawer container</td>
<td>Steel</td>
</tr>
<tr>
<td>21</td>
<td>Drawer container slide</td>
<td>Steel</td>
</tr>
<tr>
<td>22</td>
<td>Sliding screen</td>
<td>Perforated metal</td>
</tr>
<tr>
<td>23</td>
<td>Sliding door</td>
<td>Glass</td>
</tr>
<tr>
<td>24</td>
<td>Sliding door guide track</td>
<td>Teak wood</td>
</tr>
<tr>
<td>25</td>
<td>Floor tiles</td>
<td>Studded rubber</td>
</tr>
<tr>
<td>26</td>
<td>Bathroom Window</td>
<td>Glass lenses</td>
</tr>
<tr>
<td>27</td>
<td>Condensation channel</td>
<td>Slate</td>
</tr>
<tr>
<td>28</td>
<td>Interrogated radiator grill</td>
<td>Cast iron</td>
</tr>
<tr>
<td>29</td>
<td>Condensation gutter cover</td>
<td>Teak wood</td>
</tr>
<tr>
<td>30</td>
<td>Flashing</td>
<td>Steel sheet</td>
</tr>
<tr>
<td>31</td>
<td>Trim</td>
<td>Teak wood</td>
</tr>
<tr>
<td>32</td>
<td>Door handle</td>
<td>Brass</td>
</tr>
<tr>
<td>33</td>
<td>Paneled door</td>
<td>Brass</td>
</tr>
<tr>
<td>34</td>
<td>Glazing stud</td>
<td>Chrome</td>
</tr>
</tbody>
</table>

Figure 95: The pivoting drawer container.

This storage system keeps clothing well organized, out of view, and away from the steam, yet in reach and very easily accessible.

Figure 96: Master bathroom partitions (closed).

The folded and bent steel partitions are outfitted with a number of storage spaces containing adjustable shelves and pivoting rods.

Figure 97: Master bathroom partitions (opened).

The partitions allow access to what is needed, concealing it when unneeded. The industrial materials of the space reinforce the medical atmosphere.
Carlo Scarpa
(1906 - 1978)
Italian Architect | Glass and Furniture Designer

In order to properly situate a discussion of architectural detail, ornament, and the inner workings of architecture, we would be remiss to not take a moment to reflect on the work of Carlo Scarpa. It is difficult to pinpoint Scarpa’s work within a framework of architectural history, yet the importance of his work continues to be appreciated years after his death. Typically, Scarpa existed between ideologies, and among the excluded. Throughout his life, he contended with an Italian government which nullified his title as an architect, and contemporaries who questioned his teachings. While judicial challenges plagued him, his work is not any the less rich. Neither is his architecture limited through the range of inspirations in which his tectonic forms took shape (particularly the work of Frank Lloyd Wright), nor is it limited by the narrow geographic range in which he primarily worked (the Veneto, Italy).123

Scarpa’s appetite for experimentation and exploration began to resonate in his later work. As Forster writes; “Scarpa’s architecture gained its cultural significance by dint of the peculiar depth of his thinking and its power to inform every element. His work is radical to the extent that he was able to plumb the inner workings of architecture while displaying its manifold manifestations.”124 Scarpa developed a vast material logic, leading to his rejection of traditional methods and material combinations for his own architectural vocabulary. His mastery of these materials is more characteristic to that of a craftsman or sculptor than an architect, evident in his innovative handling and scrupulous use of these materials. He is known in particular for using stucco lucido, applying some of marble’s unique surface qualities onto a base of plaster, as well as grinding marble to the grain of sugar, and framing surfaces and edges with metal profiles. Scarpa yields a striking beauty in his use and limited palette of bronze, wood, alabaster, with stone and gray cement for the Funerary Chapel at the Brion Cemetery.125

It is precisely these attributes that concern our contention: the character of detail, use of intrinsic color, grain, and material, as well as a deep expression of light and movement. While many of Scarpa’s ideas exist only in his prolific drawings, the Brion Cemetery is one of his most complete realized projects, and one that demonstrates his complete mastery and range of skill in these elements. We place particular emphasis on the counterweighted pulley system that governs the opening and closing of the glass gate at the Eastern end of the compound.

While elaborate, the system is precisely the kind of awareness for the everyday architectural elements our contention seeks to instill within a learning environment. The symbolic nature of Scarpa’s system is intriguing; however our analysis distills a very different lesson. The detail embedded in Scarpa’s alternative system of entrance is one that absolutely should be interactive, evident, and celebrated within an environment dedicated to the cognitive development of a learner. The following discusses the importance of Scarpa’s Brion Cemetery in the broader context of constructivist thought.
Brion Monumental Complex
(1969-1978)
Altivole | Treviso | Veneto | Italy

The Brion monumental complex is, in its own right, a work of art. The commission was virtually free of restrictions, and Scarpa found himself with 21,530 square feet to work with. While there are many elements and parts of this complex that could lend themselves to deep investigation, our focus is on the southeastern section, the entrance to the water pavilion from the complex’s main entrance. Here is a large pool with a meditation pavilion centered over it, built upon iron and spruce planking. The entrance corridor to this area is beyond the symbolic circular openings, where one must lower a heavy door of crystal and bronze into a cut in the corridor floor, which is filled with water from the surrounding pool. The door system is regulated by a counterweight, visible on the eastern wall as a constellation of carefully placed pulleys.

Figure 99: View westward towards the main entrance, with the iconic overlapping circular wall cuts.

Figure 100: Scarpa’s working drawing of the iron counterweight and bronze and stainless steel sliding door pulley system.
Figure 101: Looking west at Scarpa’s pulley wall in the lower East portion of the complex. As the crystal door behind the wall is pushed down, the counterweight is raised out of the water.

Figure 102: Detail of the pulley system while the door system is engaged.
Figure 103 (Top): Plan of the Brion Tomb.

Figure 104 (Right): Corridor entrance to the Water Pavilion, with the pulley assembly visible on the right side of the image.
Figures 105-108
(Left): Gateway in use. Its operator pushing the sliding door into a slot in the corridor floor.

Figures 109-112
(Right): The engaged pulley system on the opposite side of the corridor wall.
Tom Kundig
(1954 - )
American Architect | Principal at Olson Kundig Architects

Tom Kundig grew up in a modest landscape in the Pacific Northwest region of the United States. Present in many of his buildings are tastes of his early influence from working at a sawmill, and the natural scape that he takes advantage of as an outdoorsman. He often likens the outdoors to his profession: “Mountaineering and architecture have many parallels - they’re about solving the problem in as clear and economic means as possible - it’s not about getting to the top.”

All of these influences from experiences in his youth continue to operate as clear design tactics in many of his residential projects. They’re celebrated in what he calls “gizmos” - often systems of wheels, pulleys, gears, and motorized drives that populate his buildings.

Figure 114: Chicken Point Cabin exterior at night.
These gadgets and gizmos have a hefty, handcrafted look, and resonate with the heavy mechanical imagery we associate with the industrial revolution. In many ways, Kundig returns to the user a sense of kinetic control and simple logic. We can trace structural loads in his buildings, and understand the multiplicity of cranks, gears, and flywheels that beg to be handled and operated. The kinetic moments are celebrated. These lessons are essential in how we envision our contention becomes manifested in architecture. These simple kinetic moments are also teachable moments through which a learner might become physically involved with to develop a learning experience through which their new understanding of physical kinematics can now be understood and applied. Even more, these simple moments empower the learner to quite literally take hold of and shape their learning environment.

**Chicken Point Cabin**
Hayden Lake | Idaho

One of Tom Kundig’s most familiar works is a lakeside residence in Northern Idaho. The owners of this waterfront property had one request for Kundig: to make the house as open to the water as possible for the family’s use in Idaho’s oppressive summers. Tom’s primary design tactic was centered on this, and so he developed a massive pivoting picture window that opens the cabin’s largest space to the landscape. In Tom’s own words, “Little house, big window.”

This major design objective presented considerable architectural and engineering difficulties, and subsequently underwent a number of iterations from a counter-balance system using sandbags, to a power-generated system that lifted the window life a garage door. Ultimately, however, Kundig and his client arrived at a hand-cranked physical contraption, a mechanism requiring direct and physical action by the user. The carefully engineered cranks and gears only require minimal input to move the six-ton steel and glass window. Although quite sophisticated, the clear and logical movement of the observable mechanism provides a very tactful experience to achieve a desired outcome. This user experience is very much like the one our contention desires in a learning environment. Kundig’s use of an interactive user environment at Chicken Point illustrates an architecture whose clarity of connection, movement, and detail can act as numerous teachable moments within an ever-changing physical environment.

![Figure 115 (Left): View from dock at dusk.](image1)

![Figure 116: (Right): View from main living space, with picture window fully open.](image2)