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Augmenting the Third Teacher

Christina Hoover

AUGMENTING THE THIRD TEACHER

A study of the school environment in response to technologies, pedagogies and the architectural manifestations of both.

Christina Hoover
ARC 505 | Thesis Prep Book
Advised by Bess Krietemeyer with Roger Hubeli

"[the success of todays young person] depends in large measure on the

experiences s/he has in school.

Those experiences will be shaped by adults, by peers and ultimately by places, by the physical environments where they learn. United in conviction that

the environment is our children's third teacher,

we can begin anew a vital mission: designing today's schools for tomorrow's world."

- The Third Teacher

CONTENTION

This thesis explores the formal and material design potentials of the school and contends that for it to adapt to the needs of today's techno-centric youth, dynamic and responsive materials should be integrated to enhance the environmental quality of spaces for a child's developmental benefit.

Contemporary school design is presented with the opportunity to compensate for a child's overuse of *recreational and entertainment technologies* in the home environment, which can be detrimental to a child's sensory, social, and spatial development. Historically, schools have been able to compensate for the uses and effects of technology by means of an *educational application* of technology, as well as adapt to new pedagogical approaches formally and materially. The prolonged exposure of recreational technology however, has created a new set of needs for the school environment that have yet to be addressed.

The current trajectory for school design insists upon advancing forward in a *technological integration of systems and materials* that affect the quality and experience of the environment, which differs from an educational application of computational tools, displays and digital media. Educational technologies are provided to supplement the teacher directly, but it is key to note that children learn not only from the teacher, but even more so from their environment, both experientially/spatially and socially through interaction with peers.

By applying responsive materials to Chicago Public Schools, these materials can enhance the environmental quality of space for child developmental benefit, respond to changing pedagogical approaches in an architectural manner, and act as a prototype for the CPS, as they progressively address the district-wide issues of overcrowding and a diminishing focus on academics.

TABLE OF CONTENTS

KEY TERMINOLOGY

Recreational Technology
technology and media used for recreational purposes

Educational Technology
technology and media used to supplement the teacher's instruction

Pedagogy
method and practice of teaching

Reggio Emilia Approach
pedagogical approach emphasizing the importance of an interactive environment

Montessori Method
pedagogical approach emphasizing the importance of learning by doing

Spatial Pedagogy
proximity and interaction of student to teacher, peers, and self that affects learning process

The Third Teacher
the learning [and living] environment

Interactive Display and Material Systems
dynamic wall systems that respond to external climate conditions and users within

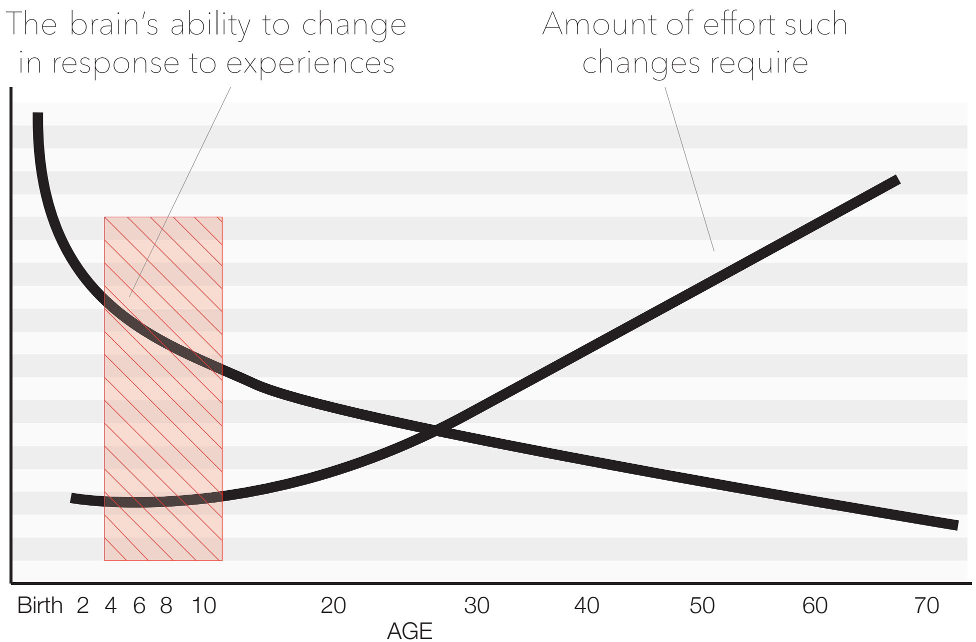
"Early environments and experiences have an exceptionally strong influence on brain architecture.

As a neural circuit is maturing and beginning to function, a child's environment and experiences "can have an enormous impact on that circuit, causing adjustments in its genetic plan and changing its architecture in fundamental ways."

- NSCDC

PREFACE

image reference 1

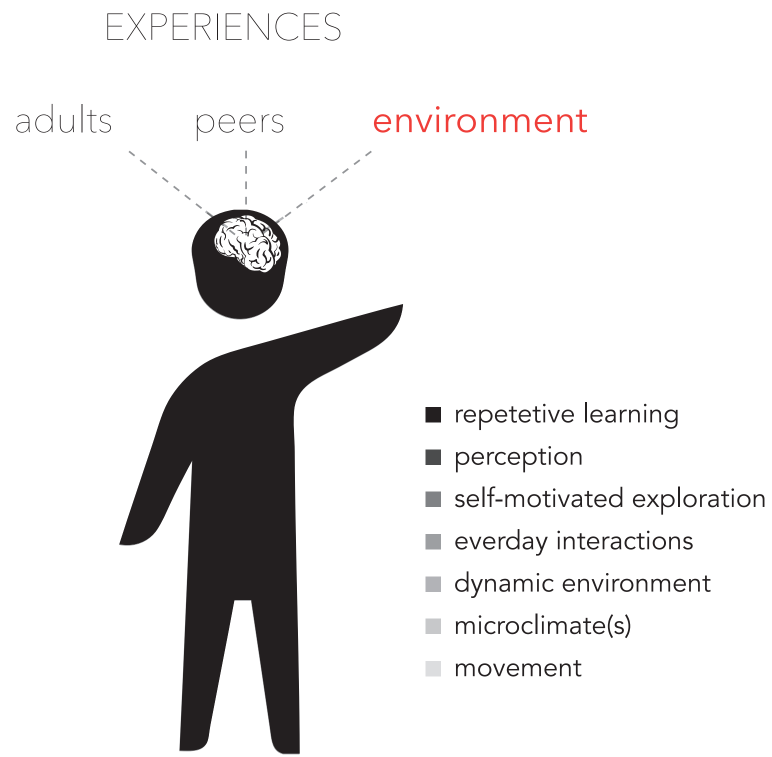


adaptation | image reference 2

"The first years of life are a very busy and crucial time for the development of brain circuits. The brain has the most plasticity, or capacity for change, during this time, which means it is a period of both great opportunity and vulnerability. The impact of [environmental] experiences on brain development is greatest during these years. It is easier and less costly to form strong brain circuits during the early years than it is to intervene or "fix" them later. "

sources: center on the developing child, harvard university

Strong brain connections are created through a child's learning and living experience. The three ways and sources from which children learn and development are their experiences with teachers, with peers and with the environment. It is the role of architecture to design consciously to create specific environmental qualities in the school and classroom that encourage and foster interactions between a child and his/her teacher and peers. Therefore, the environments for those between ages 4 and 11, when the brain is most malleable, must be sensorially and spatially experiential.



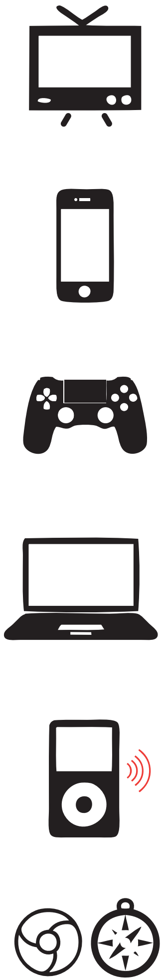
how the mind learns

source: architecture for children

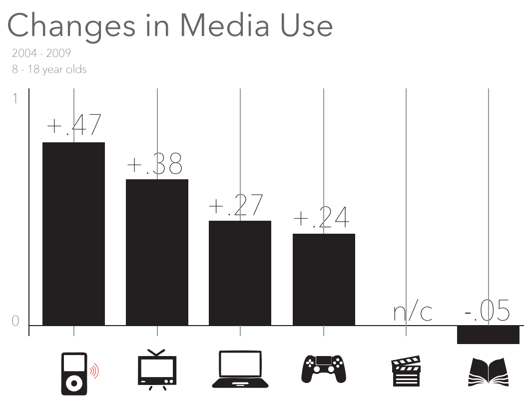
CHAPTER 1. INTRODUCTION TO THESIS TOPIC AND CLAIM

recreational use of technologies

image reference 3



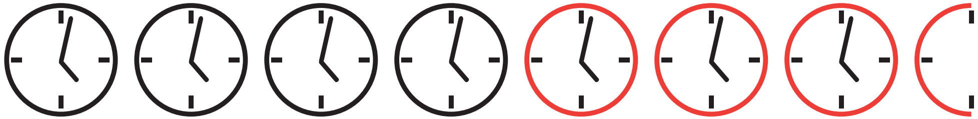
RECREATIONAL USE OF TECHNOLOGY



adaptation | image reference 4

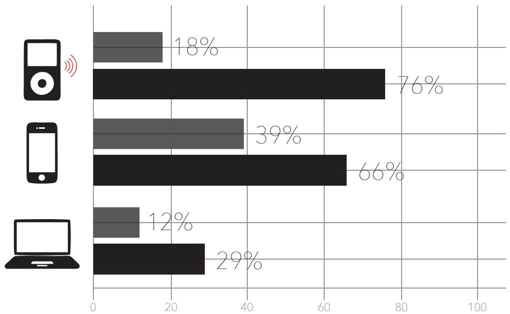
Today's society has become exceedingly more advanced in communication, information and entertainment technologies, such as mobile devices, gaming systems, and the internet. These recreational technologies have in many ways been beneficial to our lifestyles, however we are now learning of the unintentional negative impacts of their use on the sensory and spatial development of children. On average, today's child spends 7.5 hours with recreational technology a day, but studies in conjunction with the American Academy of Pediatrics, show that any more than 5 hours of exposure and use results in what they call brain pruning. "Children are using 4-5 times the amount of technology recommended by Pediatric experts."

source: research review regarding impacts of technology on child's development, behavior and academic performance



avg 7.5 hrs/day with recreational technology
5+ hours = "brain pruning"

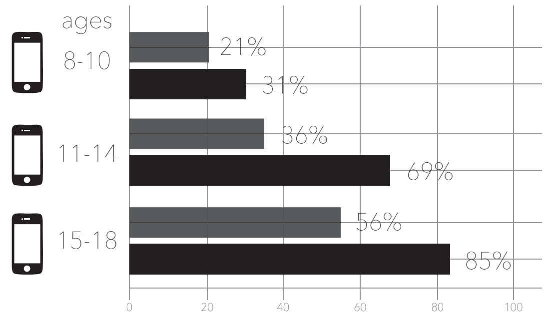
Mobile Media Ownership



2004
2009

adaptation | image reference 5

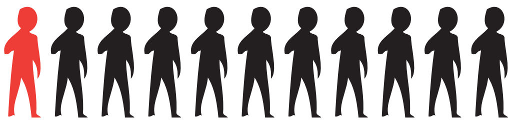
Cell Phone Ownership



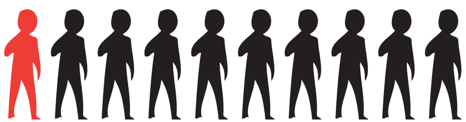
2004
2009

adaptation | image reference 6

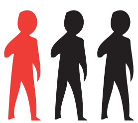
source: research review regarding impacts of technology on child's development, behavior and academic performance



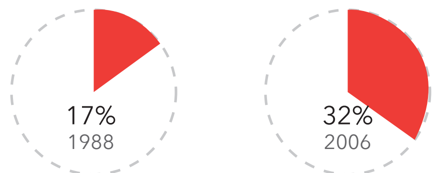
1 in 11 children have an addiction to entertainment technology



1 in 10 children have ADHD as a result

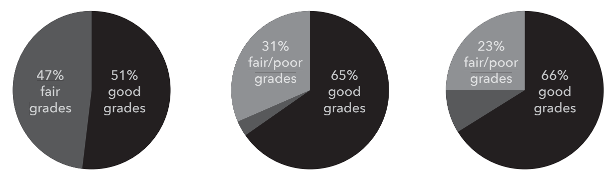


1 in 3 children enter kindergarten developmentally delayed



% of children with developmental issues

Media Use and Grades



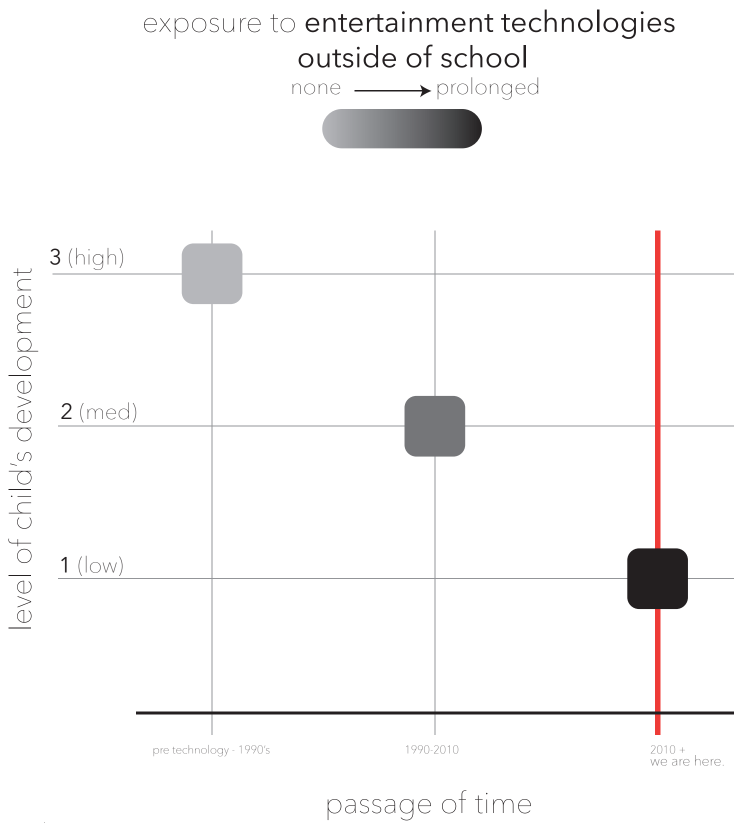
heavy use moderate use light use

reproduction | image reference 7

sources: research review regarding impacts of technology + early learning partnership

As a result of the overuse of recreational technologies, there is an drastic increase in the percentage of children entering school with developmental issues, ranging from social ineptitude and attention deficiency. Research from the Early Learning Partnership at the University of British Columbia says that 1 in every 3 children now enter kindergarten developmentally delayed, and every 1 in 10 children have attention deficit hyperactivity disorder.

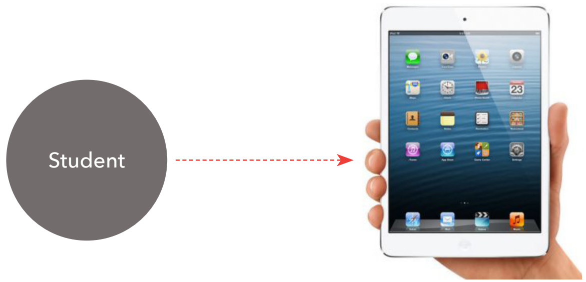
In summary, research shows that the longer children are exposed to recreational technologies, the more their cognitive, social, and spatial development decreases.

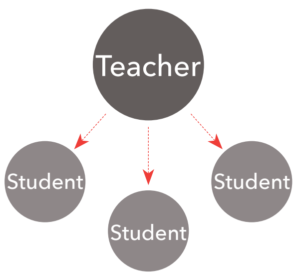


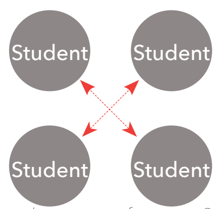
source: *research review regarding impacts of technology + early learning partnership + kaiser foundation report*

educational use of modern learning technologies *image reference 8*

EDUCATIONAL USE OF TECHNOLOGY







adapatation | image reference 9

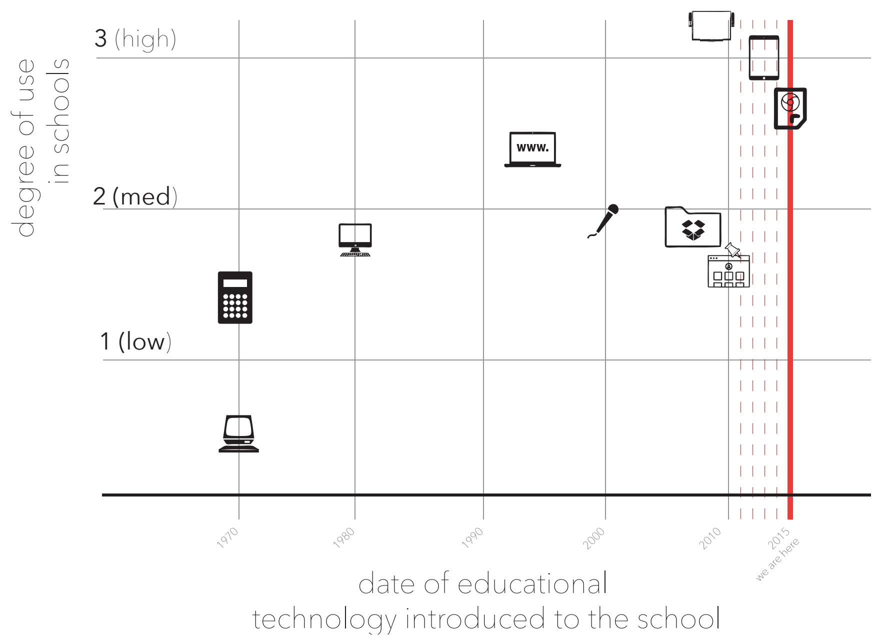
source: ipad: effective use in the classroom

While the use of recreational technologies has increased, the educational application of modern learning technologies have also increased and begun to be integrated into the school system and pedagogical framework. Technologies, such as the iPad or the SmartBoard, are a great supplement to the teacher's instruction as well as a new vehicle for digital discovery and self-dependent learning, even in elementary schools.

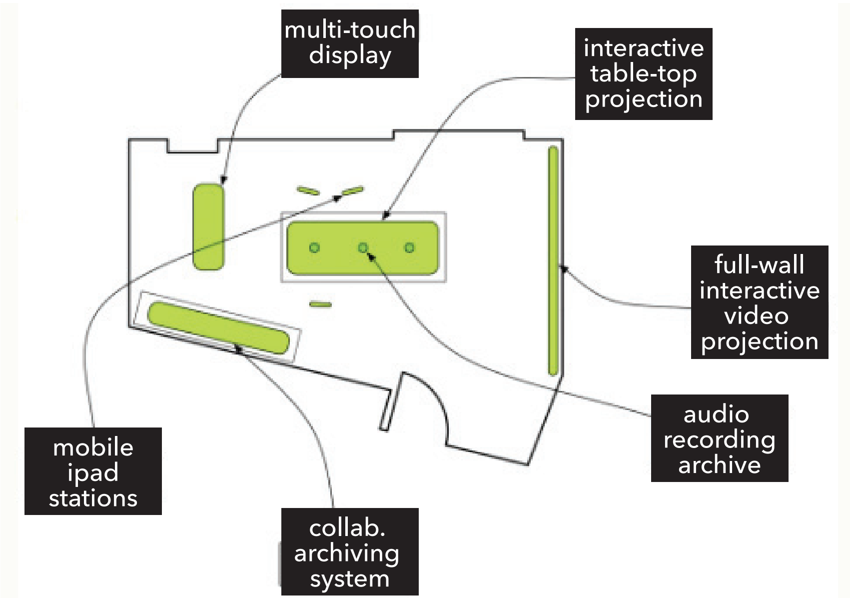
Schools have consistently been attaining and integrating technologies into their curriculum as they manifested themselves, in hopes of keeping up with the advancing times and equipping students with the necessary skills to succeed professionally in their future.

Since the initial integration of technology in the school setting with the basic calculator and computer, more technologies have been introduced and put into effect in most schools settings. The level of integration is still up for debate in many cases due to how closely the technology works within the curriculum, but as schools progress further into the 21st century school ideal, this thesis speculates that technologies like the iPad, interactive projection screens, and digital media will ultimately become the standard platform for instruction and learning.

application and use of **educational technologies** in schools



ThinkLab



reproduction | image reference 10

As a case study of educational technologies in the classroom setting, "Thinklab formed an experimental research, teaching, and collaboration environment in The Nancy Cantor Warehouse at Syracuse University. Running for two years, this environment facilitated experimentation in new media, collaboration, visualization, and interaction technologies [through the inclusion of] digital pens, interactive tables, and gesture-recognition systems."

image reference 11

source: thinklab at the warehouse

Einhorn Next Generation Studio

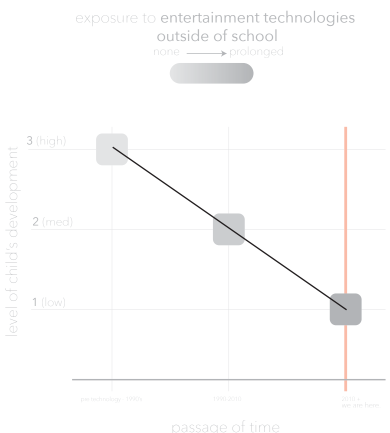
In a similar fashion, the Einhorn Studio at Syracuse University's School of Architecture acted as a test bed for technological integration of educational and modern learning technologies. "The studio's greatest potential was for hands-on exploration with design technologies, and it sought to design an adaptable structure that not only would accommodate this, but which would explicitly encourage team-based learning and interdisciplinary work."

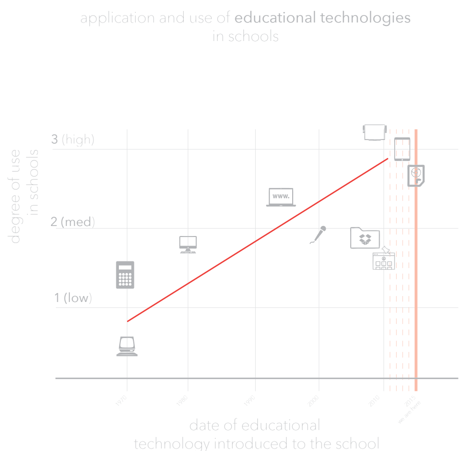
A common observation of both modern classrooms is that the key to their successes is an integration with the curriculum, as some student are more attuned to exploration through learning varying means and media.

image reference 12

source: einhorn next generation design studio

THESIS POSITION

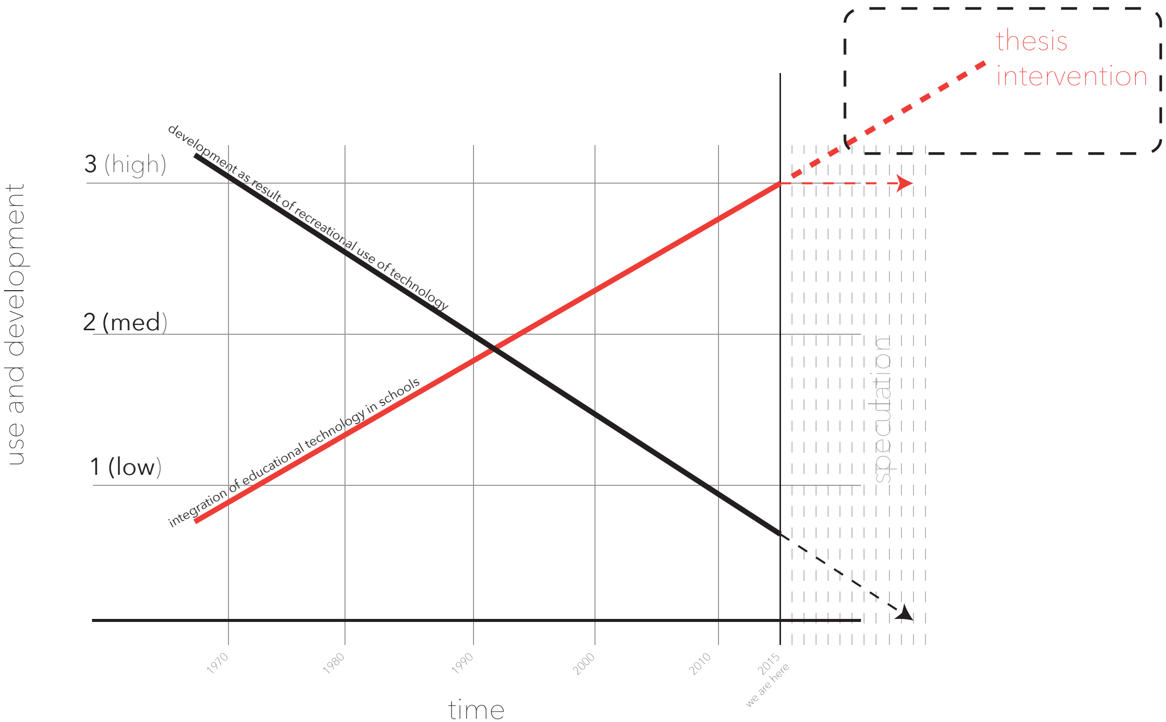




Through comparing the uses of both recreation and education technologies, one can hypothesize that we, as a society, have begun to see a plateauing of school's ability to integrate educational technologies, while children continue to become more developmentally delayed.

This thesis contends that in order to continue countering the negative effects of recreational technologies, a different kind of technological integration needs to occur within the school environment. In tangent with the use of technologies as an educational supplement, this thesis explores the design potentials of technologically advanced material systems and their ability enhance the learning environment, and furthermore a child's sensory and cognitive development.

child and technology matrix



how?

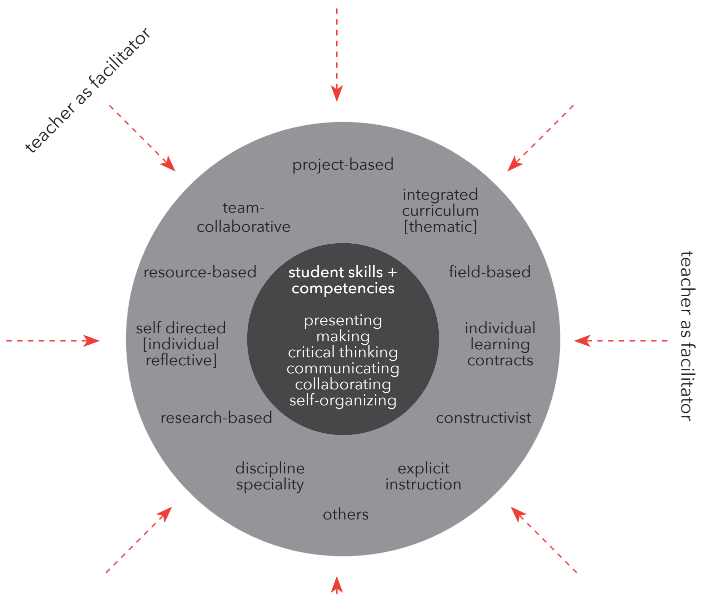
integrate technologically advanced material systems that affect the environment of a child's learning space

CHAPTER 2. EXISTING PEDAGOGY AND ARCHITECTURAL MANIFESTATIONS

Reggio Emilia Classroom
image reference 13

Montessori Classroom
image reference 14

PEDAGOGICAL APPROACHES

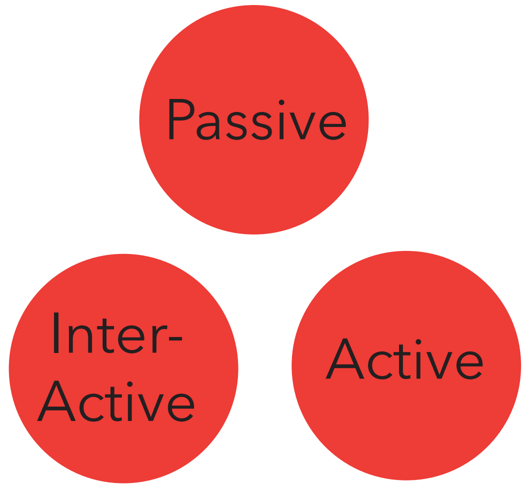


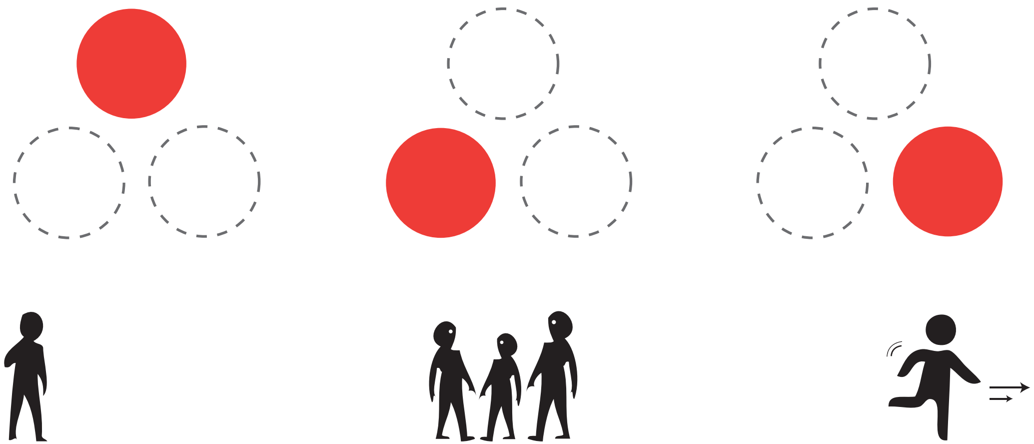
adaptation | image reference 15

sources: educational facilities planning + linking pedagogy and space

Throughout history, pedagogy in the American school system has been constantly evolving and adapting to new means of instruction, from strict and direct instruction from the teacher to very open education and self exploration in the 1960's marking the first major educational reform. With these varying pedagogical approaches, the architecture of schools and classrooms have adapted formally and materially to aid in creating specific learning environments. Looking through the lens of two major approaches [the Reggio Emilia Approach and the Montessori Method], this thesis maps the progression of school design and begins to speculate on future design processes as today's pedagogies become more integrated with educational technologies.

Types of Learning





physically inactive
can learn alone / at own pace
presenational set up

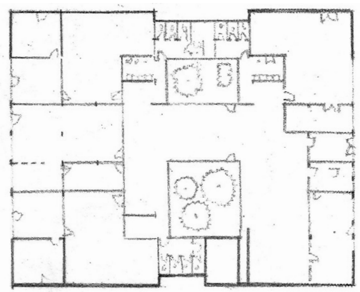
interactive in small groups
required to participate
various types of learning activities
begin personal territory violations

learning by doing
space consuming
cognitive
affective
psychomotor

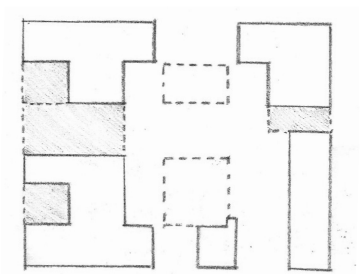
source: designing productive learning environments

Reggio Emilia Approach

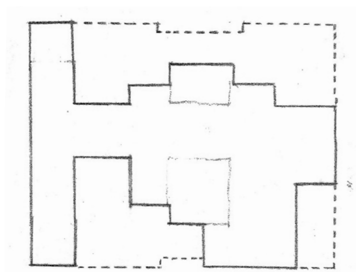
Inter-
Active



Diana School, Reggio IT



Ateliers in relationship to classrooms



Interactive communal space

Key Points

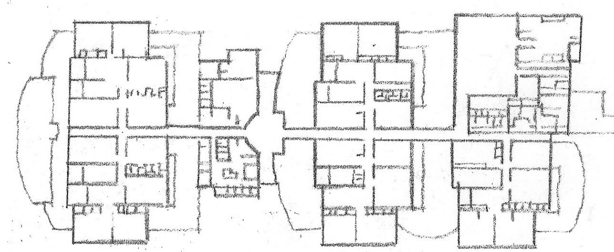
1. Children are capable of constructing their own learning
2. Children form an understanding of themselves and their place in the world through their interactions with others
3. Children are communicators
4. The environment is the third teacher
5. The adult is a mentor and guide
6. An emphasis on documenting children's thoughts
7. The Hundred Languages of Children

source: what is the reggio emilia approach?

Montessori Method

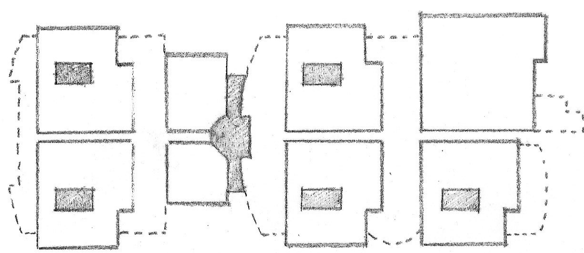
Key Points

1. Children are to be respected as different from adults and as individuals who differ from each other
2. Children possess an unusual sensitivity and intellectual ability to absorb and learn from their environment that are unlike those of the adult both in quality and capacity
3. The most important years of children's growth are the first six years of life when unconscious learning is gradually brought to the conscious level
4. Children learn by doing

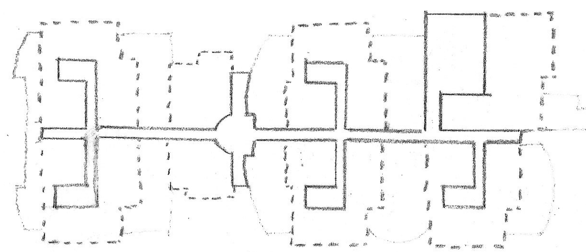


McWillie Elementary School, Jackson MS

Active

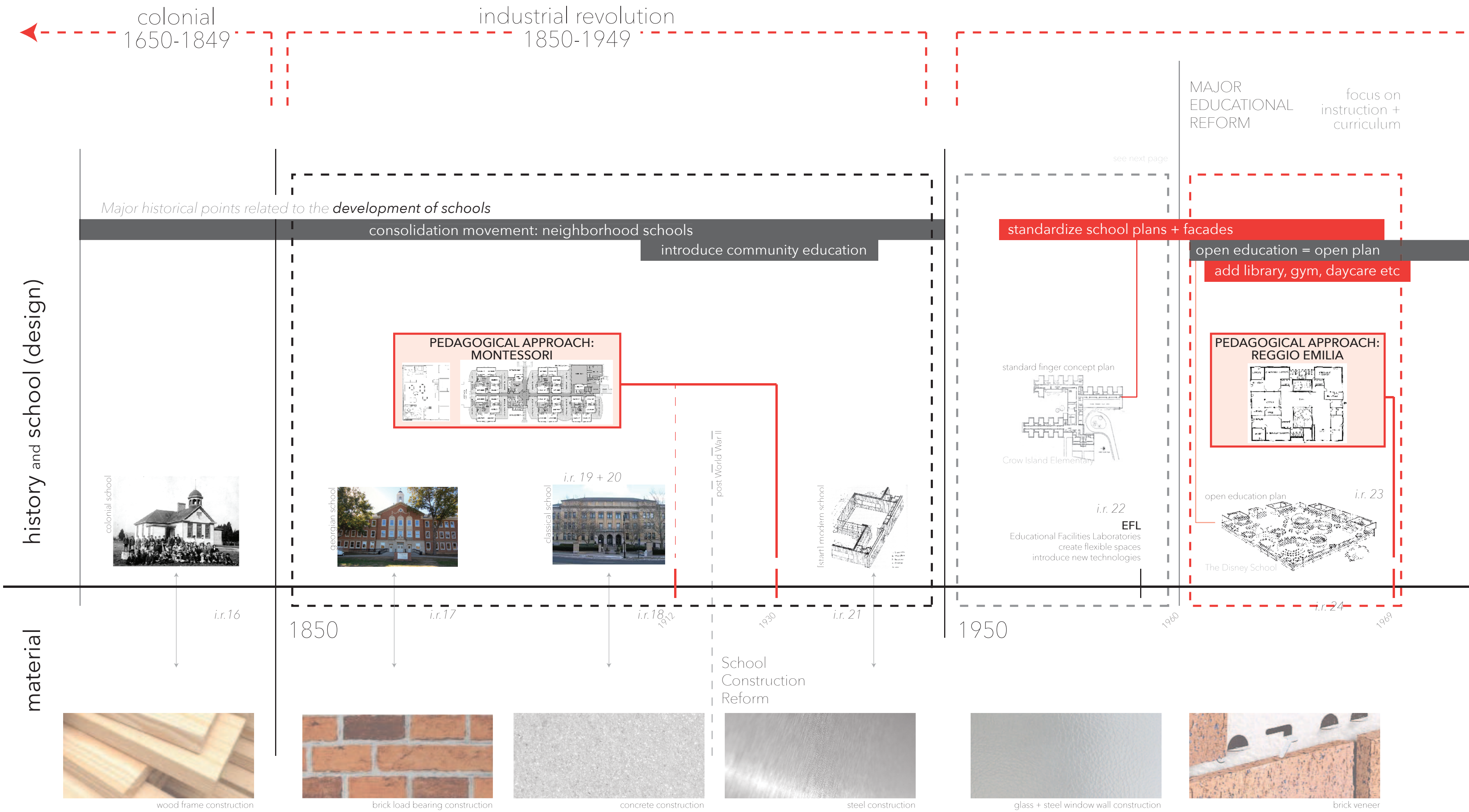


Ateliers in relationship to classrooms

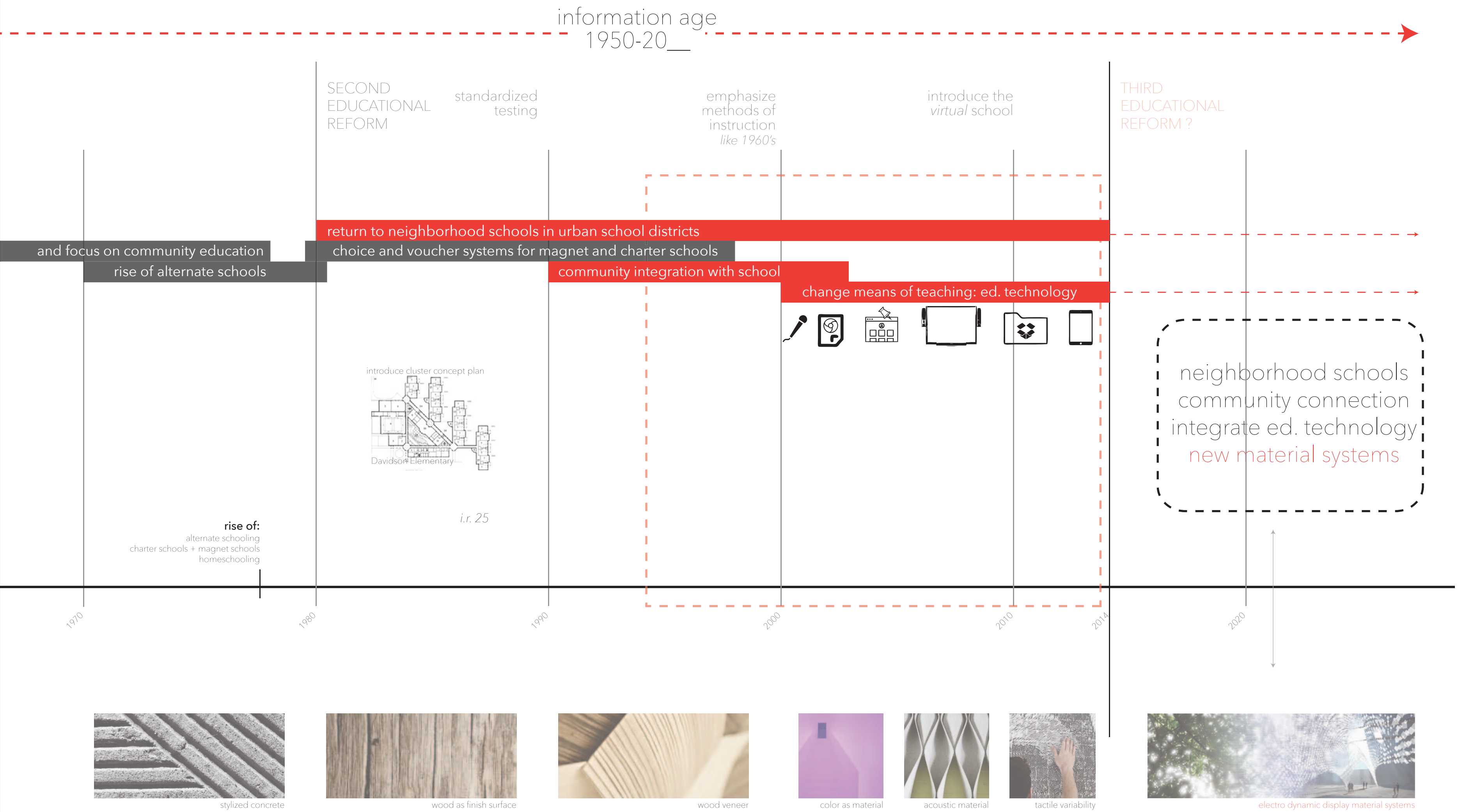


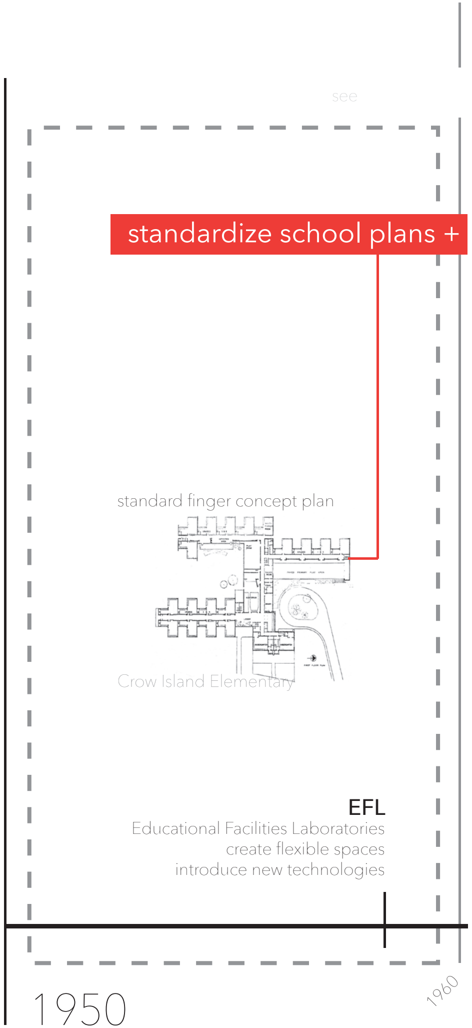
Interactive communal space

source: what is the montessori method?



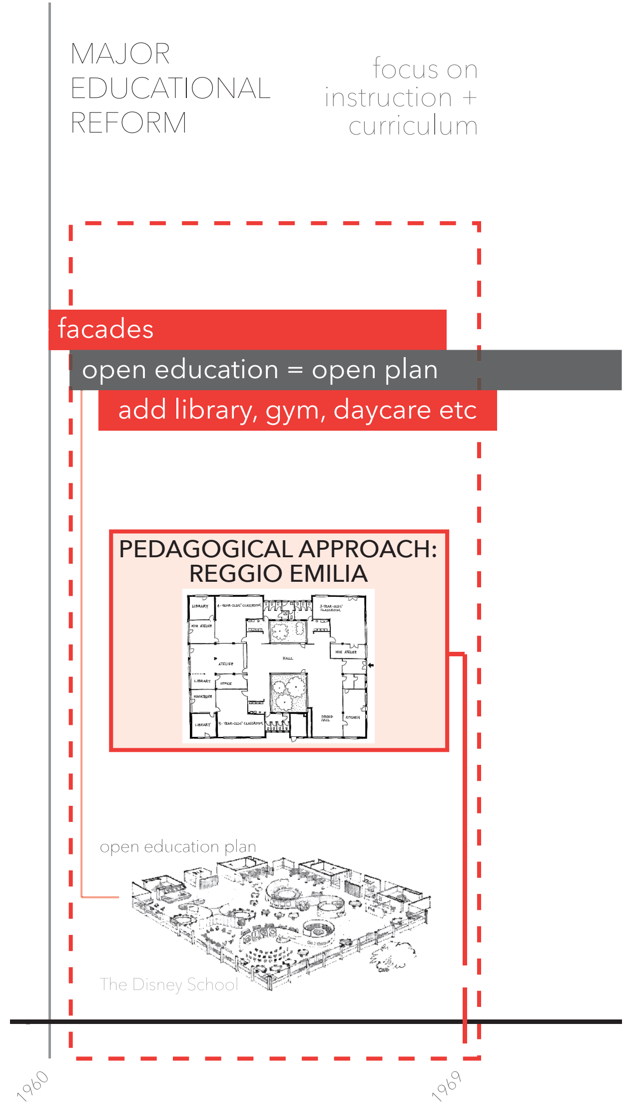
source: educational facilities planning


information age
1950-20__
SECOND EDUCATIONAL REFORM
standardized testing
emphasize methods of instruction
like 1960's
introduce the virtual school
THIRD EDUCATIONAL REFORM ?
return to neighborhood schools in urban school districts
and focus on community education
choice and voucher systems for magnet and charter schools
rise of alternate schools
community integration with school
change means of teaching: ed. technology
neighborhood schools
community connection
integrate ed. technology
new material systems
introduce cluster concept plan
Davidson Elementary
i.r. 25
rise of:
alternate schooling
charter schools + magnet schools
homeschooling
1970
1980
1990
2000
2010
2014
2020
stylized concrete
wood as finish surface
wood veneer
color as material
acoustic material
tactile variability
electro dynamic display material systems



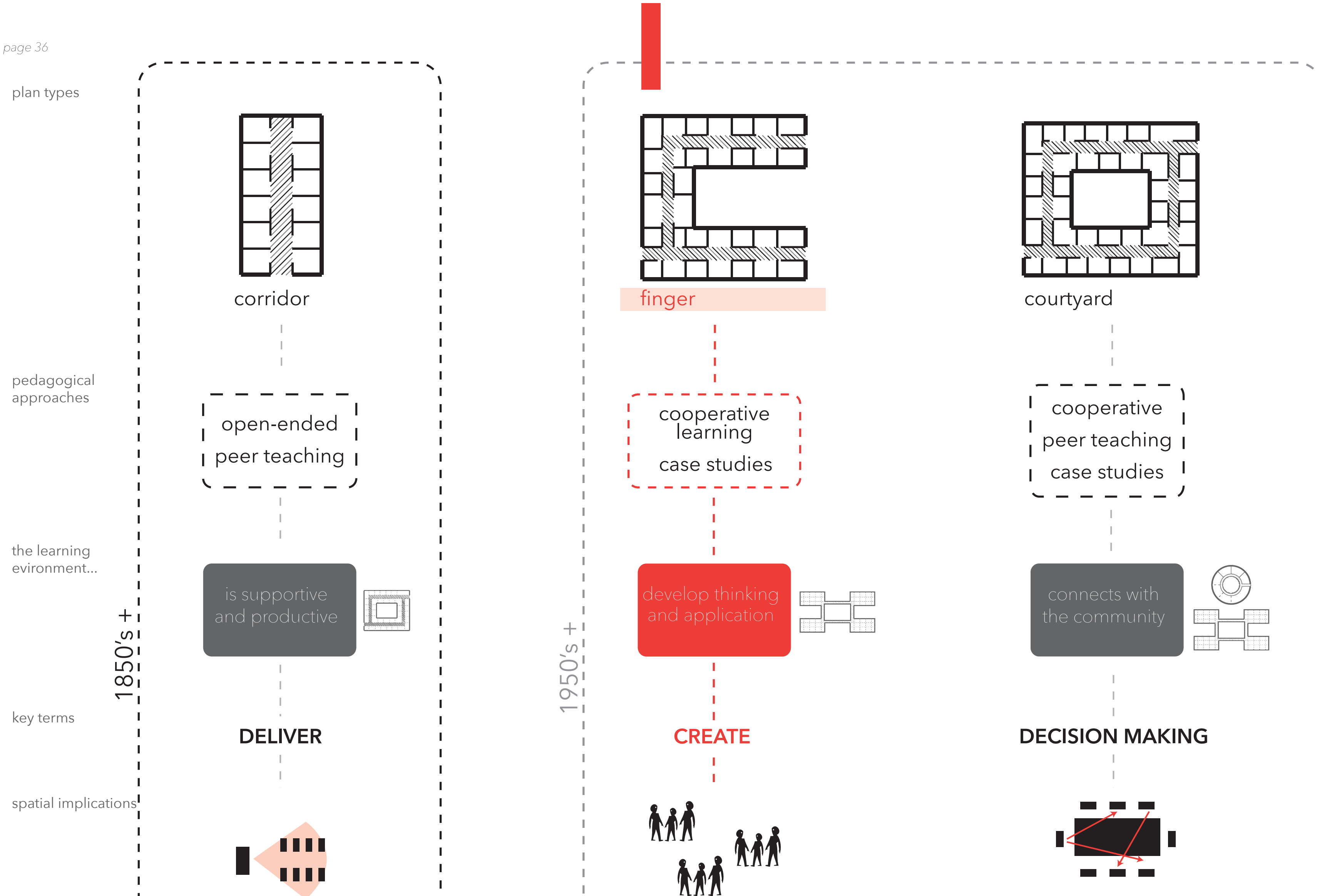
The 1950's and 1960's are exemplary of the major pedagogical and architectural shifts that occurred in the history of school design. The fifties marked an era when there was a rapid growth rate of student population due to the baby boomers, which resulted in an increase in school construction. Plans and facade aesthetics were becoming standardized with finger concept plan rather than the simple corridor, and more modern material use of glass and steel window wall construction. There also became a huge emphasis on the flexibility of spaces within the school with the initiatives of the Educational Facilities Laboratories.

source: educational facilities planning



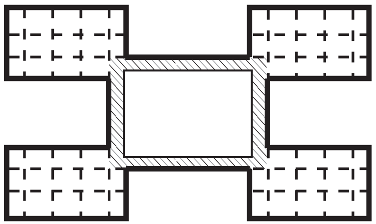
Shifting into the sixties, the idea of flexible and open classrooms began to take on an entirely new identity. The concept of open education turned into open plan organization, which interiorized all activities. Simultaneously in Reggio Emilia, Italy, the Cluster concept plan organization became the ideal school for its translation of open education into open ateliers and a focus towards outdoor spaces, rather than barrier-free interiorized plans.
In tangent with the varying approaches to open education, as white flight occurred from the cities, the suburbs were booming and lacked a sense of community. This marked the beginning of schools with public programming potential, such as the in-school libraries, gymnasia, day care centers and recreational spaces.

source: educational facilities planning

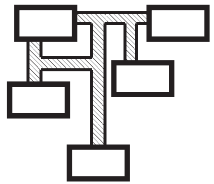


sources: designing productive learning environments + linking pedagogy and space

1960's +



cluster/house



campus

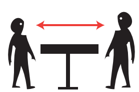
interdisciplinary

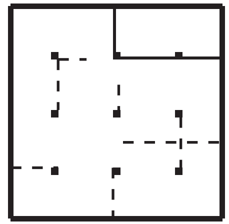
assessment
evaluation

locus of control

involves assessing and practice

APPLY





open

discovery

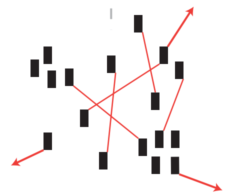
open
education

locus of control

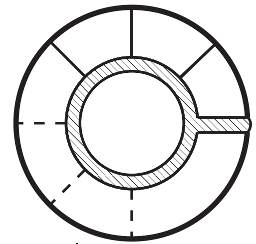
"open vs. degree of openness"

promotes self-motivation, individuality + flexibility

FREE



Contemporary



circular

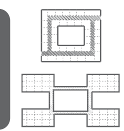
plans reproduction | image reference 26

values of
clarification

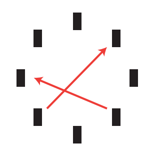
experiences

differentiated

students needs reflected in program



COMMUNICATION

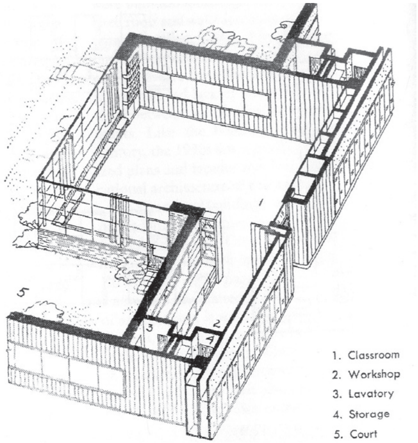


adaptation | image reference 27

Finger Plan Concept “Standard” | Crow Island Elementary, Eero Saarinen

image reference 28

image reference 29



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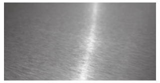
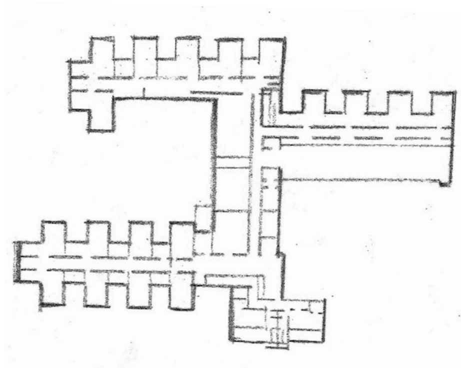
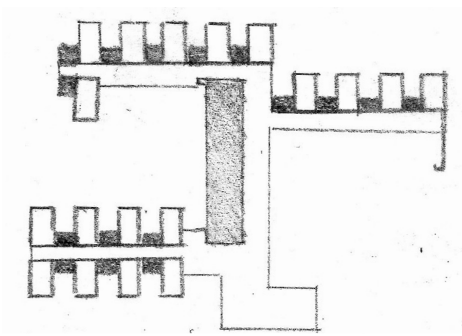


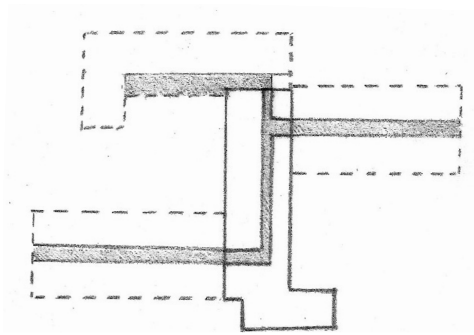
source: educational facilities planning



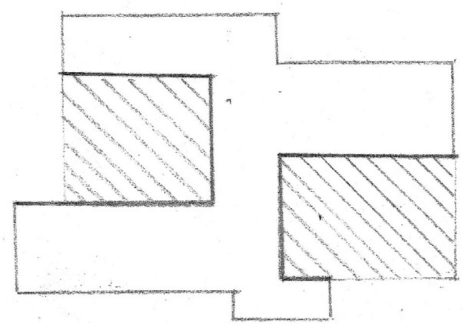
Crow Island Elementary | finger concept plan



classrooms in relation to ateliers



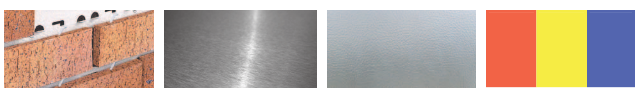
central corridor with branches of classrooms

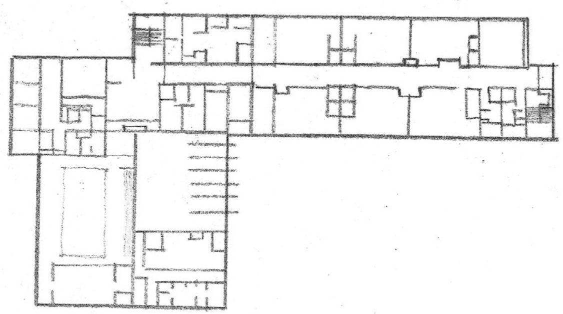


connection to outdoor learning space

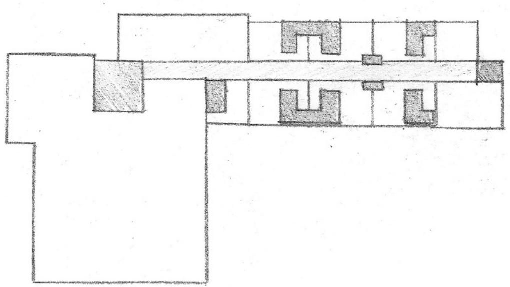
Finger Plan Concept “Modern” | Prieto Math and Science Academy, STL Architects

image reference 31

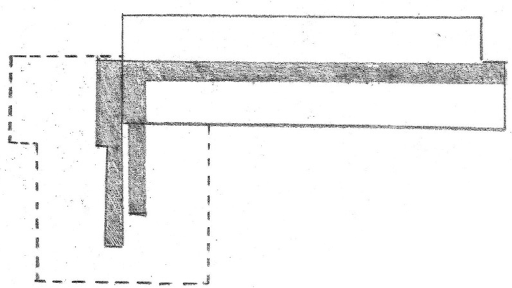




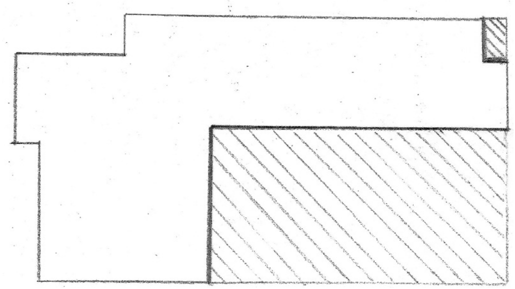
Prieto Math and Science Academy | finger / corridor concept plan



classrooms in relation to ateliers



central corridor with branches of program



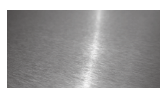
connection to outdoor learning space

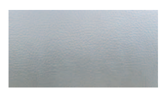
Cluster Plan Concept “Standard” | Diana School, Reggio Emilia

image reference 32

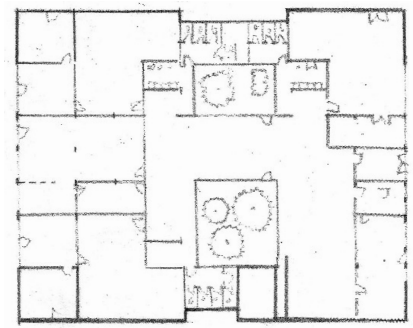
image reference 33

image reference 34

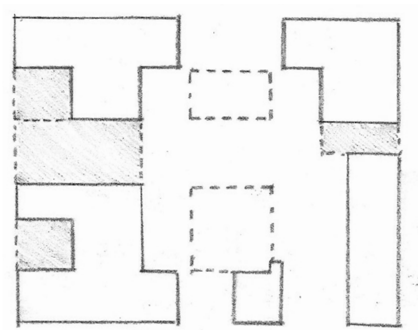




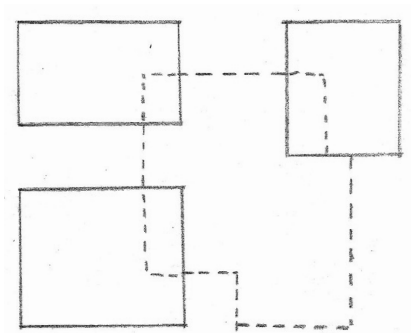
source: amiable space in the schools of reggio emilia



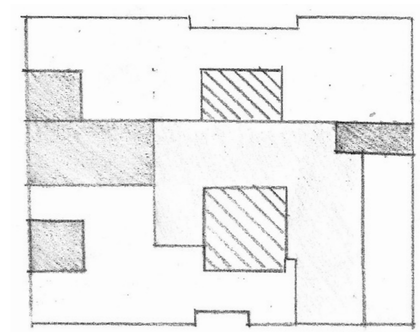
Diana School | cluster concept plan



individual classrooms in relation to ateliers



central atelier with classroom clusters



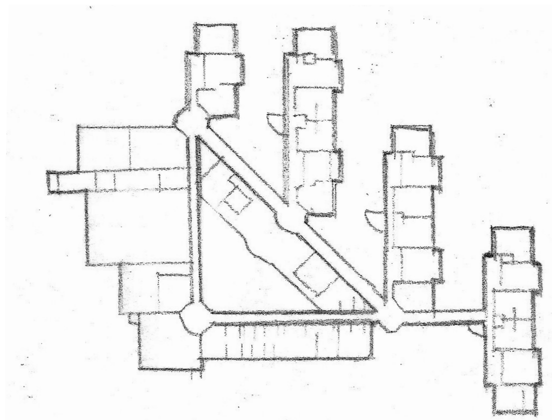
division of spaces: Classroom mass, atelier, outdoors

Cluster Plan Concept “Modern” | Davidson Elementary School, Adams Group

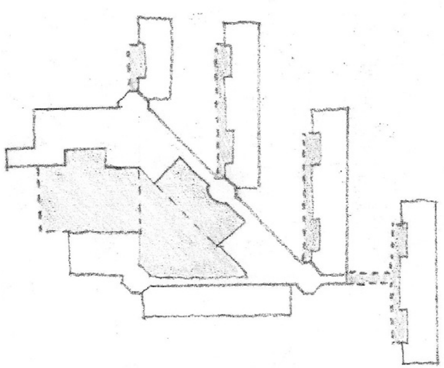
image reference 35


image reference 36

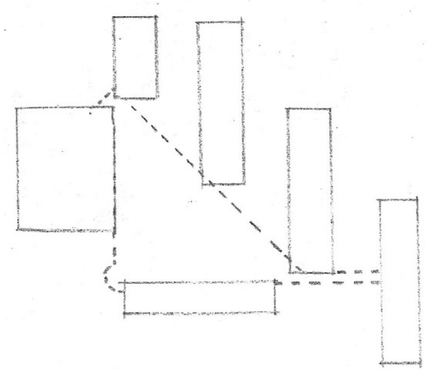
source: designing a responsive school environment



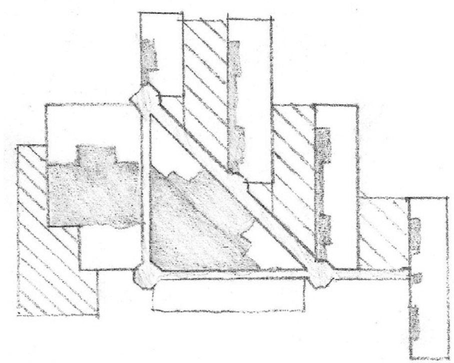
Davidson Elementary School | cluster concept plan



individual classrooms bars in relation to ateliers

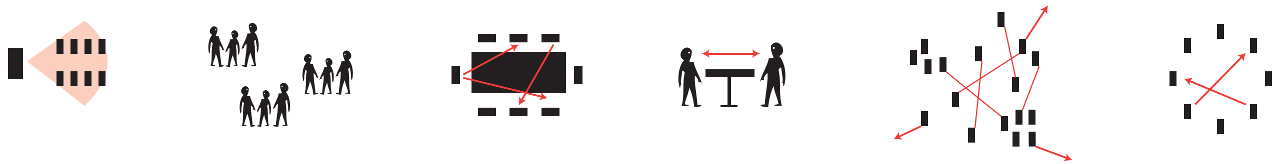


central atelier with classroom clusters

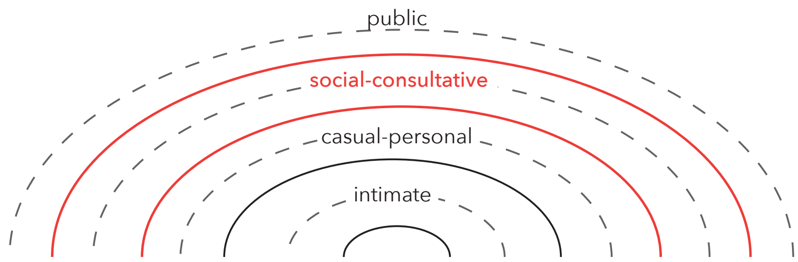


division of spaces: classroom mass, atelier, outdoors

CHAPTER 3. SPATIAL AND PROGRAMMATIC IMPLICATIONS



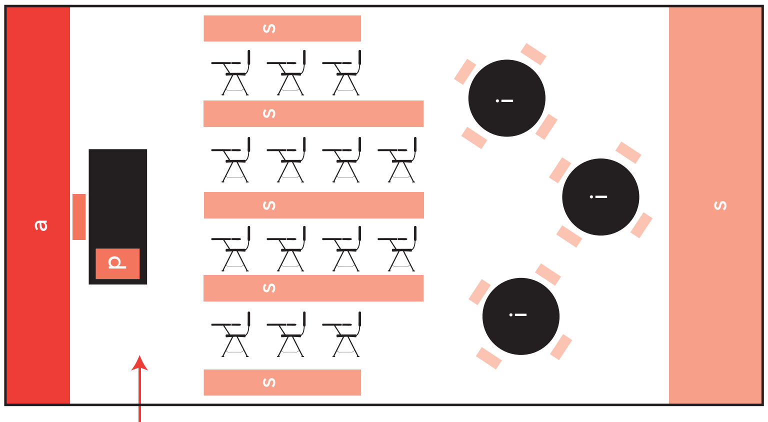
adaptation | image reference 37



social-consultative space:
student - teacher relationship

reproduction image reference 38

SPATIAL PEDAGOGY



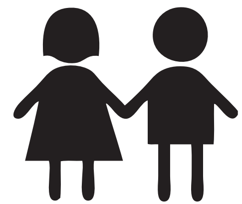
spatial pedagogy of a teacher within the space of a classroom

authoritative
personal
supervisory
interactive

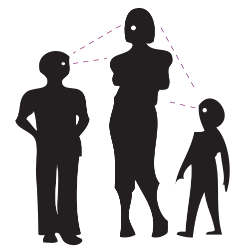
source: spatial pedagogy: mapping meanings in the use of classroom space

In addition to the varying pedagogical approaches of instruction, there have been studies on the spatial pedagogy of the classroom, relating to interactions between the student and teacher, student and peers, and student and themselves in the school environment. Spatial pedagogy, as defined by Dr. Kay O'Halloran of Curtin University, works in tangent with instruction techniques, is "realized through patterns of positioning and the directionality of movement," and is classified through four types of space in the classroom. Those four spatial constituents are authoritative, personal, supervisory and interactive, which separately and collectively affect a child's learning experience.

The four spatial zones of the classroom foster varying degrees of interaction among all parties. The authoritative and supervisory are used almost exclusively by the teacher and involve the least interaction. The interactive area facilitates interactions between a student, teacher and peers simultaneously. Research from the Lucy Brock Child Development Program highlights how different types of interactions benefit their spatial understanding and experience of the classroom environment. Through hands on activities as well as interaction by observation, children become more involved in the learning processes, are more open to spontaneous interactions and more likely to be attentive of their peers and the environment.



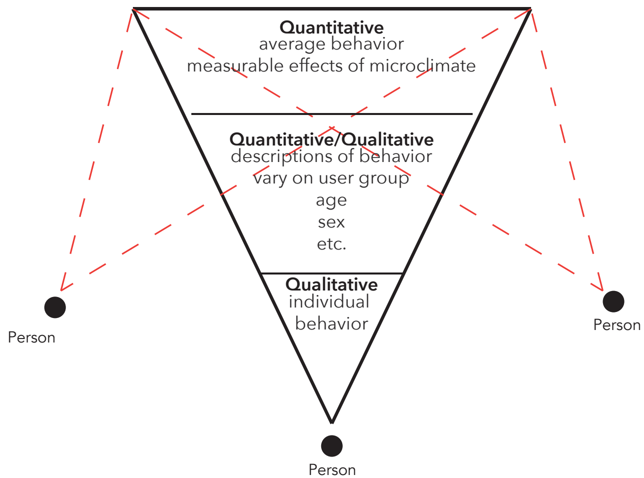
direct contact with others



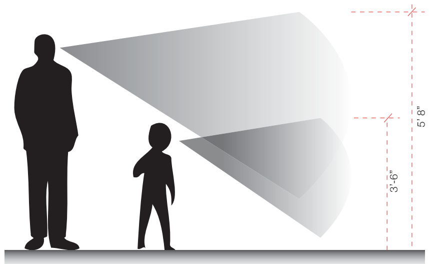
mixed age group interactions

group interaction by observation

sources: early childhood research & practice + lucy brock child development laboratory program + what is the montessori method?



adaptation | image reference 39



adaptation | image reference 40

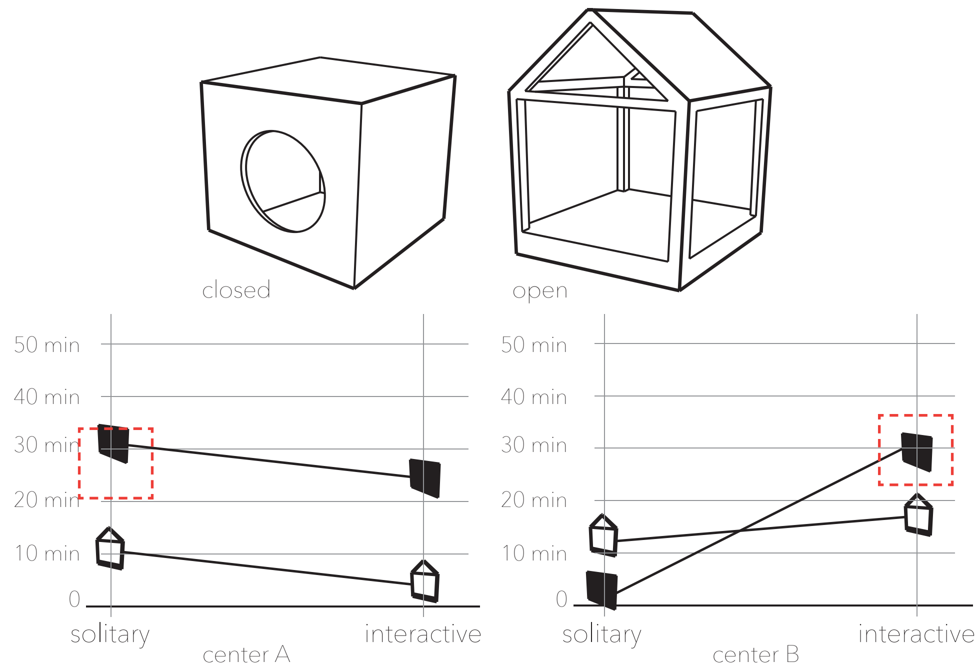
sources: childhood's domain + architecture of early childhood

Each space in the classroom, as well as other spaces within the school, should be intentionally designed to cater to the adult but even more so the child and his/her area of perception. Children perceive experiences and space differently than adults but also differently than their peers. All users in a particular space can be quantitatively understood by their collective behavior but a qualitative understanding is based solely on an individuals behavior.

Similarly, the quality of the space based on atmospheric effect and aesthetic character is entirely perception based, as is a user's response to the space. Architecture, therefore, must address the spatial parameters that affect both child and adult, such as the height at which they perceive the space and the tactility of materials.

Another spatial parameter that should be considered in all classrooms relates to spaces that encourage not only interactions but solitary play and exploration. Research done, in tangent with the Youth and Environments Center at the University of Colorado Boulder, analyzes how different encapsulating spaces promote varying means of play. The most successful structure type for interactive play was the closed space in both centers. In contrast, the open structure in center A provoked solitary play, while in center B, it was the closed structure.

When considering both interactive and solitary play, the more successful scenarios from centers A and B involved closed play areas.

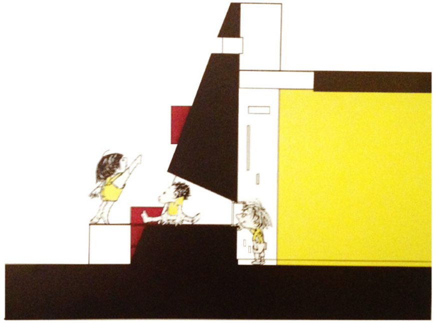


sources: privacy in the preschool environment, children's environments. vol. 10

adaptation | image reference 41

CASE STUDIES (child perception)

perception | spatial parameters | views



Sjötorget Kindergarten, Rostein Arkitekter
St. Clare's Parish Child Center, Studio 16
Little School, Mark Horton Architects
Children's School, No.MAD Arquitectos

Spatial Parameters:
child perception height
exterior glazing mullions
detailed undulating surfaces 30" or below

Interaction:
occupiable niches
levels of transparency stimulates group interaction

source: kindergarten architecture + architecture of early childhood

THE SENSES

In addition to considering the spatial implications that school and classroom design has on the child, facilitating sensory stimulation is crucial. At the earliest stages of life and development, the child is exposed to many experiences that are essential in the development and growth of their senses as well as their skills.

As direct result of their school environments and personal interactions, sensory maturation of the haptic, kinesthetic and synesthetic systems occurs.

Often the senses are understood to be composed of 5 fundamentals including:

sight	touch	sound	smell	taste
vision	*somatosensory*	*audition*	*olfaction*	*gustation*

sources: zero to three + humans have a lot more than five senses

" [their] perception is an active experience (movement) aided by designs that support function and nourish the childs sensory and aesthetic sensibilities."

- Ismail Said, Architecture for Children

However, there are many more senses and skills that are relevant to the perception of the body in space. The remaining senses relating to perception include:

propioception ability to locate body parts relative to other body parts

equilibrioception sense of balance and body movement [acceleration and directional changes]

thermoception ability to sense heat and cold

nociception sense of pain

time ability to perceive time and the passing of it

acuity perceptin of fine detail

binocularity coordinated use of both eyes

sources: zero to three + humans have a lot more than five senses

sensory experience

HAPTIC SYSTEM	KINESTHETIC SYSTEM	SYNESTHETIC SYSTEM	NERVOUS SYSTEM
skin, joints, and muscles	muscles and joints	neurological	
exploration (through touch)	exploration (through movement)	sensory connection and transference	
varying configurations of touch	varying positions and movement of body parts	memories	
	propioception equilibrioception		thermoception nocioception

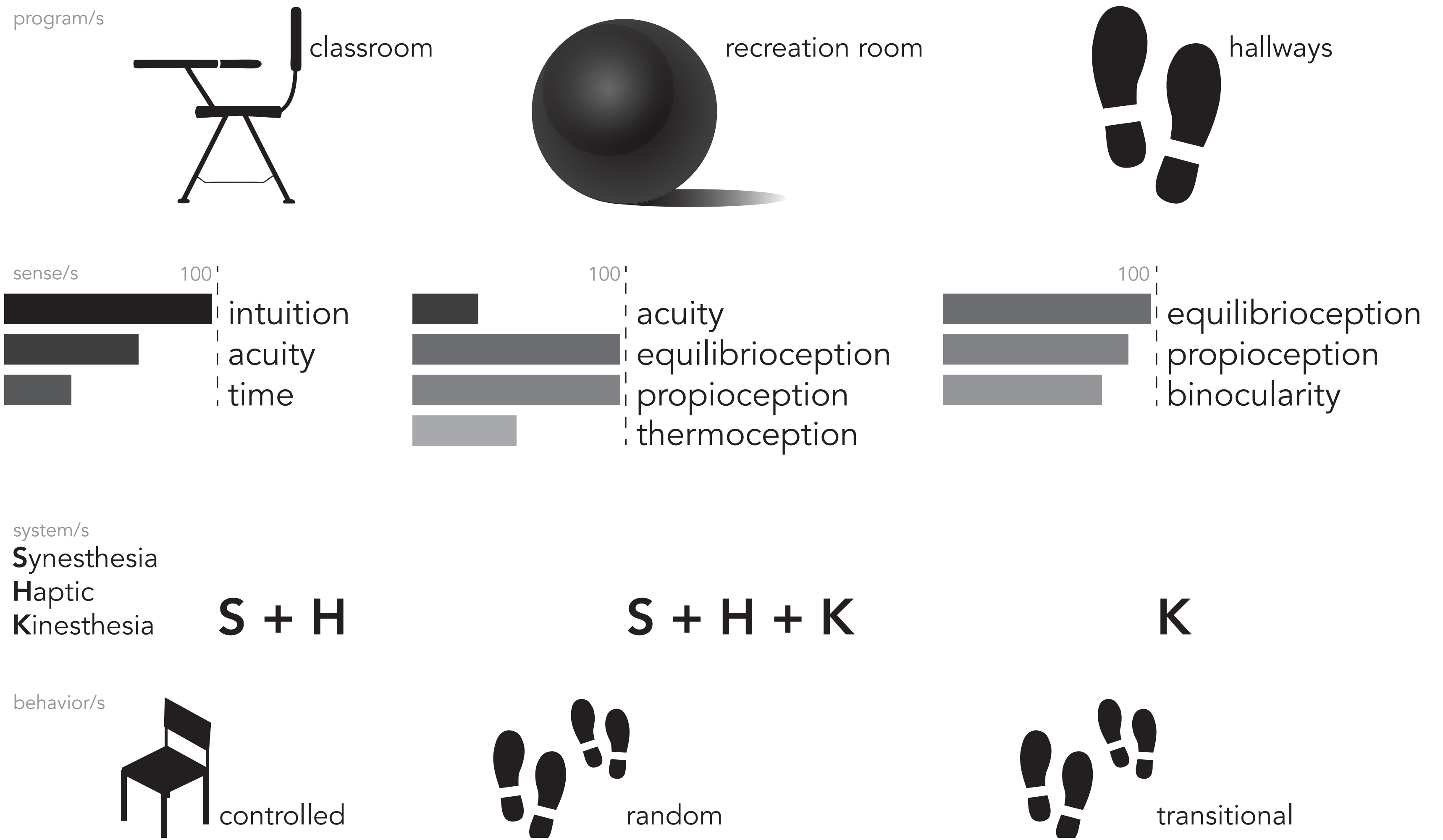
adaptation | image reference 42

sources: technology of the senses + sensory design

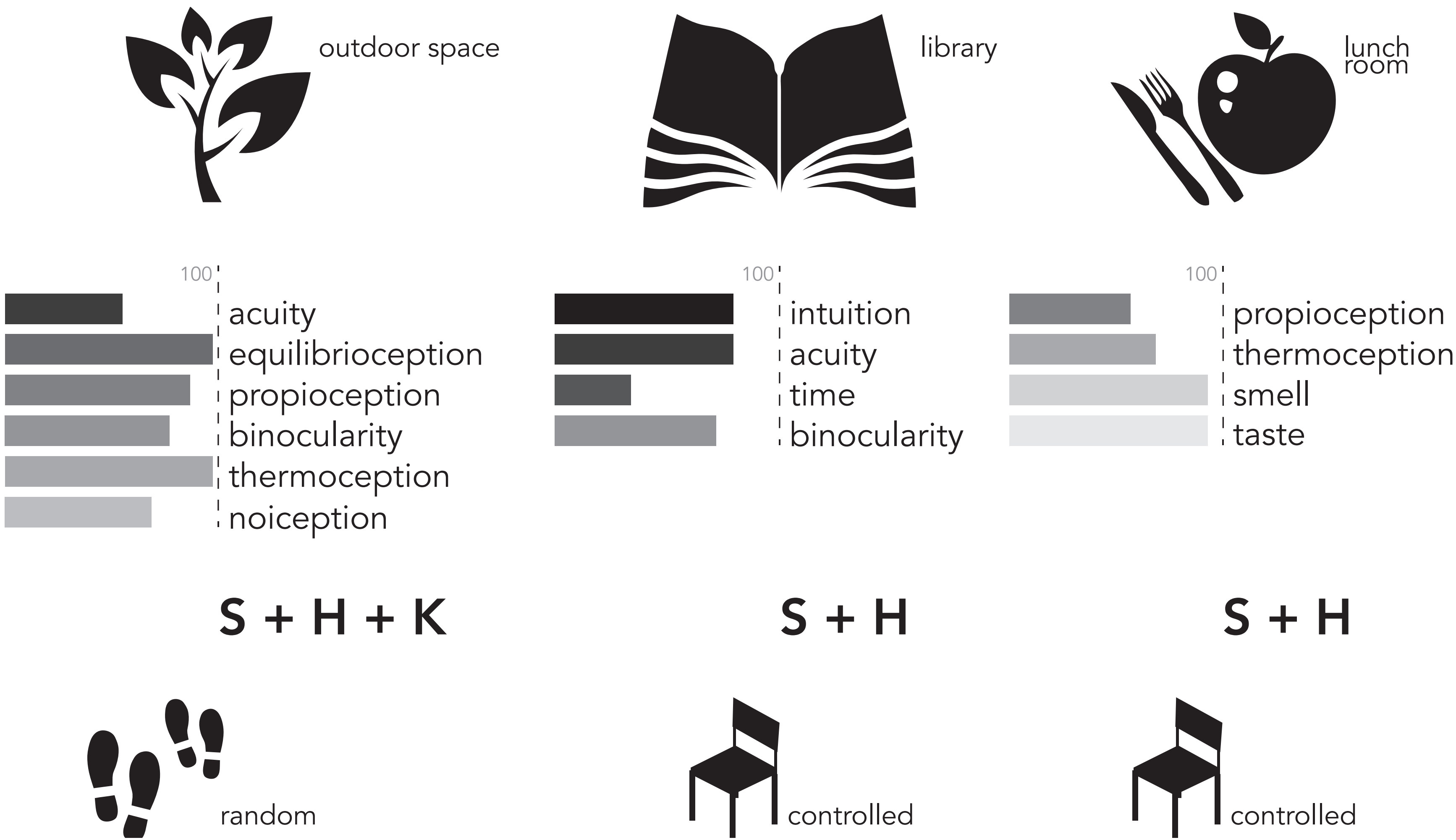
SYSTEM	ANATOMY OF ORGAN	ACTIVITY OF ORGAN	STIMULI AVAILABLE	SKILL
sight	ocular mechanism	looking / fixating	variables of structures in ambient light	binocularity acuity
touch	skin (hands)	touching / feeling	textures, weight etc.	
hear	cochlear organs	orienting to sounds	vibrations in the air	
smell	nasal cavity	sniffing	composition of a medium	
taste	oral cavity	savoring	composition of ingested objects	

adaptation | image reference 43

sources: technology of the senses + sensory design



matrix of program and related senses and systems that influence development


outdoor space
library
lunch room
100
acuity
equilibrioception
propioception
binocularity
thermoception
noiception
100
intuition
acuity
time
binocularity
100
propioception
thermoception
smell
taste
S + H + K
S + H
S + H
random
controlled
controlled

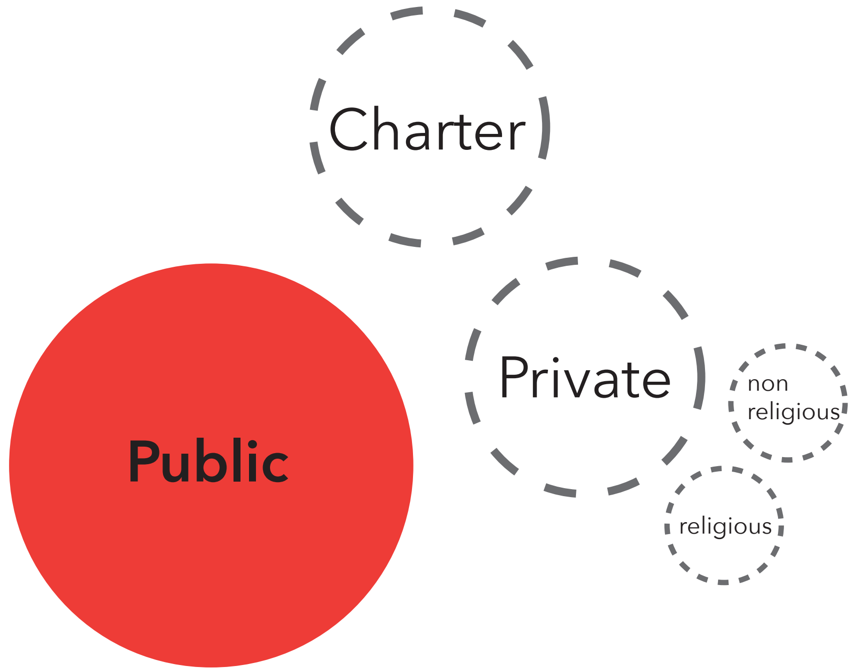
PROGRAM

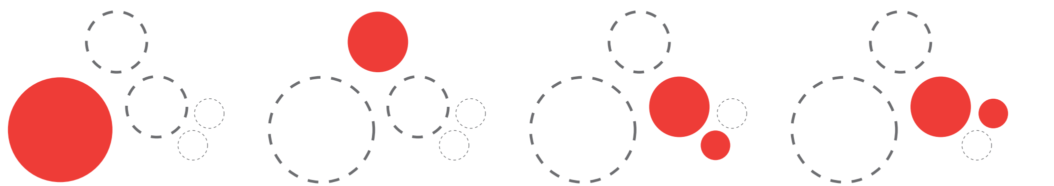
The home and the learning environment are the primary locations where a child has the most potential to develop cognitively and emotionally. The latter of these includes day care facilities, community centers and schools and upon further research, the environments with the most consistent and dynamic experience potentials are found within the program of the school.

As succeeding research suggests, the schools that require the most architectural and environmental consideration are public urban schools, rather than private or charter schools. Non-suburban schools are faced architecturally with issues of limited daylighting and exterior surfaces, closed plans, and limited expandability due to smaller lot sizes, while administratively they must address and constantly revisit inadequacies in academic and resource structure.

The design criteria for the today's urban school acknowledges that the augmentation of the environmental conditions, as a means of compensating for deficiencies otherwise, is the main focus along with working in tangent with relevant pedagogical approaches to create appropriate opportunities for integrating technologies that supplement instruction.

Types of Schools





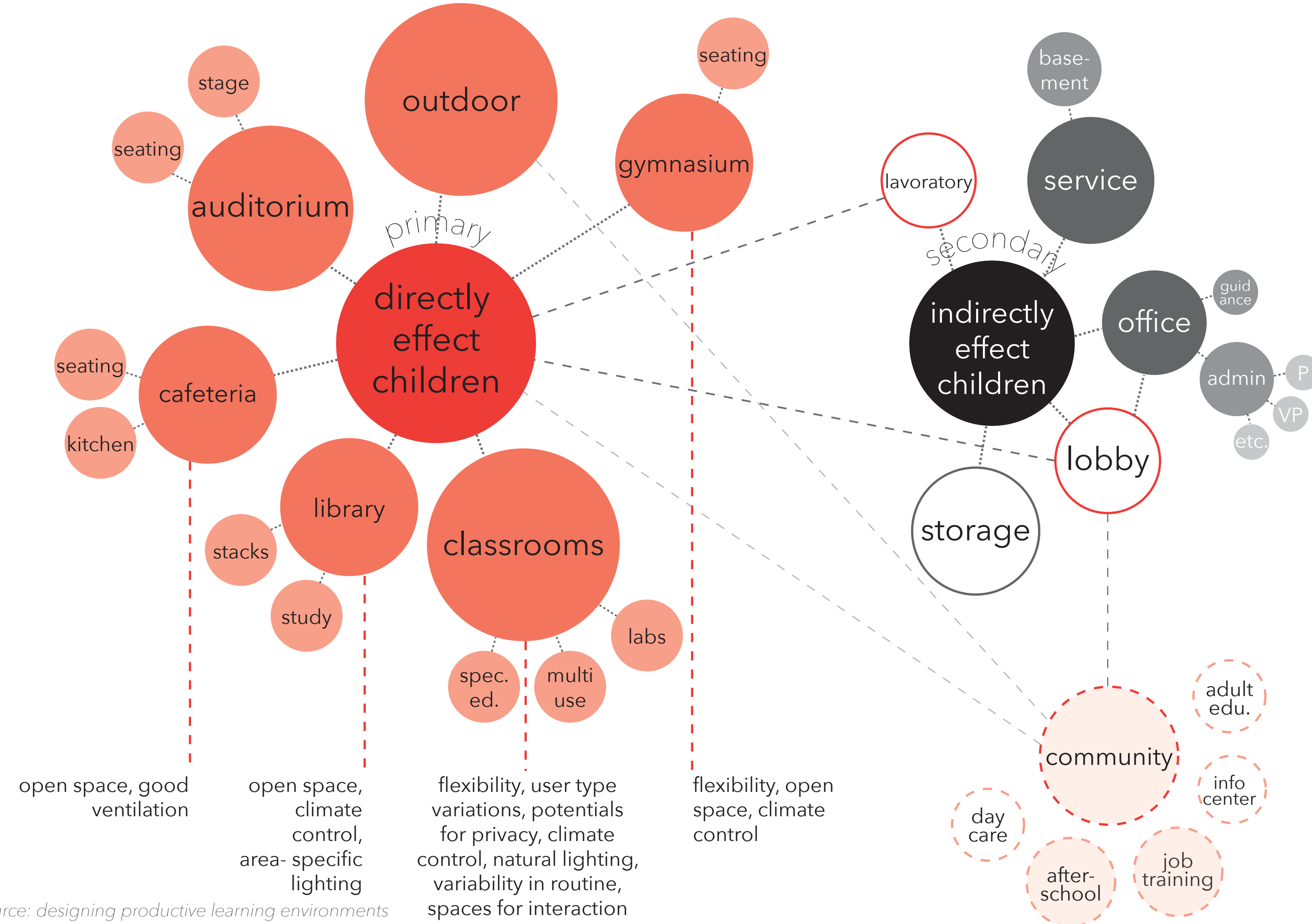
99,000 public schools
education is free
reliant on federal state and local tax dollars
must follow state guidelines

free tuition
application for enrollment
independently run
for-profit private or funded by government

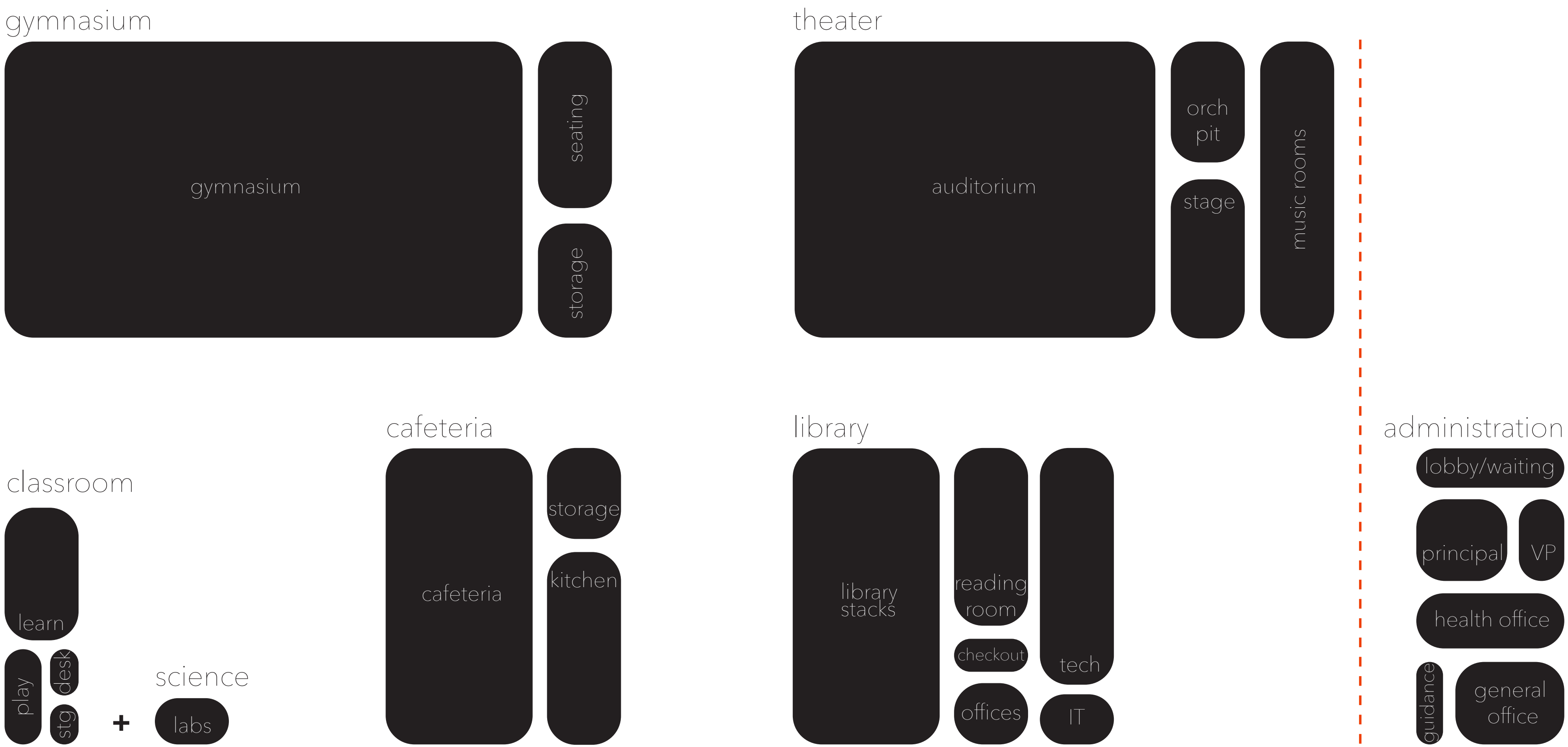
depend on own funding
not regulated by state standards
programs must undergo review by outside sources
expensive tuition

religious elementary:
$3,700/yr
high school:
$8,200.yr

source: public vs. private vs. charter schools

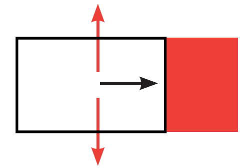


source: designing productive learning environments



flexibility:
few loadbearing walls
movable partitions
portable partitions
operable walls

source: guideline for square footage requirements for educational facilities

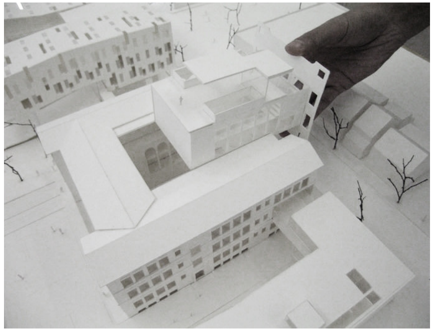


UNO Galewood Elementary School, Chicago IL
UrbanWorks
Photographs by Christopher Barrett

Form:
corridor plan concept
community based vision
common spaces share with community during off hours
varying heights define varying program/space

Transparency:
controlling views outwards and inwards
varying degrees of privacy
create space for community

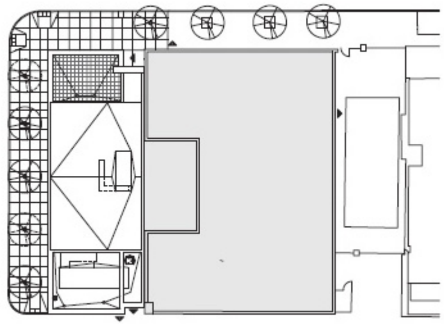
finger | transparency | community



Robbins Elementary School, Beverly Hills CA
Urban Office Architects
Renderings by Urban Office Architects

Form:
finger plan concept
use of the exterior surfaces
communicate with existing Historic buildings

Transparency:
controlling views outwards + inwards
encourage pedestrian dimension
create space for community

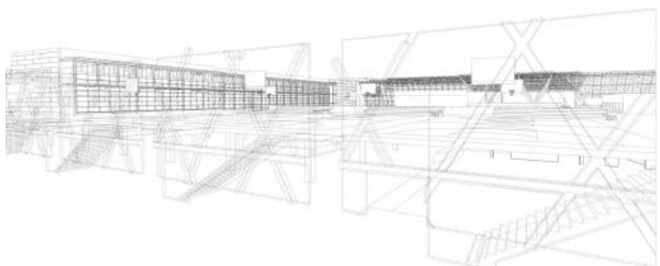
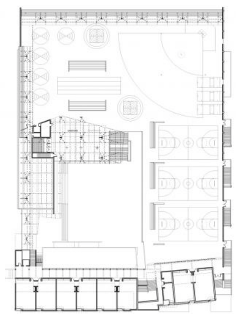
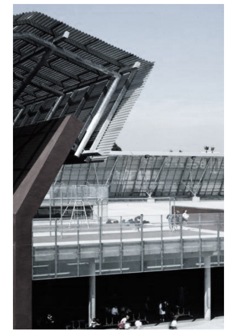


Erie Elementary Charter School, Chicago IL
John Ronan
Photographs by Steve Hall ® Hedrich Blessing

Form
varying interior heights define varying program/space

Program:
annex to existing school
provide gymnasium, playground, outdoor space
elevated active space open to sky
hide services

corridor + finger | stacked program | community

International Elementary School: Morphopedia, Long Beach CA
Morphosis Architects
Photographs by Tom Bonner

Form:
stacking program strategy
free from enclosed volumes
finger plan concept

Program:
elevated outdoor community assembly
school at ground, play above

CHAPTER 4. CHICAGO PUBLIC SCHOOLS AS SITE

The Chicago Public School system is the third largest in the nation made up of over 600 schools and serving 400,000+ students. After many building reformation initiatives and revisits to fiscal budgets over the past few years, the district has been able to concisely determine their main areas of focus as they move forward. These initiatives come in response to a need for change as over 50 schools closed in 2013 and many schools have over utilization rates that result in overcrowded classrooms.

The area that this thesis is examining is located in the O'Hare district, northwest of the Loop. Of the 1.6 million in additional funds for O'Hare's fiscal year, much of this money is set aside for new school and annex construction to relieve the high rates of utilization. In a neighboring district, CPS has already begun work, similar in nature to their current endeavor, by building a LEED certified neighborhood school. Using Prieto Math and Science Academy as a case study for existing efforts to accommodate the new set of goals for CPS, this thesis will explore the design potentials of technologically advanced material systems with a renovation and annex design proposal for Arthur E. Canty Elementary school

source: CPS capital improvement plan for fiscal years 2015-2019

CPS DISTRICT INITIATIVES

Address District Needs

Empower Principal as School Leader

$
- $130 mil principal's discretion
- $100 mil enrichment programs + hire teachers
- $60 mil supplemental services

Increase Acces to Quality Education Programs

- develop 10-year neighborhood vision
- **invest $$ in early education**
- add magnet + gifted programs
- expand charter opportunities

Upgrade Information Technology

- career + tech education
- college + career suites
- **upgrade learning technology**

Building Interior Renovations

- modernize laboratories
- **modernize + repair buildings**
  - add A/C units
  - upgrade outdoor play areas
  - protect health + safety

sources: CPS 2013 + 2015 fiscal year plans

Relieve Overcrowding

Downsize to Relieve Overcrowding

- reinvest in the classroom

Arthur Canty Elementary School

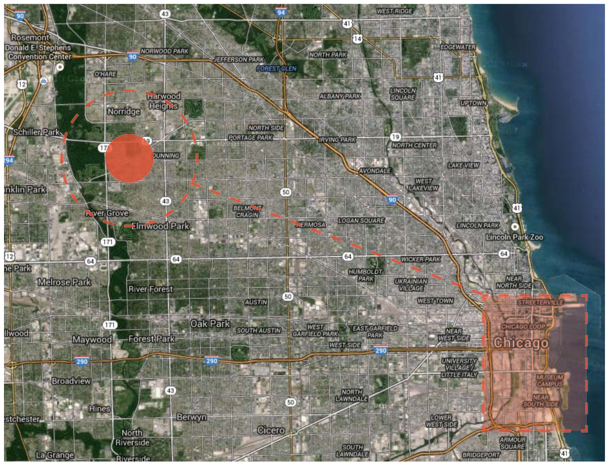
- utilization rate or 150%
- modular units on campus
- no cafeteria
- small library
- hallways for storage

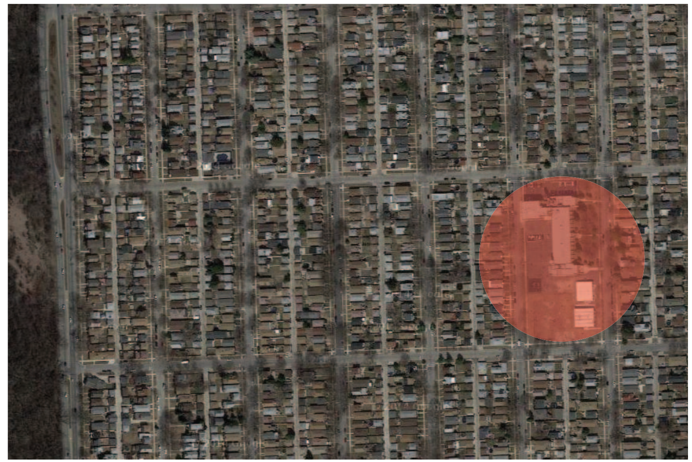
Transparency

Open-ness of CPS Budget

- make balanced budget public
- increase public + community affairs
- engage family + community

THE SITE | CHICAGO





sources:google maps


N Paris Av
W G
N Panama Ave
W Waveland Av


W Waveland Ave
N Panama Ave
N Paris
W Grace St

THE SITE | CANTY ELEMENTARY SCHOOL

source: *Interview with Dr. Lucja Mirowska-Kopec and Collette D. Laurencell, of Canty Elementary*

Arthur E. Canty Elementary School is a level 1 performing neighborhood school in the O'Hare district of the Chicago Public School system. Built in 1965, the two story building is in need of major repairs of its brick enclosure, as well as updated HVAC systems and aesthetic renovations. Its students are predominantly of Polish decent, as it is located within a heavily populated Polish neighborhood community, however it doesn't have strong ties to the programs at Hiawatha Community Center, two blocks from its campus.

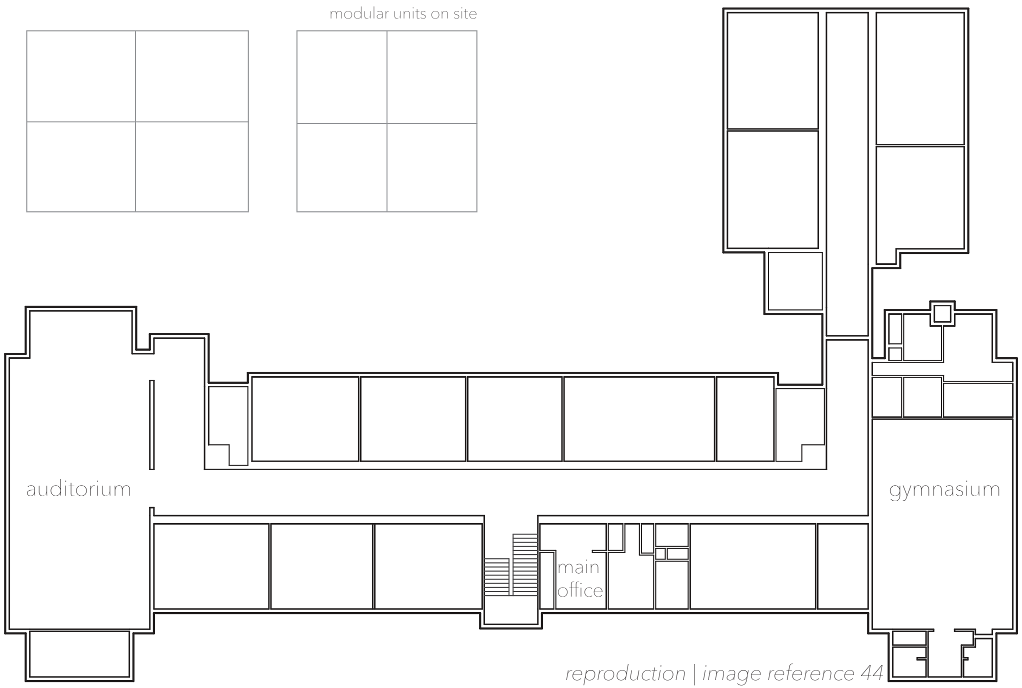
Currently CPS, mainly including the O'Hare and Fullerton districts are experiencing extreme cases of over utilization or overcrowding. Canty has a utilization rate of 150%, working with 300 students over maximum capacity.

Due to the exceeding student capacity, Canty occupies four separate modular units, two of which are located on the campus ground while the remaining two are at a remote location six blocks away.

The main entry is not very distinguished because of the fence barrier around the premises and there are accessibility issues. Parking for faculty is not located near an entrance, therefore the teachers and staff have to walk around the building to enter.

The large plot of land that is not being utilized by building or landscape is ideal for the planned annex addition as a more permanent solution to their overcrowding issue.

source: Interview with Dr. Lucja Mirowska-Kopec and Collette D. Laurencell, of Canty Elementary



reproduction | image reference 44

sources: Interview with Dr. Lucja Mirowska-Kopec and Collette D. Laurencell, of Canty Elementary

The layout of the school can be classified as both corridor and finger concept plans, however the site encourages both a finger and cluster plan organization. A major critique of the school is the minimal allocation of space for the auditorium, gymnasium and library. There is no cafeteria, so the already inadequate auditorium is currently doubling and the lunch room, with food warmers in the hallways for storage.

The current annex proposal requests for 15 new classrooms and a multipurpose room that will act as an addition gymnasium space, lunchroom, warming kitchen and potentially community activity center for after hours.

As for the classrooms themselves, they are equipped with ELMO projectors, while only 3 classrooms have SmartBoards. Each grade year has a designated iPad cart that holds both iPads and chromebook cards.

Lastly, in addition to the annex, the funding Canty received has been speculatively set aside to expand the classroom-sized library, update the interiors with better insulated enclosures and up to date wall and floor finishes, and to equip the remaining classrooms with the most relevant educational technologies.

source: Interview with Dr. Lucja Mirowska-Kopec and Collette D. Laurencell, of Canty Elementary

THE STUDY | PRIETO MATH AND SCIENCE ACADEMY

Dr. Jorge Prieto Math and Science Academy is a level 3 performing neighborhood school in the Fullerton district of the Chicago Public School system. The three story building was designed by STL Architects and completed six years ago. It is a the first LEED Silver certified school within the CPS system and includes solar panels, a green roof, recycled materials, native landscaping and a rain garden. Its students are primarily of Hispanic decent, as it is located within a predominantly Hispanic neighborhood, and through after school activities, Prieto creates a connection the community as well as the parents of the students that attend.

source: Interview with Amber Richard, of Prieto Math and Science Academy

The major critique of this school is the inadequate consideration of the number of students attending. Prieto is another school operating at a utilization rate higher than maximum capacity.

Since overcrowding is a common trend among the neighborhood schools in this area of Chicago, modular units have become the standard fix. Prieto occupies two modular units that hold 8 classrooms each, accessible by an uncovered walkway beyond the rain garden. The modular units do not match the aesthetics or LEED certification of the main campus building, however each classroom is equipped with their own SmartBoard, and computer cluster.

source: Interview with Amber Richard, of Prieto Math and Science Academy

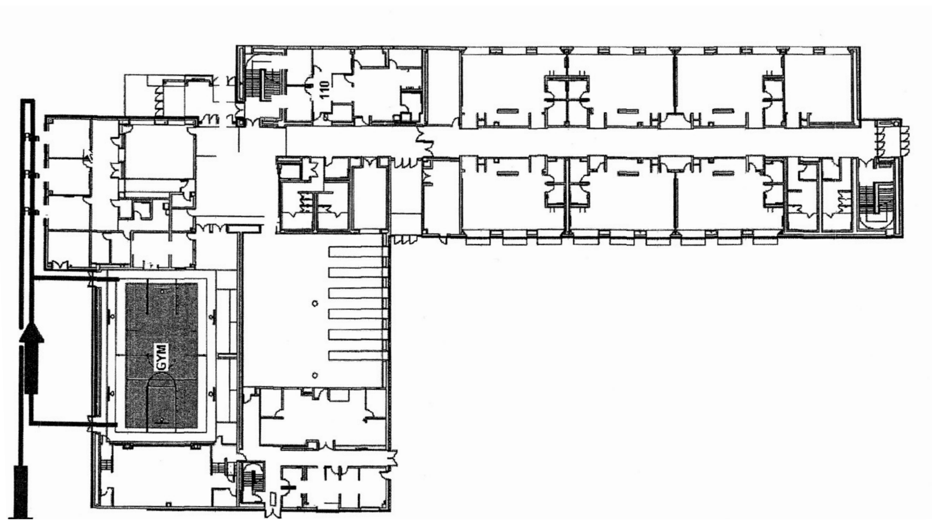


image reference 45

Prieto is classified as both a corridor and finger concept plan, which includes carved out niches in the hallways that act as group teaching spaces. A reoccurring theme throughout the building is the access to communal atrium spaces, which can be found in the main lobby area, through the hallways, and at the ends of each floor. The intent for these were to create a common ground between classes, and the encourage group learning exercises outside the confines of their home classroom. Due to their utilization issue, however, many of these spaces were taken over by classroom entirely, which created less-than-ideal classroom environments, filled with external noise and distraction.

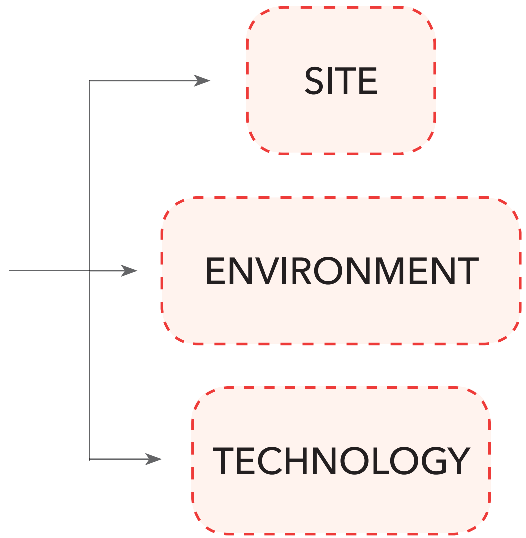
sources: Interview with Amber Richard, of Prieto Math and Science Academy

Most of the elective classrooms, including art and science laboratories were also taken over by classrooms, to accommodate the number of students.
The larger elective spaces, such as the library, gymnasium, cafeteria and music hall have minimal complaints architecturally, but again, during transition periods, the claustrophobic halls of children become hazardous.
Lastly, Prieto is furnished with a 32-desktop computer lab that sits within the library. Each grade class has access to an iPad cart while each classroom has a SmartBoard.
Prieto Academy will be used as a key case study for the renovation and annex proposal of Canty Elementary because of its green initiatives, proximity and solutions to similar issues to those at Canty.

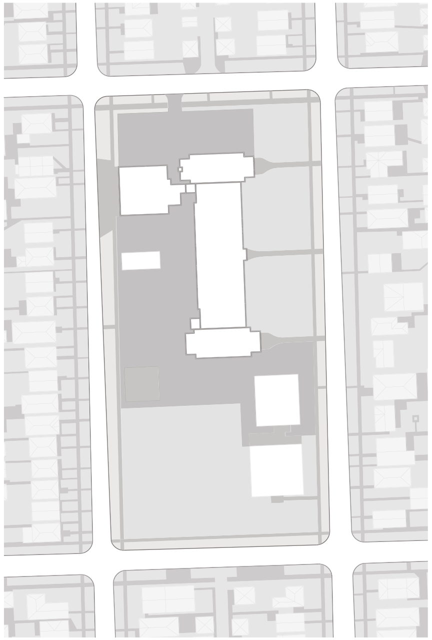
source: Interview with Amber Richard, of Prieto Math and Science Academy

CHAPTER 5. DESIGN CONSIDERATIONS AND CRITERIA

image reference 46

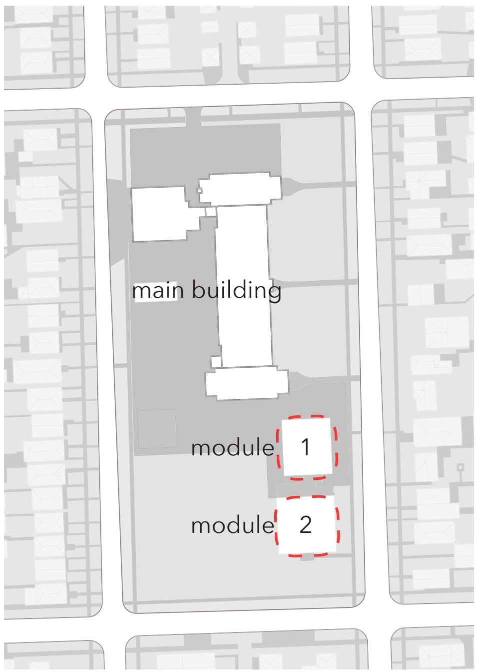


CHAPTER 5.1 PRELIMINARY MASSING DIAGRAMS

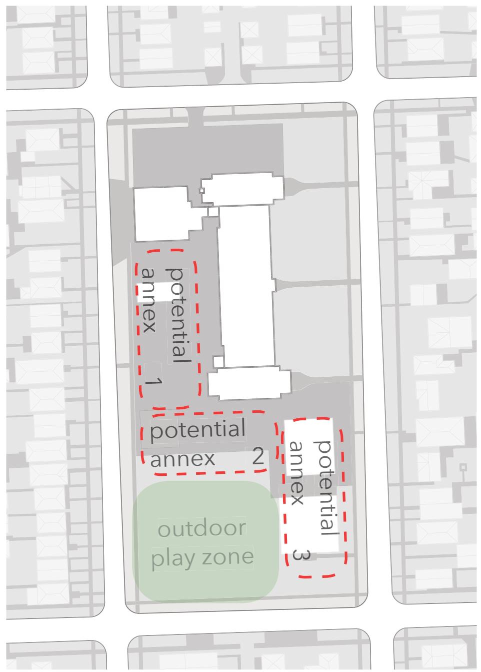


connection to the Hiawatha Park Community Center

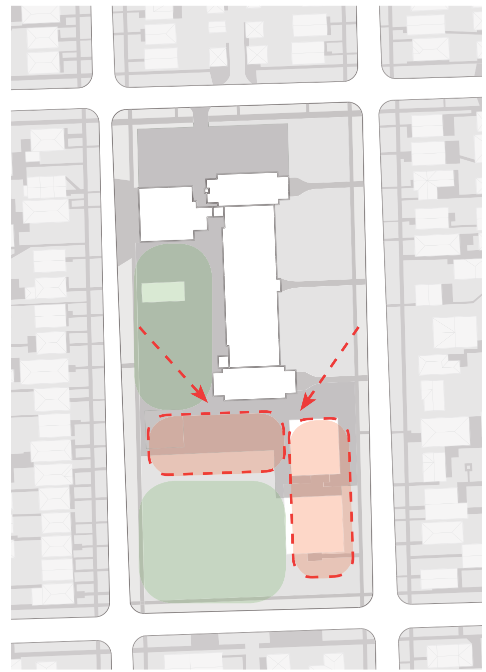
reconnect to community, utilize open space on lot



existing campus layout



potential annex locations


new potential entry condition

"A child's experience of a place is directly affected by the spatial [and atmospheric] properties of the environment."
- Ismail Said, Architecture for Children

CHAPTER 5.2 DESIRED ENVIRONMENTAL QUALITIES

The built environment plays a major role in the development of a child's brain, sensory function, communication skill level and ability to interact with other users physically. Interactive means of tactility and responsivity have been proven to have a positive effect on the atmospheric quality of a space and a child's cognitive growth.

The designer must consciously address each particular user group and provide a range of atmospheric characteristics for each environment that involves lighting, color, acoustics, controlled interior climatic conditions and material application.

ie. designing for:

social interaction, self-motivated engagement, and responsive interactions in conjunction with systems that provide heating/cooling, lighting, and acoustics.

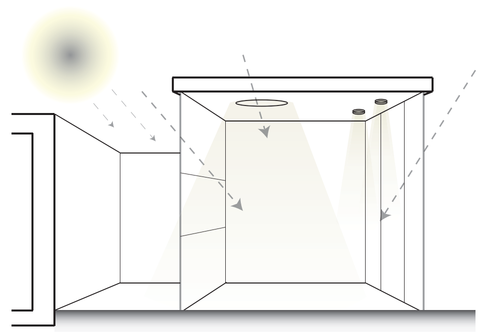
LIGHT

Lighting in the classroom is an important aspect of design that can immensely improve a child's ability to stay attentive. It becomes a visual material when it is explored and controlled autonomously by children. It is key to emphasize natural daylighting but to also incorporate it with artificial lighting to create various types of lighting.

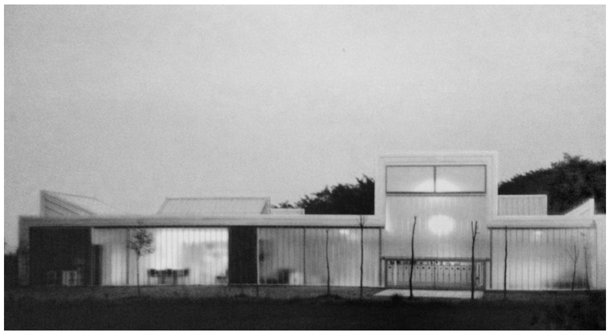
Natural light creates a relaxing effect when its provenance is multidirectional because children feel in harmony with the environment outside of the school. Artificial and indirect lighting blended with natural exploits different expressive and inhabited characteristics of a room.

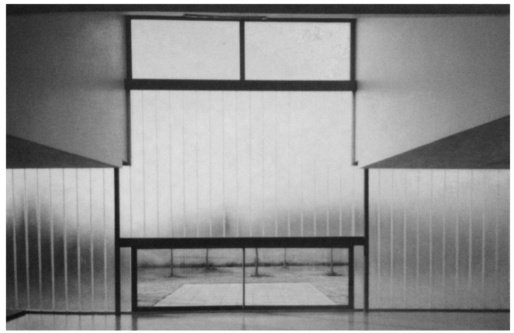
Above all else, the key is manipulability of both natural and artificial light sources.


lighting | natural and artificial


multidirectional lighting

sources: *children spaces, relations + designing productive learning environments*

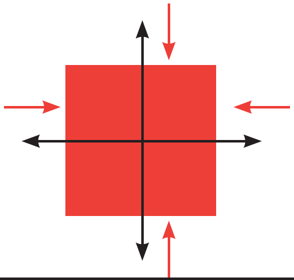




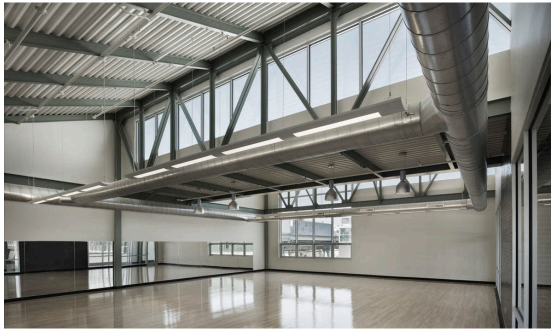
Children's School, Sondika
No.MAD Arquitectos
Images from *Preschool + Kindergarten Architecture*, Mostaedi, Arian 2006
Photographs by César San Millán

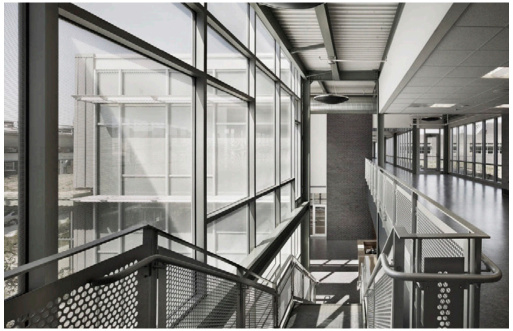
Exterior glazing:
natural sunlight
diffuse lighting
solar heat gain
passive heating and cooling

Transparency:
informing children of exterior natural forces
controlling views outwards and inwards
varying degrees of privacy



cluster | constant views | lighting





Kensington High School for the Creative and Performing Arts, Philadelphia PA
SMP Architects
Photographs by Barry Halkin

Exterior glazing:
fritted glass, sunshades and wheatboard
natural sunlight
borrowed light in corridors
artificial light off 98% of daylit time

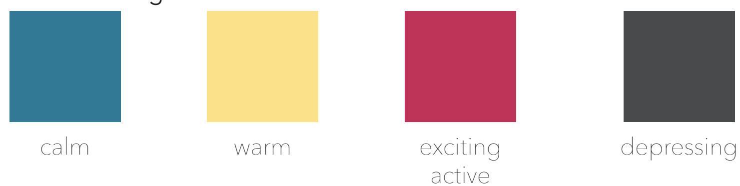
Transparency:
controlling views outwards and inwards

Orientation:
building oriented with maximum southern exposure

COLOR

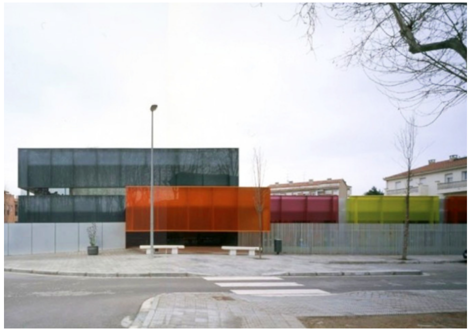
Color plays an important role in defining the perspective and layout of environments, while stimulating the formation of knowledge and identity building processes. Some colors are perceived as being in the forefront, like reds and yellows while cooler colors are pushed to the background like blues and greens. The perceptive richness and chromatic variety create a sense of harmony in both the children and adults of a particular space.

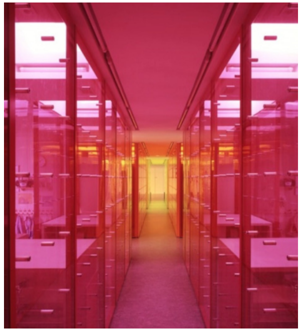
passive participation/learning
use blues or greens



larger and service spaces
use pale colors

sources: children spaces, relations + designing productive learning environments





'Els Colors' Nursery School, Barcelona SP
RCR Architects
Photographs by Eugeni Pons

Color:
components identifiable by color
any metal is red orange or yellow
exterior paving is green

Architectural provision:
color signifies separation between rooms
spatial awareness

identity | transparency | soften

The VM Houses Nursery School, Ørestad, Copenhagen DK
Plot
Photographs by Rikke Guldberg Hansen

Color:
used to characterize rooms
soften monotone colors
color applied to transparent materials

Architectural provision:
each room has its own identity

SOUND + ACOUSTICS

Sound waves affect the entire body and its understanding of the spatial qualities of the space in which it is situated. It is a subjective sensation, however studies show that all bodies react to the pulses and rhythms of background noise. As a design parameter, reverberation and loudness should be controlled to minimize echoes, which lower mental and physical health.

Higher decibels of sound increase the heart rate and the chance of stress reactions including attention deficiency and in extreme cases, loss of muscle coordination, nausea and fatigue.

reproduction | image reference 47

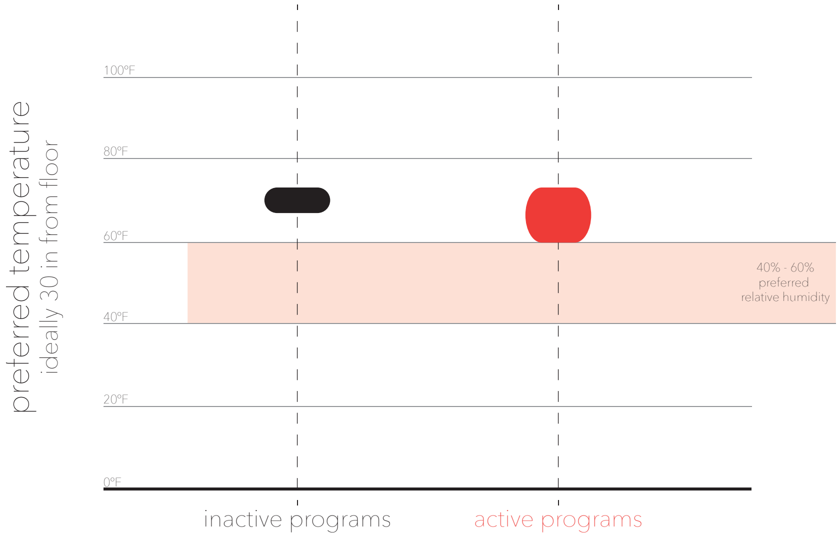
sources: designing productive learning environments + the third teacher

INTERIOR CLIMATE

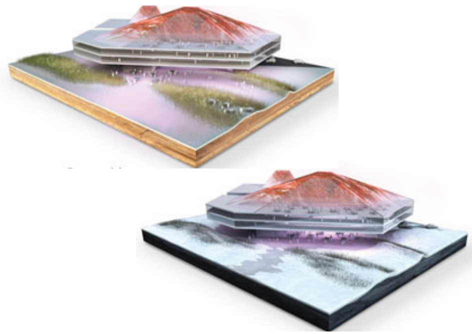
"Temperature, relative humidity, air movement, odor, and air cleanliness are important when providing a comfortable environment for learning. The human organism is highly adaptive, but a student cannot attend, perceive, or process information easily when his or her physical environment is uncomfortable."

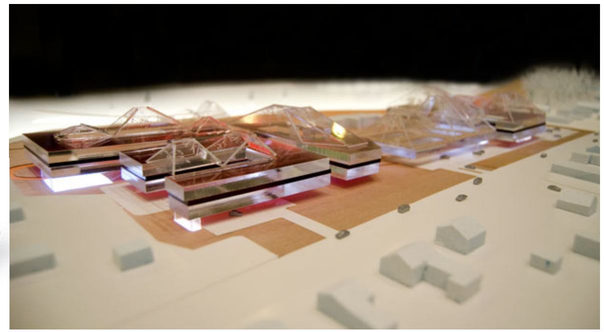
A child's ability to perform certain tasks deteriorates in overheated environments as well as under heated environments.

The most simple solution to circulating heat flows in a space involves air conditioning, but natural heating and ventilation as result of responsive enclosure materials is ideal.



source: designing productive learning environments



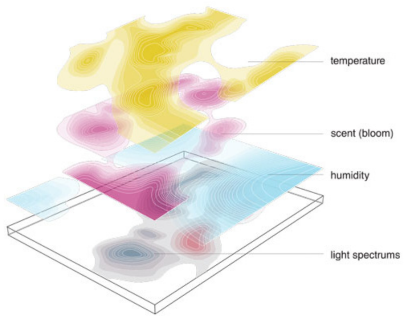


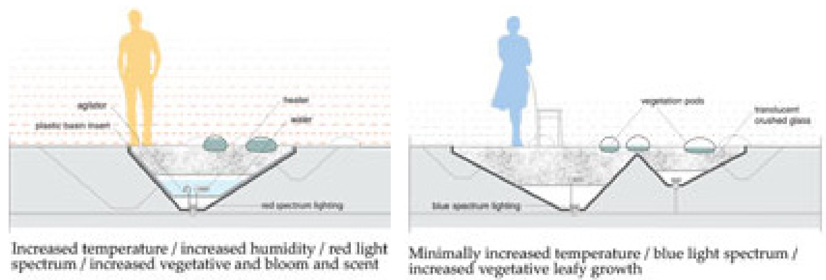
Tamula Lake Side Competition, Voru Estonia
with Morris Architects
Weathers | Sean Lally

Climate:
climatic “materialities”
gradient climate zones vary by season
large role in programs use
program linked to exterior environment

Goal:
meet program needs with seasonal planning

microclimates | intensities | gradient conditions





Reford International Garden Design
Weathers | Sean Lally

Climate:
varying intensities of material variabilities that exist simultanesously
humidity, air temperature, scent, light spectrums
emerged sources of gradient zones
boundaries implied by gradient conditions

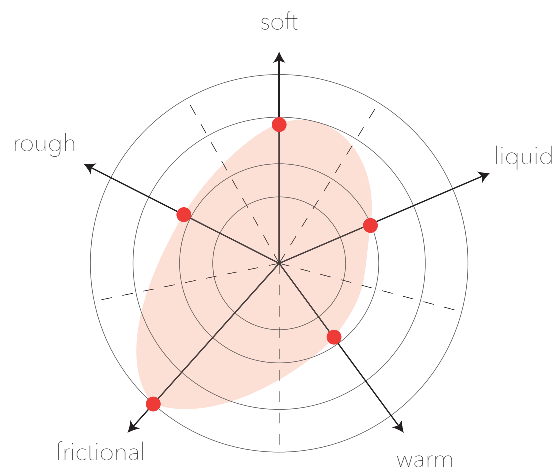
Control:
create microclimates
organized by gradient intensities

MATERIAL

"The tactile nature of space is expressed in perceptive as well as physical terms; that is, by synthesis that involve the individual's processes of orientation and spatial judgment"

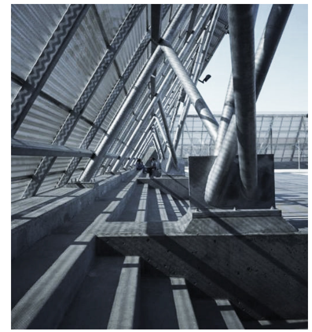
The tactile materiality of environments for young children is essential for a child's development of sensation. Children sense materials through exploring by touching everything within reach.

In the contemporary design world, manipulating "natural" materials has transformed the basis of material application. The focus has transferred from solely aesthetic and structural needs to varying duration periods, permanency and tactility, thus adding a layer of complexity to each surface.



reproduction | image reference 48

sources: children, spaces, relations + what is the montessori method?

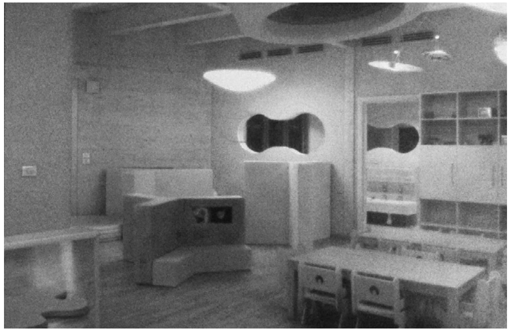


International Elementary School: Morphopedia, Long Beach CA
Morphosis Architects
Photographs by Tom Bonner

Material:
wrapping perforated metal wall
typical parts of architecture assume new roles
didactic surfaces

Provision:
weather protection
security
cohesive aesthetic

transparency | soft | sensory stimulation



"Nido Stella," Nursery School, Modena, Italy
ZPZ Partners
Photographs by Antonio Marconi

Materials:
transparent materials stimulate visual connections and interactions
provide light passing through rooms
soft materials stimulate exploration

Provisions:
sound absorption
acoustic quality
stimulate touch and interaction

CHAPTER 5.3 MATERIAL SYSTEM AS SOLUTION

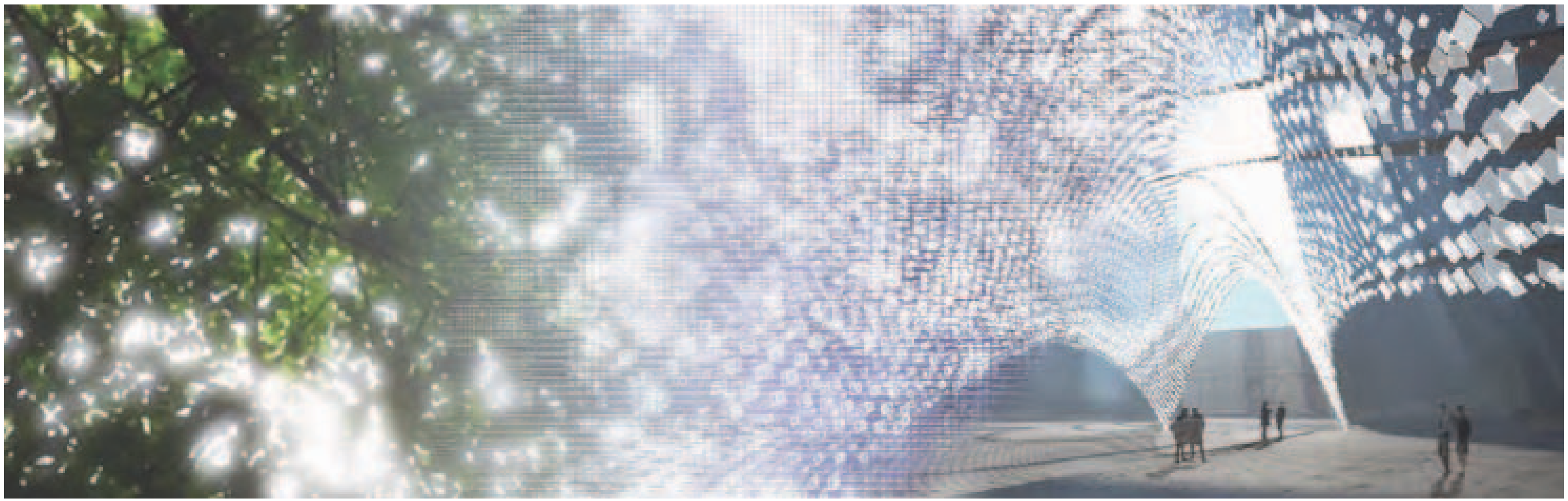
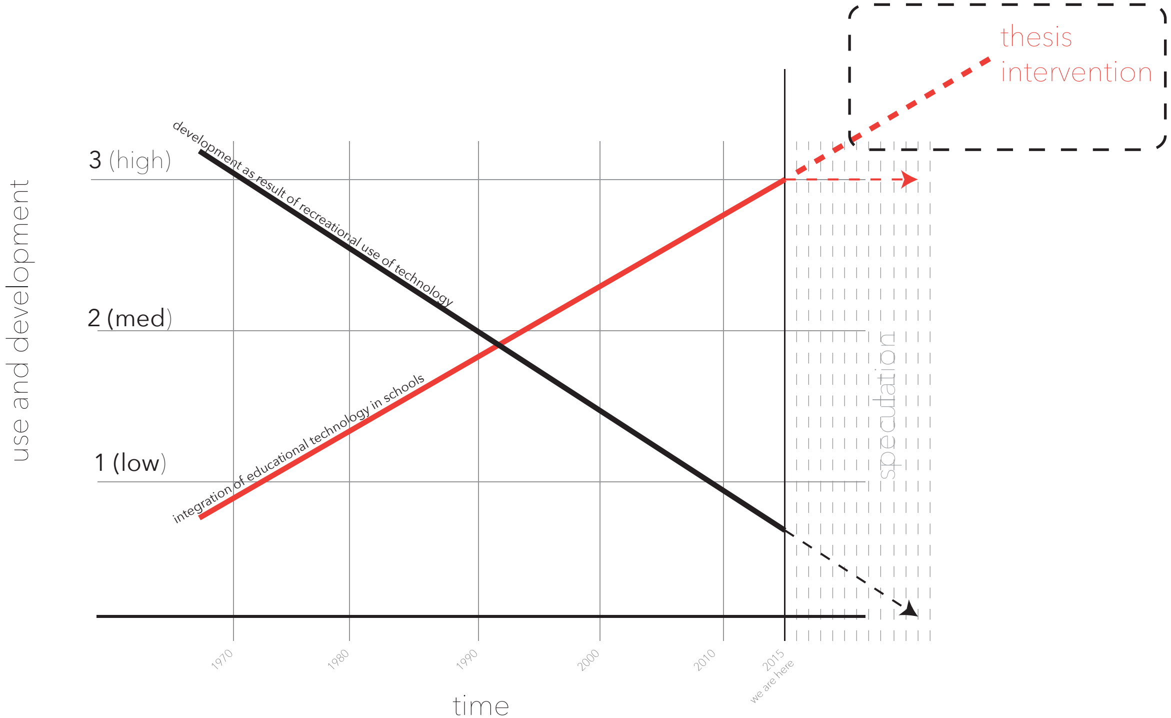


image reference 49

child and technology matrix

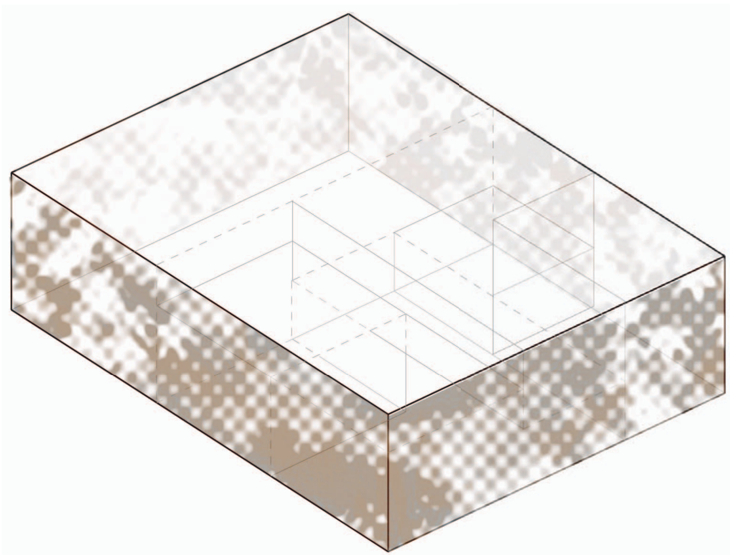


how?

integrate technologically advanced material systems that affect the environment of a child's learning space

The question remaining is how can architecture utilize the aforementioned design criteria in a way that further enhances the child experience? School design has been evolving materially and formally in response to today's techno-centricity and varying pedagogical approaches but have we reached the pinnacle level of advancement? This thesis studies and claims that the trajectory for school design must include the integration of responsive technologies and material systems to work in tangent with the pre-existing environmental design parameters as well as with technologies that supplement instruction and learning. If applied, the criteria that already strengthens cognitive development (micro climate control, flexible spaces, sensory experience, interactivity etc) would be enhanced and furthermore ingrained in the architectural form and identity.

source: designing productive learning environments

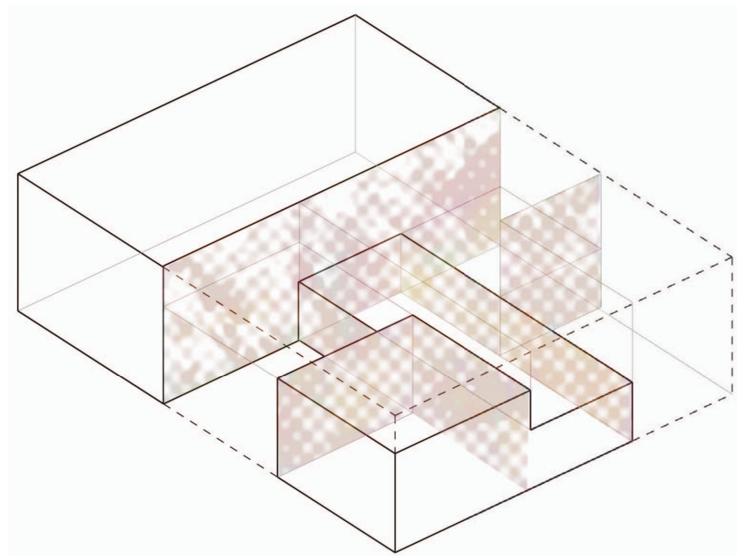


Exterior Application

Responsive display systems, as of late, have drastically transformed the way in which we (architects) imagine efficiency and aestheticism in design. As an external application, they offer climate control by responding to external forces of sunlight, wind and temperature, privacy by mapping user location, and can translate image or video to facade.

sources: *electroactive dynamic display systems + designing material behaviors*

When applied internally, they respond to user proximity, enable sensory exploration, provide patterned lighting and color to a space, while creating dynamic divisions of spaces and programs.



Interior Application

sources: electroactive dynamic display systems + designing material behaviors

THE SYSTEM

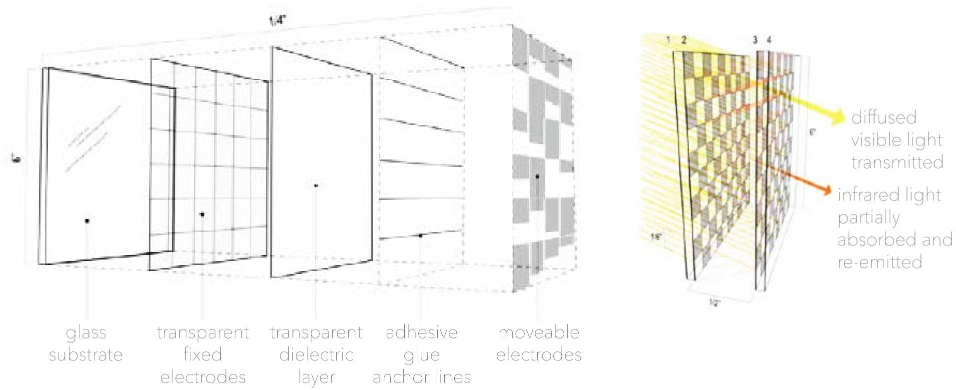


image reference 50

The means by which these technologies perform involve programmable electrodes that move automatically in response to outside climatic conditions of solar heat gain and infrared light. These electrodes can also respond to user proximity to the surface and can be programmed to clear or fill pixels. At its current state of development, the responsive wall system allows for single-faced user interaction, but one can speculate about the future of its design catering to user proximity on both sides of the wall. Lastly, the system's dynamic nature can be classified into emotive or utilitarian capabilities, which affect the school environment simultaneously.

sources: an enviro-aesthetic dance of agency

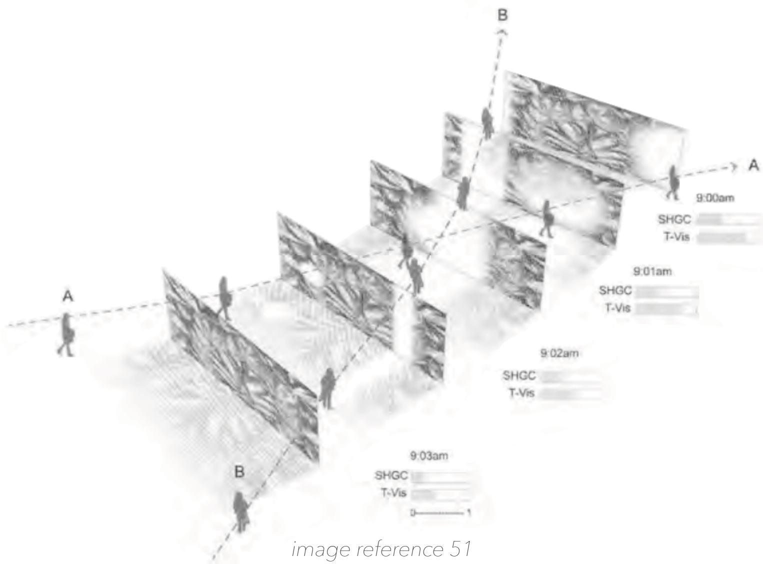


image reference 51

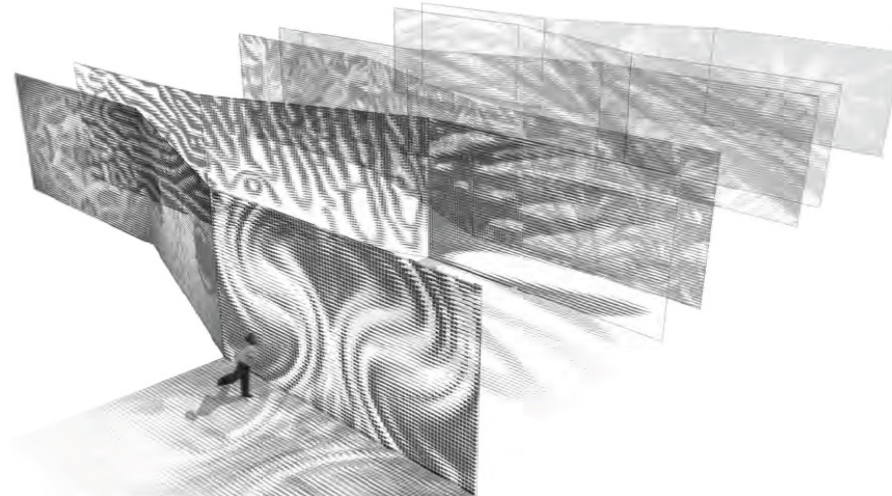
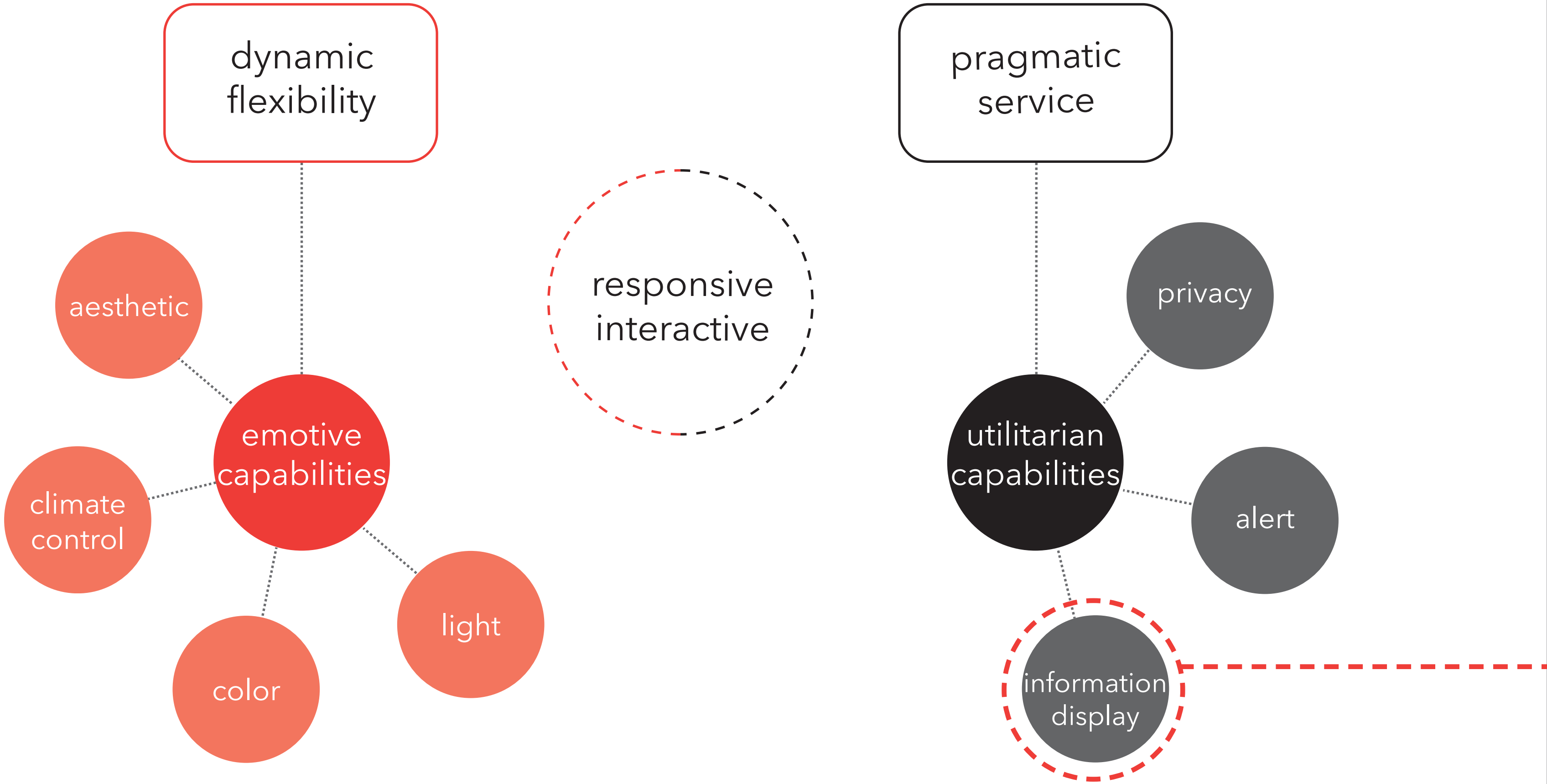
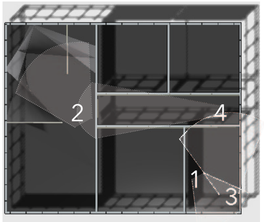


image reference 52

sources: electroactive dynamic display systems



sources: designing material behaviors + an enviro-aesthetic dance of agency



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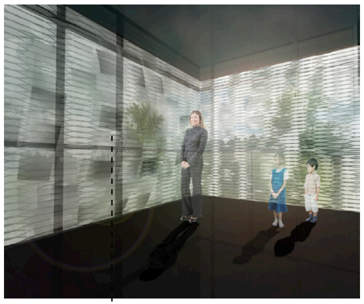
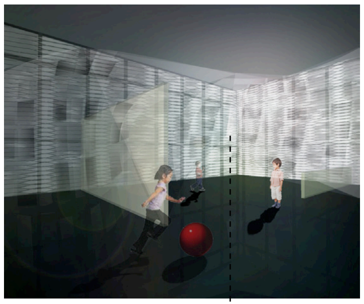
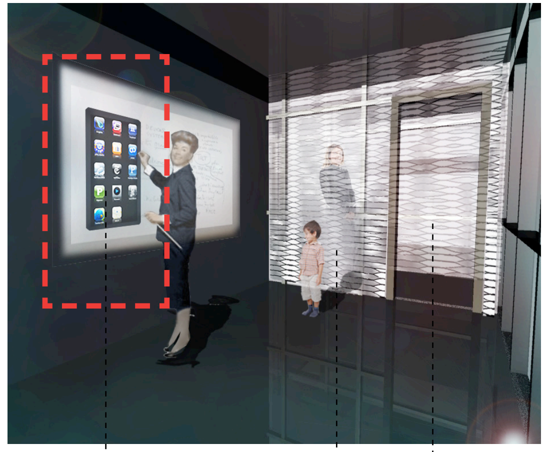


classroom (exterior)

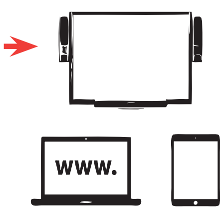


gymnasium (exterior)



classroom (interior)

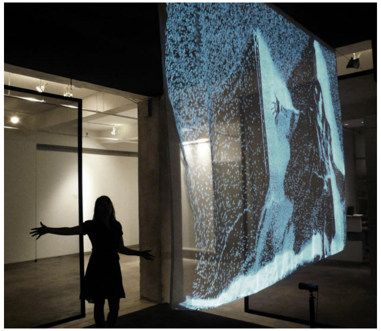
hallway (interior)



utilitarian needs exist
in all programs

CASE STUDIES (technology)

responsive materials | deceptive perception

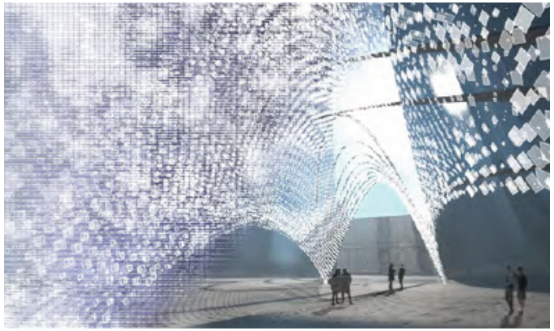
Weave Mirror, Daniel Rozin
Snow Mirror, Daniel Rozin
Paradise Institute, Janet Cardiff + George Bures Miller
Paradise Institute, Cardiff + Bures Miller
Nature Walk, Jason Bruges
NYC Public Covered Plaza Proposal, SOM + CASE

Experience:
distortion of reflection
distortion of time
pixelation
deceptive percpetion
physcial reaction

Technology:
projection
moving parts
tracks movement of users
aural and visual landscape

sources: see yourself sensing

interactive | patterning | dynamic display



"Responsive environments may not be as geometrical or mystical, but they are unpredictable. They modify both themselves and their inhabitants and create feedback loops that change the variables of space and habitation... whether its fluctuations in light and enclosure, we will need to co-evolve with our new environments."

"Our behavior, social interaction and perception will be transformed as the relationship between humans and animated surroundings becomes more complex"

Experience:
interactive animated surfaces
embedded at various heights
atomspheric patterning
filter sunlight

Technology:
led panels
patterns of light
electroactive dynamic display system
multifunctional building envelope

sources: see yourself sensing + an enviro-aesthetic dance of agency

MOVING FORWARD

How does the Responsive material system affect the appearance of the school? Will it redefine the school aesthetic?

How can Responsive and Dynamic material systems instigate exploration through various spaces?

How does the use of Responsive and Dynamic material systems affect the architectural process of design?

Are these limited to rigid materials? Or can they be applied to malleable materials like fabric or finishes?

How can these materials be interpreted as more than simply information technologies or digital projections?

How would these materials work in tangent with existing educational and communication based technologies in the school.

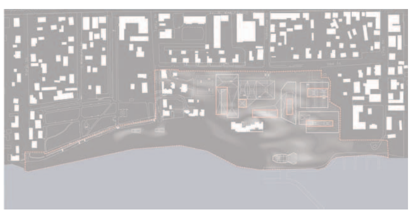
METHODS AND PROJECTED SCHEDULE

METHODS AND TECHNIQUES

Draw.
experiential drawings [ref sean lally]
storyboarding
photo montage | collage

Model.
conceptual models
experiential models
site model 1/32" or 1/64"
massing models for site
sketch models 1/16"
physical model 1/8"
prototype diagram model 1/4" or 1/2"

Animate.
walk through animation
simulation at CoE with EDDS



DECEMBER/JANUARY

revise diagrams from final prep review
storyboarding experiences of child v adult
site model lasercut files
test simulation/animation styles
portfolio review and edit
revise sample page[s]
contact firms

JANURARY

s	m	t	w	th	f	s	
	12	13	14	15	16	17	site model
	19	20	21	22	23	24	programmatic diagramming | concept models
25	26	27	28	29	30	31	collage montages | massing model studies

FEBRUARY

s	m	t	w	th	f	s	
1	2	3	4	5	6	7	design | start computer moeling
8	9	10	11	12	13	14	[material] design | test animation at CoE
15	16	17	18	19	20	21	midereview
22	23	24	25	26	27	28	design charrette

MARCH

s	m	t	w	th	f	s	
1	2	3	4	5	6	7	design
							visit firms | site visit 2? | finalize design
15	16	17	18	19	20	21	final design charette
22	23	24	25	26	27	28	last week of design [fingers crossed]
29	30	31					drawings drawings drawings

APRIL

s	m	t	w	th	f	s	
			1	2	3	4	begin model | lasercut templates
5	6	7	8	9	10	11	physical model
12	13	14	15	16	17	18	lineweight drawings | renderings | collages
19	20	21	22	23	24	25	animation[s] | 1. simulation of climate control 2. child experience
26	27	28	29	30			thesis book | presentation layout | print

MAY

s	m	t	w	th	f	s	
					1	2	thesis book
3	4	5	6				reviews | thesis book

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Institutional Research

American Academy of Pediatrics
American Psychological Association
Center on the Developing Child, Harvard University
Center on Media and Human Development
Children's Digital Media Center @ Los Angeles
Early Childhood Research & Practice
HUMAN, Early Learning Partnership
International Society for Technology in Education
iPad Research Team, Pepperdine University
Kaiser Foundation
Lucy Brock Child Development Laboratory Program
The Seven Senses Foundation
Zero to Three: National Center for Infants, Toddlers, and Families

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Interview

Personal Inteview by Author at Arthur E. Canty Elementary School
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Personal Interview by Author at Prieto Math and Science Academy
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