Does architectural design of childcare environments influence early childhood development?



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Abstract

This essay is exploring how kindergarten and primary school spatial architecture influences the development of young children. Does the space in which we grow up, our second home, impact our understanding of architecture later in life? Is it important to comprehend spaces? What does it mean to understand space? And how can we create educational approaches for primary education that nurture sensitive individuals with a demand for more complex architecture, ultimately preparing them to become the next generation's architect commissioners and employers?

Architects of childcare buildings should study the psychological effect that different environments have on children. Forms, masses, colours and temperatures. How can a place be exploratory, to encourage children to discover and engage with their surroundings? This study examines how different types of spaces influence the interactions and engagement among children.

To support the essay, important to get to know radical examples in the subject, these should be critically analysed and reflected upon. As precedents the essay presents, a kindergarten in Tokyo by Tezuka Architects and the Canadian Strawberry Vale Primary School by Patkau Architects and last but not least the Green School Bali developed by IBUKU in partnership with Jörg Stamm and Atelier One. Opinions and previous studies from experts around the issue contributed to the essay.

Through this collection of research, I hope to justify the importance of creative and adventurous architecture and encourage architects to improve children's lives while refining future generations' open-mindedness towards the arts. Previous experimental educational designs, research, and literature on the subject should contribute to the collective knowledge and validated findings should be incorporated into the legislative system.

Keywords: child development, design evaluation, legislative system

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Introduction

In 1936, Christopher Alexander highlighted the significant impact of childhood play on mental health, asserting that insufficient interaction with peers during the initial five years could potentially result in future mental health issues (A Pattern Language). This underscores the crucial significance of encouraging children to engage in collective play and exploration to foster their creativity and spatial comprehension, an essential consideration in the design process of childcare spaces. Building on this notion, Arndt (2012) emphasizes that even before entering formal schooling, a child's brain has already assimilated substantial information through lived experiences and perceptual learning. These early experiences play a vital role in shaping ingrained perceptions and expectations related to architecture and spatial design.

Key developmental theories such as those proposed by Piaget (1963) and Werner (1949) highlight the pivotal role of a child's interaction with their surroundings in fostering development. Piaget terms this interaction as the "nourishment" or "food for thought" essential for cognitive growth. Piaget's theory underscores the child's active participation, emphasizing their role as active participants who explore, interact, and discover within their environments. Hence, it is crucial for children to engage in play and learning within enriched environments that offer abundant resources. These environments enable children to explore, experiment, and learn from the outcomes of their actions, fostering development through trial, error, and subsequent learning from those experiences. Moor (1987) suggests that the more extensive and unrestricted the environment, allowing room for exploration, errors, and learning from them, the more conducive it is for the child's developmental progress.

Several analyses have shown a clear link between the architectural definition of behavior settings and various behaviors observed within those settings. Specifically, there is a significant correlation between well-defined settings and increased engagement in developmentally supportive activities as well as higher levels of exploratory behavior. This connection with exploratory behavior holds true across different measures and appears to be unaffected by other individual or group variables. Additionally, cooperative behavior tends to occur more frequently in well-defined settings, whereas competitive behavior appears to be somewhat associated with 'resource poor' settings. The extent of social interaction among children is closely tied to the definition of the setting, with greater social interaction observed in spatially well-defined settings. Furthermore, the manner in which teachers interact with children is linked to the definition of behavior settings, with teachers displaying more active and supportive engagement in settings that are clearly defined (Moor, 1986).

Based on the Eurostat demographic database, during the 2010/2011 academic year there were slightly more than 64 million students in the EU in kindergartens, primary and lower secondary education. There were about 15 million children in nursery schools, about 28 million pupils in primary schools, and about 22 million students in lower secondary schools. In most countries, students attend school for five or six days per week and spend on average from 700 to 900 hours per year in classrooms. The number of teachers working in primary and secondary schools is close to 4.5 million. The teaching profession constitutes 3% of the total working

population in the EU (SINPHONIE, 2014). According to this data collected by the European Committee, the responsibility on architects is greater than one realises as we are the one designing the places and spaces that needs to accommodate and encourage all important activities for healthy development of children.

The essay goes through different types of literature including research papers, methodology publications, handbooks and policies. Also support the examination of the topic with case studies. Then reflects upon the childcare institutes building bulletin and policies. In order to concentrate on the functionality and impact of childcare buildings this study is disregarding academic teaching methods like Montessori, Waldorf or Froebel.

After Christopher Alexander's advice on an adventurous playground, "A castle, made of cartons, rocks, and old branches, by a group of children for themselves, is worth a thousand perfectly detailed, exactly finished castles, made for them in a factory" (A pattern language, 1936) we can rethink a children play area with a new mindset.

Tools for healthy and successful environment

Research confirms the importance of the physical setting of the ECE learning environment to the developmental, learning and social outcomes of young children. Noise, interior spatial design, light, air quality and legibility operated in isolation and in synergy to shape exploratory behaviour, attention, and interaction. Thus, it is imperative that environmental research be effectively translated into the public policy sphere in order to take full advantage of evidence regarding the built environment in order to support educational quality (Matthews, 2019).

In an article written by Julia Manning-Morton, an expert on early child development, explains the importance of well-being, in the physical and emotional aspect as well. The subject of well-being was in the focus of several discussions and researches for example by Unicef in 2007 or in the UK Government Every Child Matter proposal in 2003 (Manning-Morton, 2015). Though it has been 20 years since published Sir Paul Ennals, chief executive of the National Children's Bureau (NCB), claims its themes are as relevant today as ever (CYP Now, 2011). Nevertheless, Julia Manning-Morton sees that during the economic recession, taking care of children's well-being seems like something the UK is less willing to do. However, she suggests that these are when children's well-being should be prioritized (Manning-Morton, 2015). Many elements contribute to a person's welfare. Their social background, family, and community significantly influence their well-being. Additionally, their physical surroundings, something that can be influenced by professional environmental design strategies, also play a crucial role. Architects need to consider various factors like air quality, ventilation (IAQ), noise levels, temperature, natural and artificial lighting, colour schemes, access to green spaces, as well as crowding and density, especially when designing childcare facilities.

All of these aspects are ingredients working to create the final meal. The required components and the design decisions. One has to organise the ingredients so that they work well together, complement and reinforce each other rather than working against their goals. As with all environmental systems there is a synergy between the aspects of heat, light, air and sound absorption: all need to be considered holistically (Clegg, 2015).

Natural Light

Bringing daylight into a school is not as simple as providing glazed areas: to create truly dal-lit spaces while avoiding excessive solar gains and glare, daylighting can be difficult to manage. Reducing glare and external gains is important. They decrease visual performance and may result in discomfort, with symptoms including eyestrain and headaches (Winterbottom, Wilkins, 2009). The most effective way of controlling the daylight within the spaces is to effectively block the direct sunlight from reaching the working areas using external shading such as brise soleil, vertical fins or deep window reveals. Eliminating sunlight completely can result in spaces becoming deadened: the occasional shaft of direct sunlight can lift the spirit. But by allowing this to happen in less thermally sensitive spaces, such as atria or circulation areas., the solar gains can be effectively separated from the teaching spaces (Clegg, 2015).

Artificial light

Mark Winterbottom and Arnold Wilkins studies showed that 80% of UK classrooms are lit with 100 Hz fluorescent lighting that can cause headache and impair visual performance. (2009) Lindner and Kropt (1993) found younger individual demonstrated relatively high sensitivity to harsh fluorescent lighting (100 Hz flicker). The choice of fluorescent circuitry for school classrooms could therefore be very significant, and may adversely affect pupils' task performance and learning. Winterbottom's and Wilkins's paper also reveals that from their 90 classroom sample blinds were absent in 23%, in 51% of those that had blind, the blinds were either broken, or at least one was missing. Blinds were often ineffective in controlling daylight. They reckon, that most of these problems are unnecessary and appear due to poor policy decisions. In most cases, action to correct the problems would be simple, and any cost would be offset in the medium term, due to increased efficiency, reduction of wastage, and benefits in terms of health of pupils and staff.

As an example, to show how "guaranteed" a good lighting design, here is the section regarding lighting in educational facilities framework in an extent of 45 words.

School Premises 2012 statutory framework: Lighting

8.(1) The lighting in each room or other internal space must be suitable, having regard to the nature of the activities which normally take place therein.

(2) External lighting must be provided in order to ensure that people can safely enter and leave the school premises (legislation.gov.uk, 2012).

Indoor Air Quality

Considering that classrooms serve as a second home for both children and teachers, ensuring good air quality is of paramount importance. Insufficient air circulation within classrooms and buildings has been associated with "sick building syndrome," a range of respiratory, neurological, and allergic symptoms that worsen due to prolonged exposure to inadequate ventilation systems (Mendell, 2016). However, maintaining satisfactory indoor air quality in school buildings poses a significant challenge. The combination of high student densities and challenging site limitations frequently leads to complex design choices (Clegg, 2015).

Air quality in schools can have an impact on children's health, attendance and learning performance Indoor air quality in schools may be responsible for acute health effects (e.g. respiratory irritation), chronic effects (e.g. asthma and allergies), symptoms associated with sick building syndrome (SBS) (headaches, nausea etc.), and lack of concentration. Symptoms commonly attributed to poor IAQ include: headaches; fatigue; shortness of breath; sinus congestion; coughing; sneezing; eye, nose and throat irritation; skin irritation; dizziness; and nausea. Odours are often associated with a perception of poor air quality, whether or not they cause health-related symptoms (Sinphonie, 2014).

Sound and acoustics

The room acoustics have an essential role, especially for primary school students. Due to an auditory system yet to mature (Litovsky and Ashmead, 1997). This sound problem not only influences the cognitive functions negatively but is also an emotional stain. Several research investigations have shown that continuous exposure to unavoidable background noise, typically generated by nearby construction, transport centres, highways, airports, and similar sources, along with factors like overcrowding and disorder in the environment, induces a stress response that hampers learning (Evans and Hygge, 2007). Additionally, inadequate acoustics within the classroom setting have been linked to diminished reading comprehension and speech recognition abilities in children (Cohen, 1973, Bronzalf, 1981).

Three dimensions of noise require consideration: airborne noise, impact noise, and reverberation. Each of these aspects holds significance and when improperly managed, can adversely affect the learning environment. Airborne noise in school settings originates from various sources: external sources like aircraft or traffic, external yet within the school premises such as playgrounds or sports fields, internal sources from adjacent spaces, and noise generated within the space itself like air conditioning or projectors. Impact noise, also contributing to ambient noise levels, arises from physical activities in nearby areas, often caused by movements like shifting chairs or footsteps (Clegg, 2015). High ambient noise levels have been shown to have negative effects on memory and performance in cognitive tests (Shield, 2003). To prevent acoustical disturbance guidelines and legislative documents should expend on its importance. Nonetheless in 2012 the school premises devoted two lines to the subject.

School Premises 2012 statutory framework:

7. The acoustic conditions and sound insulation of each room or other space must be suitable, having regard to the nature of the activities which normally take place therein.

Space organization

Consideration of space area, density and avoiding crowding is very important in early childhood educational centres. Alain Legendre study result is important in this subject as it shows that the bioemotional reactions of toddlers in group settings are related to the environmental attributes of the child care services and facilities. Moreover, regarding bioemotional reactions, the amount of area available per child is virtually as important as the number of adults in the caregiver team. His data allow us to assert that it is not the total area of space allocated to the group but the area corresponding to part of the rooms accessible to the children that matter. If we look for a better use of the day care facilities with lower levels of emotional arousal, it would be desirable to provide children with play spaces that make at least $5m^2$ available per child (2003).

In toddler group, it has been shown that ease in establishing eye contact with caregivers from every part of the playroom has tangible effects on the children's exploration and use of

all the space available to them as well as on the occurrence and duration of interactions among peers (Legendre, 1995).

Designated activity spaces distinct from the classroom using changes in elevation, textures, lighting, and physical divisions like bookcases or cabinets. To enhance clarity, newly defined areas can be further distinguished by employing specific wall or floor colours strategically (Barrett, 2015).

Ferreira's (2018) study demonstrated that children could express the relationship between their capacity to modify an object's function and their learning process, highlighting the significance of being able to make physical alterations within their learning environment. Going beyond mere personal preferences of teachers or students, the capability to reconfigure the classroom has been associated with enhanced academic achievement (Barrett, 2013, 2015).

Case studies

Fuji Kindergarten by Tezuka Architects



Fig. 1, Tezuka Architects 2007. Fuji Kindergarten [architecture]

The International Moriyan RAIC Award winner Fuji Kindergarten was built just outside of Tokyo in 2007. Its oval shape creates a safe and endless playground for about six hundred little children aged between two to six. The rounded, enclosed shape as an embracing

hug insures children with security. The ground floor open plan design with integrated soft partition furniture permit discovery to kids supported by the Montessori teaching Method. The room hight is only 2.1 meters tall creating a children scale design. Connection with the environment is achieved by threes growing from the inside of the classrooms going through the roof towards the sky. This is reinforced by the movable walls towards the courtyard, thus blurring the threshold between the interior and exterior. By leaving the classrooms open, the sound of 600 children creates the level of white noise found in natural environments.



Fig. 2, Tezuka Architects 2007. Fuji Kindergarten [architecture]





Fig. 3, 4, Tezuka Architects 2007. Fuji Kindergarten [architecture]

Tezuka believes that “Just as a fish cannot live in purified water, children cannot live in a clean, quiet and controlled environment”.



Fig. 5, Tezuka Architects 2011. Ring around the Tree [architecture]

Kids encouraged to explore and experiment the multifunctional play areas. Play with water, to run around endlessly in circles permitted by the circular building's deck roof, and to climb trees. "If a kid is strong enough, they can reach the upper level without using the stairs. Other schools might not allow this, but the principal here believes children know their own limits. They stop when they have to stop" (Tezuka) The architecture itself functions as a giant playground (Tezuka, 2007, Dezeen, 2017, Ha, 2015).

Strawberry Vale Elementary School by Patkau Architects





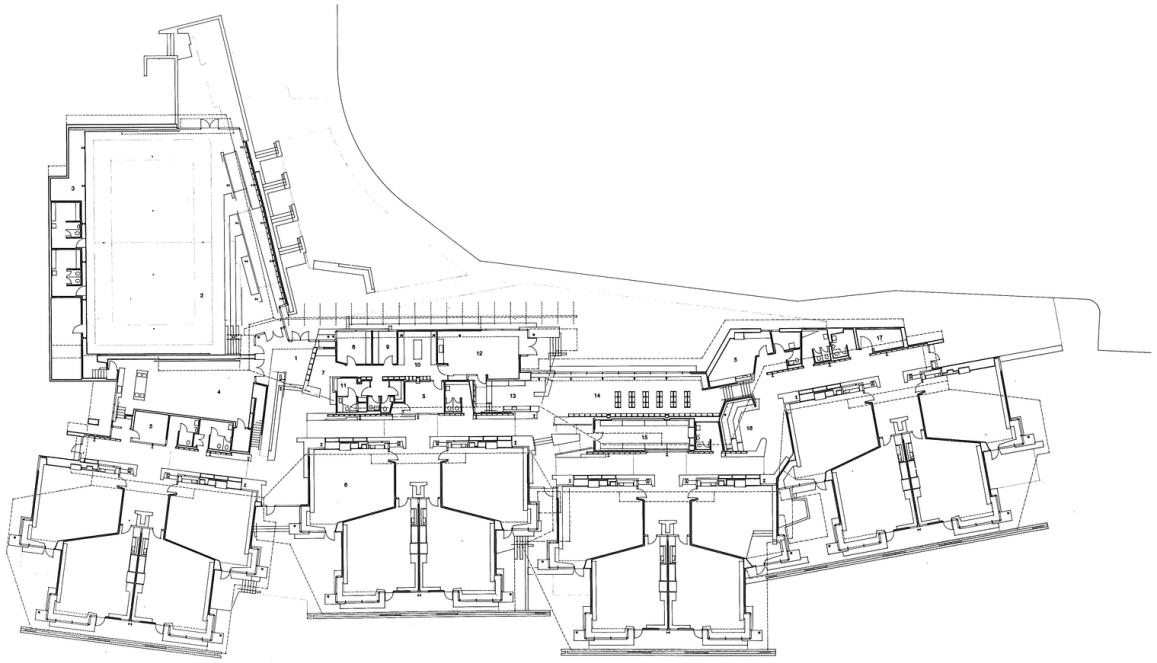


Fig. 6, 7, 8, Patkau Architects 1995. Strawberry Vale Elementary School [architecture]

The Strawberry Vale Elementary School is located in the semi-rural Canadian, Victoria community, integrating to its environment with the building local material palettes with a rich tectonic vocabulary that borrows from the diverging currents of modernity and vernacular practice. The building consists of sixteen classrooms, a gymnasium, a library, and other spaces usual for an elementary school. The building's staggered masses follow the Garry Oak woodland unique environment preserving and emphasising the connection between the two. Furthermore, a prominent geological rift been wrapped around the school has a deep influence on the building's unexpected form. The classrooms organised in clusters creating in-between spaces, both interior and exterior accommodating a broad range of activities. While wide openings and controlled placement of windows allowing direct connection with the surroundings cultivating the geospatial awareness also permitting the building to play an active pedagogical role, encouraging the students' engagement with nature. Meanwhile helping to optimize the use of solar energy.









Fig. 9, 10, 11, Patkau Architects 1995. Strawberry Vale Elementary School [architecture]

The environmental sensitive philosophy is strongly represented in the interiors as well. The artful complexity emerges from the intersection of hovering beams, broken surfaces, and revealed mechanical elements. The exposed surfaces reveal the raw materials in majority of native lumber, metal, and glass. Its spatially complex architecture highly contributes to cognitive and social behavior development through visual and acoustic perceptions as well. It helps with social group organizing and, in the meantime, facilitates quit retreat nooks allowing children to listen to their own social needs. In fullness, the architecture is a source of wonder and exploration, balancing playfulness with sophistication through its abundant richness (Langdon, 2015, Patkau Architects, 1995, Arndt, 2012).

Other professionals say that the partitioning of the space into open clearly laid out areas, and protected havens takes into consideration natural human preferences and thus conveys feeling of security (Orians and Heerwagen, 1992). The decision for compromises is in the architect or conditioners hand to achieve their educational program.

Green School Kindergarten by IBUKU



Fig. 12, IBUKU 2008 Kindergarten Green School [architecture]

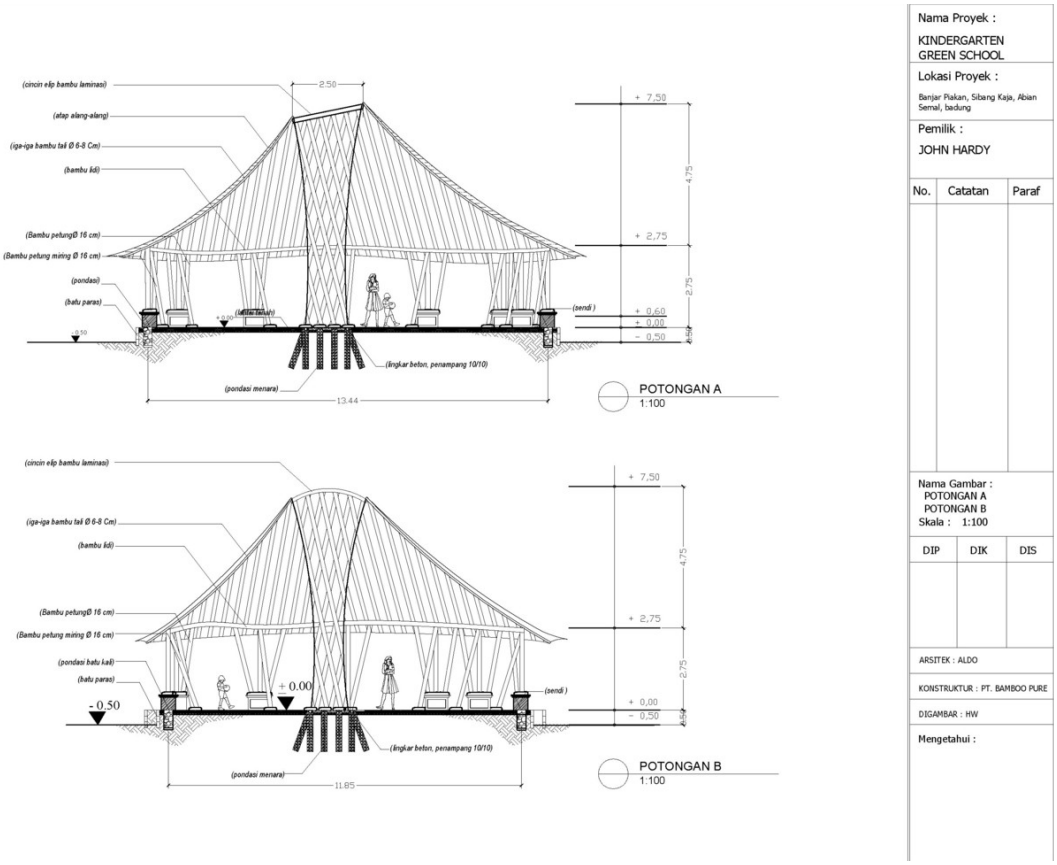
The Green School Kindergarten is located on a sustainable campus within the lush Bali jungle with native plants, trees and animals. The school was founded in 2008 by John and Cynthia Hardy on the principals of Rudolf Steiner. There are seven sustainably grown bamboo structures functioning as classrooms, gym, assembly spaces, faculty housing, offices, café and bathrooms on the full site area of 45.000 m2. Facilitating 435 students, from pre-K to high school, across 35 nationalities. The campus relies on various alternative energy sources such as a bamboo sawdust-based hot water and cooking system, a hydro-powered vortex generator, and solar panels to generate power.



Fig. 13, 14, IBUKU 2008 Kindergarten Green School [architecture]

The Kindergarten classroom designed by IBUKU architectural firm after the school opened. Its open room fits perfectly into the "school without wall" image creating unity with other part of the campus. Its light structure is supported by a woven bamboo spine leading to a skylight on the centre of the roof allowing operational light from above. The leading idea of the structure is that the roof comes down to 1m - 1.5 m height blocking the view out and inside which helps to minimize disruptions during school hours. The multipurpose room accommodates various play stations and features adaptable furniture suitable for different activities. It is situated on a surface composed of a mix of mud and concrete, sometimes covered with bamboo surface treatment chosen for its easier maintenance due to frequent use. Altogether, the pavilion structure creates a secure and sheltered space for learning activities while maintaining a strong connection with the surrounding environment (IBUKU, 2021, Hudson, 2012, Vanderbilt, 2017).





Nama Proyek :
KINDERGARTEN
GREEN SCHOOL

Lokasi Proyek :
Banjar Piakan, Sibang Kaja, Abian Semal, badung

Pemilik :
JOHN HARDY

No.	Catatan	Paraf

Nama Gambar :
POTONGAN A
POTONGAN B
Skala : 1:100

DIP	DIK	DIS

ARSITEK : ALDO

KONSTRUKTUR : PT. BAMBOO PURE

DIGAMBAR : HW

Mengetahui :

Fig. 15, 16 IBUKU 2008 Kindergarten Green School [architecture]

Performance evaluation

The evaluation of early childhood educational building quality traditionally encompasses a wide array of factors, considering social, curricular, and environmental elements. Post Occupancy Evaluation (POE) serves as a technical method that specifically assesses the structural aspects of space, aiming to identify environmental issues and ensure the construction aligns with its intended function (Cleveland and Fisher, 2014). Alongside these technical appraisals, educators and designers prioritize the functional assessment of space, focusing on how effectively it caters to the needs of teachers and students. Space attributes like size, arrangement, lighting, and acoustics significantly impact the classroom's functionality.

Simultaneously, the LEED rating system spans various exterior and interior dimensions, encompassing construction, design, air quality, ventilation, lighting, and space functionality (USGBC). LEED school design criteria offer valuable standards for early childhood programs seeking to enhance sustainability efforts and construct health-oriented learning environments. The LEED rating system encompasses a broad spectrum of exterior and interior aspects, including construction, design, air quality, ventilation, lighting, and space utility (USGBC). The LEED criteria for school design can offer valuable standards for early childhood programs striving to enhance sustainability and construct healthier learning environments.

The Childhood Physical Environment Rating Scale (CPERS) is a comprehensive measurement tool for the evaluation of the physical settings of schools. CPERS addresses the key environmental parameters most impactful on children’s development. This tool evaluates young children’s learning settings using 124 items that are organised into 14 subscales focusing on planning, overall architectural quality, indoor activity spaces, outdoor areas. CPERS is the first to assess the physical environment of early childhood environments. Other than providing systematic, evaluative information on the quality of childcare settings for policy makers, managers, childhood educators, architects and parents, and serve as a shorthand design guide for the programming (or briefing), design, and pr-occupancy design evaluation of new centres or the renovation of existing settings, it assists in fundamental research on the relations between the physical environment and child development (Moor and Sugiyama, 2007).

Apart from evaluating the attributes of educational buildings and classrooms, it's equally crucial to comprehend how both students and teachers utilize these spaces, including their independence within the classroom, as well as the influence of various physical cues on classroom behaviours. Behaviour mapping, as a method, serves to illustrate the interconnection between space, behaviour, and engagement. This method involves an unobstructed, direct observation technique, tracking the subjects' locations and their activity levels simultaneously. The outcomes aid researchers in understanding the behavioural dynamics within the built environment. This enhanced understanding of the correlation between the environment and activities could potentially shape childcare policies (Cosco, 2010).

There are many more evaluation methods and guidelines and handbooks produced by private institutions, professionals researching in this field or commissioned by the government or the European Union. There are traditional methods and experimental ways of evaluating the physical environment of childcare and educational buildings. These are for example the (POC) Post Occupancy Evaluation, the (ITERS-R) Infant -Toddler Environment Rating Scale, the (ECERS-R) Early Childhood Rating Scale, the (CELE) Centre for Effective learning Environment or the (EQES) Evaluating Quality in Educational Spaces. Other evaluating systems concerning the physical settings should be used broadly and incorporated in the legislative framework as quality assurance for the institutions and teachers. For these are good examples are the (CPERS) Childhood Physical Environment Rating Scale and Behaviour mapping method. A very important non-statutory detailed guideline has been produced by the Department for Education in 2007. Building Bulletins are offer guidance on a range of subjects, from whole school design schedules to detailed engineering specifics.

Conclusion

Answering my title question, “Does Architectural design of childcare environments influence early childhood development?” I can strongly support the notion that it is. Convinced by the extensive research and experiments conducted by architects, psychologists, and sociologists, all of whom underscored the pivotal role of architectural design.

One of the most prevalent findings highlighted by these studies is that formal childcare significantly contributes to the cognitive development of preschool children, particularly those from economically disadvantaged backgrounds. This contribution leads to enhanced intellectual competence and cognitive maturity across a wide spectrum of children (Moor and Sugiyama, 2007). As previously argued, this theory operates on both explanatory and normative levels (Moor, 1997). It not only helps us comprehend the dynamic interactions between children and their environment through the interactional-constructivist theory but also serves as a basis for environmental interventions through planning and design (Moor and Sugiyama, 2007).

What we urgently need is a transformative shift towards more supportive legislation and planning systems, particularly concerning innovative and unconventional designs within the most common built environments experienced by children and educators, aside from their homes (Sonenstein F, Gates G). Investigations into the relation between physical activity and various environmental design factors offer significant potential to shape evidence-based design policies and practices aimed at fostering increased activity levels (Pate RR, 2004). There is a notable call for the development of evidence-based design guidelines to enhance effectiveness (Cosco, 2010). The comprehension of how design impacts children's behaviour not only informs design interventions but also plays a crucial role in shaping childcare licensing policies and accreditation regulations, that may support active childhoods (Trost, 2010).

Moreover, it's essential to consider that classroom designs in conflict with the teaching methods can impose considerable strain on both learners and teachers. Looking ahead, there is a growing need for more specialized research that fosters collaboration between neuroscientists, psychologists, and educational practitioners to comprehensively examine the impact of specially organized learning environments on the developing learning brain (Arndt, 2012). As part of this progressive endeavour, further investigations should focus on identifying environmental factors precisely impacting the psychobiological processes involved in emotion regulation. A deeper understanding of these meaningful environmental characteristics holds the potential to improve the quality of childcare services and facilities, ultimately enhancing the well-being and health of children in these early group contexts (Legendre, 2003).

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