VITAL CONNECTIONS

A New School Typology for Environmental Stewardship in Honduras

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THESIS STATEMENT

Honduras faces issues of an inadequate school network and a poor waste management system. This set of problems presents a unique opportunity to develop a new school typology that establishes a waste management network while meeting the needs of the learning environment.

ABSTRACT

Developing countries face various obstacles that hinder their ability to provide a good quality of life to their population. In Honduras, two of these obstacles exist in the areas of education and environmental stewardship. More than half of the existing school network is in a precarious state, representing a hazard and a hindrance to children's ability to learn. Additionally, only approximately one third of the municipalities in the country have a waste management plan which results in large amounts of pollution.

The lack of waste management and the deteriorated school network are pervasive problems throughout the country. Seen as separate issues, solutions to these challenges tend to be completely independent from each other. Additionally, they tend to be singular proposals that do not address the systemic nature of the issues. This exploration argues for an integrated network to develop a more productive response. Specifically, it acknowledges that in a context where resources are limited, unique opportunities can be found in incorporating waste management into the school environment. The thesis proposes a new school typology that establishes a waste management network by addressing the problems with the school infrastructure in the country.
THESIS ESSAY

INTRODUCTION
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Figure 1: Location of Honduras | By author
INTRODUCTION

The built environment is an intrinsic aspect of human life. Architecture enables human beings to concretize intangible phenomena that define their identities and thus their sense of place. Consequently, it plays an important role in society and has the ability to contribute to social and environmental solutions.

In Central America, some countries struggle to provide an acceptable quality of life for their population. An excellent education and a sustainable relationship with the environment are key aspects in the development of a country; they are vital for the empowerment of people. An example of a country that fails to meet even the most basic standards is Honduras. A lack of a competent school network and a lack of proper waste management are pervasive issues that severely hinder the development of the country. Problems in these categories tend to be approached through the lens of policy, and solutions usually target the problems individually.

As a means for grounding people's identities and values in the physical realm, there is an important opportunity for architecture to be part of the answer to these social and environmental issues. There is potential to provide one intervention that addresses two distinct problems. Though architecture by itself cannot provide comprehensive solutions, it can be a vital part of the conversation.

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1 Norberg-Schulz, Genius Loci: Towards a Phenomenology of Architecture.
WASTE MANAGEMENT

The increasing environmental concerns in the planet, to which developing countries like Honduras are most vulnerable, reveal the necessity of a good relationship with nature. Embedded in this relationship is waste management, which, in Honduras, is critically defective. Due to a lack of adequate planning, the system suffers from huge deficiencies. Municipalities are the primary entities responsible for handling waste in the country; however, the regulations on the national level are insufficient. As of 2010, only 26.7% of the municipalities in the whole country had a waste management plan. Trash is a common sighting on Honduran streets and rivers, especially in the larger cities. These conditions not only represent a severe environmental hazard but are also a danger to the population's health and well-being.

Due to the lack of planning and coordination, there are huge gaps of information on Honduras' waste generation and management. Nevertheless, it is estimated that the country produces 3,792.6 tons of waste per day, of which 54% comes from the six largest cities. This figure will continue rising as the population grows and

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2 Alfaro, “Guía Nacional para la Formulación de Planes Directores Municipales para la Gestión Integral de Residuos Sólidos.”

3 Secretaria de Recursos Naturales y Ambiente et al., “Análisis Sectorial de Residuos Sólidos En Honduras,” 10

4 Tello Espinoza et al., “Informe de la Evaluación Regional del Manejo de Residuos Sólidos Urbanos en América Latina y El Caribe 2010.”

5 Secretaria de Recursos Naturales y Ambiente et al., “Análisis Sectorial de Residuos Sólidos En Honduras.”

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consumption patterns increase. Of this waste, more than half is burned or buried, and only 28% formally enters the waste management system.

This problem affects the country at various scales and represents an environmental hazard and hindrance to development.

As the largest cities, Tegucigalpa and San Pedro Sula generate a large percentage of the waste in the country. Furthermore, most of the available information regarding waste management pertains to these two cities. According to their municipalities, Tegucigalpa and San Pedro Sula produce 810 and 800 tons of waste per day respectively. Of this waste, very little is recycled, because recycling collection is mostly informal and happens at various stages.
during the waste stream, mostly at the municipal dumps. This causes some of the recyclables to be contaminated and thus no longer recyclable. Consequently, only about 11% of the waste is recycled, despite the fact that a large percentage of it could be reintroduced into the production process. Recycling facilities do exist in the country; however, there is no network in place for collection at the source, suggesting a structural problem, in addition to a lack of environmental awareness.

Environmental Awareness

According to the government, the most important factor that contributes to the waste problem in the country is a lack of environmental awareness. Environmental problems are a result of inadequate environmental education and knowledge that fail to go beyond knowing about the environment to understanding and addressing environmental problems. It is not sufficient to know about nature; it is just as important to know how human actions affect it.

Environmental awareness can be defined as “knowing of the impact of human behavior...”

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1. Environmental Awareness: Knowledge and Emotion

![Diagram of Environmental Awareness]

Figure 1.6 Environmental Awareness: By author

Environmental awareness is comprised of knowledge of the environment and an emotional connection to it.

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8 Secretaria de Recursos Naturales y Ambiente et al., 83.
9 Pavón, Manejo Integral de Residuos Sólidos en Tegucigalpa.
10 Pavón.
11 Affaro, “Guía Nacional para la Formulación de Planes Directores Municipales para la Gestión Integral de Residuos Sólidos.” 9
on the environment”, and is one of the factors that shapes pro-environmental behavior. It comprises both knowledge and emotional involvement. A basic knowledge of environmental issues is the first step to a healthy relationship with the environment; however, there is also an aspect of understanding issues that are not immediately tangible. People cannot always see the effect of their actions on the environment. Emotional involvement requires a connection with the environment that causes people to have an emotional reaction when confronted with environmental degradation. The factors that shape pro-environmental behavior are extremely complex, but environmental awareness clearly plays an important role in this process. Therefore, a sustainable waste management system depends on fostering environmental stewardship.

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13 Kollmuss and Agyeman, “Mind the Gap,” 253
14 Kollmuss and Agyeman.
SCHOOL INFRASTRUCTURE

Another extensive problem in the country is related to education. In order to foster a sustainable development, the current approach to education needs to be reevaluated. Current learning outcomes reveal the poor state of the existing model. Even though the country’s expenditure on education is high compared to other countries in Central America, its performance is one of the lowest in the region. After Guatemala and El Salvador, it has the highest illiteracy rate in Central America. One in ten people do not know how to read and write, a figure that is doubled in rural areas. The average Honduran receives only four years of education compared to a global average of twelve years.\textsuperscript{15} Furthermore, an evaluation conducted by the Ministry of Education revealed that 60\% of the students fall under the categories of “Needs Improvement” and “Unsatisfactory.”\textsuperscript{16} Despite some of the country’s efforts to invest in education, children’s performance is still significantly low.

An important factor contributing to this problem is the physical environment in which Honduran children receive their education. The school network in the country is extremely deficient. According to the Ministry of Education, the average school in Honduras needs improvement and a large quantity of these schools are actually

\textsuperscript{15} “Educational Challenges in Honduras and Consequences for Human Capital and Development.”

\textsuperscript{16} Secretaría de Educación, “Informe Nacional de Desempeño Académico.” 28

Figure 1.8 Literacy Rate | By author
One in ten Hondurans do not know how to read or write.

Figure 1.9 Student Performance | By author
A large percentage of the students’ performance needs improvement or is unsatisfactory in both Spanish Reading and Math.
Some school infrastructure is almost nonexistent, and children are forced to receive class under the open sky.\footnote{Secretaria de Educacion, “Mapa Indicador de Estado de La Infraestructura Escolar.”}

Overcrowded classrooms are not uncommon in precarious conditions and represent a social hazard.\footnote{Duarte, Jauregiberry, and Racimo, “Sufficiency, Equity and Effectiveness of School Infrastructure in Latin America According to TERCE.”} The majority of the students attend a school that lacks basic services and does not provide learning spaces other than the classroom.\footnote{Direccion General de Construcciones Escolares y Bienes Inmuebles, “Criteria y Normativas para la Planificacion y Diseño de Centros Educativos: Pre-Basica, Basica y Media.”}

In response to these precarious conditions, the government, through the Ministry of Education, released a document containing a series of criteria for the design of schools, which included considerations on site selection, space needed per child, thermal comfort, availability of appropriate outdoor spaces, and security.\footnote{Earthman, “School Facility Conditions and Student Academic Achievement.”}

These regulations, however, have not been widely implemented and the majority of the schools in the country continue to be unsuitable learning environments.

School Infrastructure and Learning Outcomes

Studies have revealed that the quality of the space in which children learn is important, especially in developing countries.\footnote{Murillo and Román, “School Infrastructure and Resources Do Matter.”} The reason why the impact is magnified for developing countries is that a large portion of the schools lack very basic services that can be found in every school in a developed country.\footnote{Murillo and Román, “School Infrastructure and Resources Do Matter.”} Murillo

\begin{itemize}
  \item \textbf{Figure 1.10} Inadequate Infrastructure \cite{El-Herald}
  \item \textbf{Figure 1.11} Overcrowded Classrooms \cite{El-Herald}
\end{itemize}
Figure 1.12 Map of State of School Infrastructure in Honduras. By author, base on data from Secretario de Educacion.

The map shows the condition of the school infrastructure in the country. Evidently, most of the public schools in the country are not suitable learning environments.
by our110, hes,:i bas c se1Y,ces are essen: a in tne school environment, and their lack can severely hinder children’s ability to learn.

Similarly, the Unesco TERCE study revealed that schools with the appropriate infrastructure, equipment, and services positively affect the learning outcomes of students in Honduras. This information suggests that targeting the quality of the architectural spaces that make up the school network will significantly improve students’ performance.
DISCONNECTED SOLUTIONS

In response to the severity of these issues, entities, both public and private, have been developing solutions to improve the current conditions. An example of this can be seen with specific case of waste management in the Distrito Central, the municipality where Tegucigalpa, the capital city, is located. As previously discussed, the biggest responsibility for the waste problem falls onto the municipalities. To address the lack of a proper waste management system, the Mayor is trying to implement a five-part plan. This plan comprises the environmental education of the population, the improvement and expansion of existing infrastructure, the introduction of waste segregation at the source, the incorporation of informal waste segregators, and the redesign of the collection routes. Despite expressing that the biggest issue is a lack of environmental awareness, the focus is on the infrastructure. The plan is to close the existing cells of the municipal dump and build new ones that follow the regulations of a sanitary landfill. Additionally, they will build a waste segregation plant that will provide jobs for informal waste segregators.24

In terms of improving the education, the Ministry of Education is focusing on six strategic areas: access, quality, efficiency, competitiveness, management, and participation. Among these areas, the school infrastructure is prioritized in the access and management categories. Access

24 Pavon, Manejo Integral de Residuos Sólidos en Tegucigalpa.
Quality of education: improving the curriculum, training teachers, tutoring.

Technology: computer laboratories, teacher certification.

Infrastructure: renovating existing buildings, building new classrooms.

Environment: waste management, gardens.

On the private sector side, companies have also sought to address the issue. An example of this is the project “Centro Clave de Desarrollo Integral” (Integral Development Center) by Fundación Terra, a branch of the corporation Grupo Terra. This project targets deficiencies in the infrastructure and curriculum of schools. They are currently working on their pilot project, Centro San Miguel; however, the goal is to work with about 22,000 other schools. In terms of infrastructure, the plan is to remodel the schools to make the spaces appropriate for learning and to add laboratories, workshops, and outdoor spaces. Additionally, they propose adding cultural and environmental programs to the curriculum.26

26 Nasser, Zuniga, and Martinez, Centros Clave de Desarrollo Integral.
Waste and education tend to be seen as separate issues; thus, the solutions proposed are completely independent from each other. This is especially evident when looking at how the Honduran government is approaching these problems given that the entities in charge are from very different branches of the government and are not working together. The waste problem is addressed at the municipal level, and the education problem is addressed at the national level. Furthermore, solutions are working within the existing system rather than aiming for structural changes that will result in more integral solutions. The pairing of both problems offers a unique opportunity to develop a single architectural solution that targets the related systemic problems. Both issues require a physical intervention, and integrating the two systems could generate more productive processes that are rooted in environmental stewardship.
"Our earth is essentially a closed materials system with a finite mass, and all the ecosystems within it, along with all of the earth's material and fossil energy resources, form the final contextual limit to all our human activities."


A VITAL CONNECTION

This thesis argues for an integrated network to develop a more productive response to the pervasive problems of waste and unsafe school infrastructure. Specifically, it acknowledges that in a context where resources are limited, unique opportunities can be found in incorporating waste management into the school environment. Existing processes for waste are ingrained in a linear pattern of human economy. However, when analyzing ecosystem operations, it is evident that linear processes are not natural. Ecosystems are cyclical in nature, where the waste of one organism becomes the food of another. Consequently, an ecosystem is self-sustaining, because, rather than producing net waste, its processes are constant exchanges of materials and energy. The earth is a closed system with a finite amount of resources, and architecture inherently has to operate within these limitations in order to create long-term feasible human operations.

As a consequence of the existing linear patterns, the infrastructure built to support human life further reifies these unsustainable patterns. As Weiss and Manfredi argue, these components of the built environment are currently growing and monofunctional. Because its design is inherently tied to human processes, infrastructure "shapes
our environment and urban life in vital, authentic, and often messy ways.\textsuperscript{31} It is rooted in models of rapid economic growth that emphasize efficiency; however, through activation of space at different scales, sectional opportunities, and hybrid programming, there is potential to achieve “more productive relationships between infrastructure, ecology, and public life.”\textsuperscript{32} Blurring the line that separates infrastructure from human inhabitation creates unique opportunities to restructure the existing linear process to become a cyclical process.

Specifically, in the case of integration of waste management and the school environment, this thesis identifies three key opportunities: addressing the disconnect between human beings and waste management systems, using the school as a physical link that negotiates between the human processes and nature, and fostering of environmental stewardship for multiple generations.

\textbf{Disconnect}

With the awareness that poor sanitation is a hindrance to development, that environment degradation is rapidly increasing, and that available resources are limited, waste management can no longer exist as an isolated

\begin{figure}[h]
\centering
\includegraphics[width=\textwidth]{disconnect.png}
\caption{\textit{Disconnect: By author} Current processes, which place no significant value on waste, create separation between waste generation and its disposal.}
\end{figure}

\textsuperscript{31} Weiss and Manfredi, Public Natures. Evolutionary Infrastructures, 8.

\textsuperscript{32} Weiss and Manfredi. 9 and 13.
The current paradigm, which places no significant value on waste, creates separation between its generation and disposal. As Massaro argues, “[the current] waste management model is easily associable with a ‘black box’ model: the composition of flows is not known exactly and the behavior of the management system remains unclear.” However, a paradigm shift in which waste is no longer a nuisance but a resource opens the opportunity to use waste as a driver for self-sustaining communities. This change of perspective allows for the introduction of cyclical processes where waste itself becomes the solution to its associated environmental problems and is integrated into the daily processes of human existence. Then, waste management infrastructure does not need to be monofunctional and can become an avenue for public engagement.

**School as a Link**

As the paradigm of waste shifts to create processes that are integrated into daily human operations, identifying locations where this integration takes place becomes increasingly important. A key consideration for this is...
the Jevons paradox which describes the phenomenon in which increased efficiency can lead to increased consumption. Solutions to the problem of waste cannot simply prioritize efficiency, because, rather than questioning the consumption that has created the unsustainable waste management practices, they might further legitimize it. Therefore, the integration must actively engage citizens and foster a better relationship to waste and the environment. In this perspective, environmental knowledge and awareness become increasingly important factors which suggest an opportunity for hybridization of the waste and education networks. As previously discussed, the school infrastructure in Honduras is in severely deteriorated state. By addressing the deficiency of proper school environments, there is an opportunity to establish the currently lacking network for proper waste management. Therefore, schools can become the vehicle to create more metabolic processes in the country while at the same time educating the population on issues of the environment.

**Knowledge Transfer**

Additionally, incorporating waste and environmental education into the school curriculum has proven to be effective in fostering

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37 Bell, “Energy, Society, and the Environment.” 149;
38 Massaro, “Rethinking the Spaces of Waste Management Infrastructure: Towards Integrated Urban Strategies to Avoid Urban Solid Waste in Contemporary City.” 129
pro-environmental behavior in certain settings. A key example is the Rotherham THAW project in Yorkshire, England. This project found conclusive evidence that school programs about waste and recycling are not only fundamental in building a child’s knowledge base about the environment, but this knowledge is also carried home, thus transforming the behavior of entire households.\textsuperscript{39} By focusing on school based solutions, there is a potential to foster environmental stewardship for multiple generations effectively expanding the area of impact.

\textsuperscript{39} Maddox et al., "The Role of Intergenerational Influence in Waste Education Programmes."
STRATEGIES FOR INTEGRATION

This thesis proposes rethinking the existing school typology in the country. As this new typology seeks to integrate ecology, education, and waste management, the way these different and seemingly incongruous components interact with each other becomes critical. The strategies to achieve this integration through the built environment can be divided into two categories: integration with waste management and integration with nature.

Integration with Waste Management:

A building can be integrated with waste management infrastructure using a sectional strategy. An example of this is the Sydhavns Recycling Center by Bjarke Ingels Group. In this project, a park and a recycling collection center exist in the same site but are separated in section. The park area is raised, and its users are able to look down into the collection center. This type of strategy allows for separation between the different programs while at the same time creating a visual connection that enables users to learn about the recycling stream.

A second strategy is one where the waste or recyclable materials that are brought into the building become the supply for a different space. In the project From Place to Plant, Lateral Office proposes a hybrid building for the management
From Place to Plant | Lateral Office

Plastic Island | Erik and Emily Goksoyır

SUPPLY

BUILDING MATERIAL
of urban materials in Chicago. The surplus of materials from the city would be brought into this building and used to supply a park on the roof. This allows for a more cyclical process where the waste of one activity becomes the supply of another.

The final strategy is to construct the building out of recycled materials. In their thesis, Plastic Island, Erik and Emily Goksøyr explore the possibility of processing recycled plastic to use as a building material through different methods. The goal of the project is to change the paradigm that waste has no value, arguing that it can be transformed into something useful. This strategy, however, must not be seen as a solution to pollution as recycling does not address the fundamental problem of society's increasing dependence on fossil fuels. The purpose of this strategy is to help establish an ecosystems approach to building materials where waste becomes a resource.

Integration with Nature:

To integrate architecture with the environment, a building can function as a frame to draw attention to the nature surrounding it. An example of this can be seen in how Snøhetta uses a series of concrete structures to frame specific aspects

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41 Lateral Office, "FROM PLACE TO PLANT"
42 Goksøyr and Goksøyr, "Plastic Island"
43 Fairs, "The Rising Use of Recycled Plastic in Design Is 'Bullshit' Says Jan Boelen."
of the landscape in their design for the Kvik Art Museum. This strategy is useful for creating a visual connection between spaces of an architectural project and nature.

Another strategy is one in which the architecture becomes the armature upon which nature can grow. The Calumet Environmental Center, Lateral Office’s Between Landscapes project, employs a series of nest walls for birds and other wildlife. This strategy seeks to support nature and create a space where it can continue to flourish. By creating space for nature, the displacement of ecosystems that occurs when constructing a building is minimized.

The third strategy is a systems approach. Renzo Piano integrated a number of systems in the California Academy of Sciences that work together with the environment in a constant exchange of energy and materials. The form of the building responds not only to the spaces inside but also to these systems that collect energy from the sun, harvest rainwater, and allow for natural ventilation. Rather than imposing a built form into the environment, this approach allows for a more coherent integration with the ecosystem.

44 Snohetta “Kvik Art Museum.”
45 Lateral Office, “BETWEEN LANDSCAPES.”
46 Renzo Piano Building Workshop, “California Academy of Sciences.”
CONCLUSION

Architecture plays a critical role in grounding people’s experience in the physical realm. It is a tool for place-making, because it materializes intangible values that are deeply rooted in communities. However, it can also be a factor that shapes society, and as such, it has the potential to be a catalyst for positive change. Furthermore, architecture can contribute important solutions to the sustainable development discourse, especially in regions that struggle to provide a good quality of life to their population.

In the context of Honduras and the challenges that it faces, there is an important opportunity to address environmental problems by developing a solution for the difficulties found in the education sector. The school network is poorly designed and many schools are in a severe state of disrepair. There is a critical need for a physical intervention that will provide good learning environments for the students. Likewise, the waste management problems require urgent solutions. There is a lack of environmental awareness and a disconnect between the country’s rich biodiversity and an understanding of how human action affects it.

This thesis proposes a new school typology that acts as a link between nature and human activity. It argues that schools should not only be environments that are conducive to learning, but that they should also be catalysts for societal change. This new typology seeks to cultivate sustainable relationships with the environment, not just in the students who attend the school but also in the community to which the school belongs. This new school typology investigates the ways in which various design decisions can establish vital connections capable of transforming society at large.
ANOTATED BIBLIOGRAPHY


This book includes discussions on the history of education, educational systems, school typologies, and spatial configurations. It explains the requirements for providing a good environment when designing a school. Additionally, it includes a series of case studies that showcase how design can be adapted to accommodate the latest educational theories.

The book is relevant to this research, because it provides a foundational knowledge of the spatial, lighting, acoustic, and sustainability standards that should be followed when designing an educational space for children. Furthermore, it makes an argument for an intrinsic relationship between pedagogical visions and architecture. This means that the design of schools cannot be standardized; it must be tailored to the specific needs of the education philosophy while also creating an environment that enhances the children’s learning experience.


This book gives a broader overview of the realities and challenges that children across the developing world face. Chapter 5 focuses specifically on education. It explains the difficulties that contribute to children’s lower performance in these regions and expresses that poor facilities are an acute hindrance to proper studies.

This chapter helps define the framework for the reasons why the discussion of the school environment is especially relevant in these areas of the world. The book expresses that a lack of resources is one of the main reasons why the school infrastructure is inadequate. This statement needs to be carefully considered for this thesis in order to provide an architectural solution that is appropriate but also affordable.


The article discusses how the effect of implementing waste education programs in schools can extend to the rest of the family. It specifically discusses the results of the THAW Project, which has been very successful in the schools in which it has been implemented. Not only is the program educating the children but the children are also sharing this knowledge with the rest of their family thus changing their relationship to waste.

Though the THAW program is not directly related to the architecture field, it provides important insight on how knowledge transfer can have a magnified effect when it begins with children.

The purpose of this investigation is to determine the impact of school infrastructure and resources on academic performance. It focuses on primary education in Latin America, making the distinction that the effect infrastructure will have in learning outcomes will be different for developed and developing countries. The research seeks to quantify the statistical impact that the built environment has on the children's ability to learn and concludes that infrastructure has a crucial role in learning outcomes. The research is extremely important for this thesis. It provides a framework for the argument that the built environment is also a determining factor for school effectiveness. Without the adequate infrastructure, children cannot receive a high-quality education.


In this book, the author asks the question “what can architecture offer learning and what does learning require from architecture?” The author studied educational spaces, and throughout her investigation, she arrived at the conclusion that the built environment has an important impact in child development. The reason for this is that have unique sensory needs and a different way of moving through and perceiving space. It includes several case studies of designs that carefully consider what it means to design for children. The discussions in this book are relevant, because designing for children comes with a different set of needs and requirements. This consideration is especially important to the development of a school typology. The typology needs to accommodate this set of criteria.


This study discusses how raising environmental awareness can be effective when done through students, because it amounts to investing in the future. It focuses on the Eco-Schools Program, and more specifically, their sites. It talks about how the program is meant to create a sense of place and increase knowledge of environmental issues. The research analyzes what sites will make this type of school more successful.

This article is important, because it discusses an existing school program that seeks to raise environmental awareness. It also provides a set of characteristics that should be considered when selecting a site. This research could influence the site recommendations for the new school typology.
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FIGURES

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PRECEDENTS: INSPIRATION

GANDO PRIMARY SCHOOL
OCEAN DOME
UNTERDORF ELEMENTARY SCHOOL
The Gando Primary School is an effort to create an appropriate learning environment for the children of a small village in Burkina Faso. The design of the school was driven by the local climate, local materials, solar orientation, and affordability. Factors that were emphasized are lighting, ventilation, and temperature. The school configuration is simple: three classrooms were placed side by side separated by an outdoor covered space. These spaces are sheltered under an elevated metal roof that provides shading while preventing the building from overheating. The classrooms have large openings on the north and south sides to provide natural light and allow for cross ventilation. The project creates an environment in which the children are better able to learn.

1 Kéré Architecture, "Gando Primary School."
2 Varanda, On Site Review Report: Primary School in Gando, Burkina Faso
The purpose of this installation is to foster environmental awareness and to propose the use of "waste" as potential low-cost construction materials. The installation features a steel structure and fifty gabions filled with plastic bottles and fishing nets. The artist was especially interested in experimenting with a low-cost construction system that utilizes cheap materials to create special visual qualities. As light travels through the plastic bottles, it creates an effect that is evocative and reminds the spectator of light as it goes through intricately designed stained glass. Through the investigation of construction methods, this installation calls attention to deep environmental issues that plague the Earth today.
The design for this school uses a cluster configuration to respond to modern educational thinking. The clusters are located on the east side of the building and consist of a central large area surrounded by two classrooms, two common rooms, and a sanitary core. Adjacent to these spaces is an outdoor area that functions as an extension to the classrooms. The glazing was carefully planned to create a series of visual axes to allow teachers visibility of their students at all times as well as to draw students to the centralized spaces. The design seeks to create a sense of community and establish relationships among students, between students and their teachers, and between the school and the local community.

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5 FLK. “Primary School in Höchst.”
6 “Elementary School Unterdorf, Höchst.”
PRECEDENTS: CASE STUDIES

EDIBLE SCHOOLYARD NYC
TIMAYUI KINDERGARTEN
NATURE AND ENVIRONMENT LEARNING CENTER
**04 EDIBLE SCHOOLYARD NYC**

**Architect**  WORK ac  
**Location**  New York, USA

*We make the connections between food, health, and environment come alive for our students.*

--- *Edible Schoolyard NYC*

The goal of the Edible Schoolyard program is to foster a healthy relationship between children and food through a hands-on cooking and gardening education. The design of the schoolyard was envisioned as a series of interlinked systems that work together to engage the way children think about and relate to the environment. The intervention incorporates three programs: systems wall, kitchen classroom, and garden, which comprises more than half of the site. The way the programs interact with each other becomes a teaching opportunity that shows what a sustainable relationship to food and the environment looks like.

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1. Edible Schoolyard NYC.  
2. Ibid.  
3. "Edible Schoolyard NYC at P.S. 216."
Figure 5  Program Relationship  By author

Figure 6  Figure 6  Ground + Circulation  By author
This project employs a modular approach to kindergarten design. The concept is based on the Loris Malaguzzi pedagogical philosophy, in which the children's freedom, experience, and creativity are emphasized.4 The spatial configuration of each module comprises three classrooms in the shape of truncated pyramids. These classrooms are arranged in such a way that they create a centralized outdoor space. This allows the three focal points of the module to be integrally related to each other.5 In developing this module, the architect sought to create a sense of community as well as a range of experiences for the children. Furthermore, these modules can be aggregated, allowing the school to grow and adapt to various sites and conditions.6

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4 Scott, Architecture for Children.
5 Mazzanti, "Timayui Kindergarten."
6 Ibid.
The module consists of three points that are connected through a triangle of circulation. These points are the classrooms and workshop areas for the kindergarten. They are arranged around a courtyard. This courtyard is in turn connected to the courtyards of other modules. The design is an additive approach that allows the school to grow and adapt when necessary. As more modules are added, additional outdoor spaces are defined.

At Santa Marta, the kindergarten is located on a long site. The modules were arranged in such a way to create a series of outdoor rooms. The organization resembles a flower chain.
In Amsterdam, primary school children participate in a special program in which they become familiarized with plants and principles of ecology. They receive additional classes on these topics in dedicated learning centers, and every child is responsible for a small garden. The learning center itself is meant to be an exemplary sustainable building. It is energy neutral, and the design was conceived to not only house the learning activities but also to be an educational tool in itself. This is materialized primarily in two ways. One is the shape of the roof, which answers to the ideal orientation for solar panels. The other is the trombe wall at the front of the building, which will heat the air the comes into the building in the winter.
The learning center represents a small portion of the site. Other than a visual connection through the large windows, there is little connection to the rest of the site.

Figure 18 Trombe Wall | By author

Cold air is warmed as it travels through the space between the glass and the concrete.
WORKS CITED: INSPIRATION


FLK. “Primary School in Höchst.” Detail Magazine, September 2018, 30-33.


Figures


8 - 9 FLK. “Primary School in Höchst.” Detail Magazine, September 2018, 30-33.

WORKS CITED: CASE STUDIES


JS. "Centre for environmental education in Amsterdam." Detail Green, January 2016, 6-7.


Figures


13 & 15 http://www.bureausla.nl/project/natuur-milieu-educatiecentrum-amsterdam/?lang=en

14 JS. "Centre for environmental education in Amsterdam." Detail Green, January 2016, 6-7.
PROGRAM ANALYSIS
NARRATIVE
PRECEDENTS
PROGRAM NARRATIVE: A NEW SCHOOL TYPOLOGY

Since existing processes relating to waste are linear and cannot be sustained, the new school typology is proposed to establish a cyclical process for waste management. The school infrastructure, through its spatial organization, becomes a metabolic system to process waste. Integrated into a curriculum focused on environmental stewardship, organic waste is composted on site. This compost is in turn used in the school's edible school garden, thus establishing a physical link in which waste becomes a resource and educational opportunity. This integration also includes a suggested school model and a curriculum for environmental education.

The Education Model: Escuela Nueva Activa

Escuela Nueva Activa is an education model developed in Colombia, which focuses on the students, their context and their community. It emphasizes cooperative learning to improve both individual and collective outcomes. There are five critical elements to this model: positive interdependence, promoting interaction, processing interaction, individual accountability, and heterogeneity. These elements allow students to work together and encourage each other to achieve shared goals. Furthermore, these values are not limited to the curriculum structure and instructional strategies; they are also physically manifested in the classroom. In the classroom children are seated in circular groups to encourage constant interaction. Classrooms also contain “learning corners” where various books and education materials are available for the children.¹

¹ Madhavan, “Cooperative Learning in Escuela Nueva Activa”
Different education models and theories have different requirements, so it is important to ask what the pedagogy needs from the architecture. This does not mean that form must follow function; the education model or philosophy does not directly conceive the design. According to Mark Dudek, "education and architecture enter into a relationship where, if everything goes according to plan, the two dimensions mesh together in a symbiotic formula to create a complex child-oriented environment which enables children to learn." Therefore, it is important to ask what the spatial implications of the Escuela Nueva Activa model are beyond the arrangement of the tables and the learning corners, and how the architecture will be influenced by and contribute to the learning model.

Environmental Education

The environmental education should permeate every aspect of the students’ education experience. The two priorities are promoting sustainable waste management and fostering a sustainable relationship to the environment. Because one of the largest gaps in the waste management system is the lack of a streamlined collection process for recyclables, the school will also serve as a recycling drop-off center. In this manner, the school becomes a link between the waste generators and the recycling facilities as well as an opportunity for the children to be constantly interacting with the recycling process.

A sustainable relationship to the environment is important to a child’s development. As the children cultivate an awareness of nature through this relationship, they will develop their cognitive functions and their identity around environmental concerns. As previously discussed, this knowledge and emotional connection fosters pro-environmental behaviors. The school should have a direct relationship to nature; children should be constantly exposed to it.

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2 Dudek, Schools and Kindergartens: A Design Manual. 9
Figure 2. Existing Process. By author

The existing process for waste management is linear and unsustainable. Most of the waste goes to a landfill or open air dump, is discarded on the streets or rivers, or is burned.
The proposed school typology creates a cycle in which the waste that can be recycled is seen as valuable and reintroduced into the economy. As a result, the majority of the waste generated in the country can be diverted from the landfill and streets.
INSTITUCIÓN EDUCATIVA SIETE VUELTAS

Figure 4  School Courtyard | Architectural Review

Architect     Plan:B Arquitectos
Location      San Juan de Urabá, Antioquia, Colombia
Area          1,776 m²
User Group    Students and community members

The school was designed as part of Colombia’s initiative to foster reconciliation, integration, and social engagement. It is located in one of the regions most affected by armed conflict. This building not only functions as a school but also as a community center. Most of the spaces are organized around a central courtyard in which children can play. In addition to classrooms and laboratories, there is a restaurant that serves the community. A sports court acts as the threshold between the school and the village establishing a connection between education and social engagement.
Figure 5 Section Diagram | By author, linework by Plan b Arquitectos

Figure 6 Plan Diagram | By author, linework by Plan b Arquitectos
SYDHAVNS RECYCLING CENTER

This proposal seeks to re-imagine the typically utilitarian infrastructure into interventions that become neighborhood amenities. Spaces for recreation (running tracks and pic-nic and sitting areas) are organized on a man-made hill around the recycling station. The different programs are physically separated in section; however, there is a visual connection which allows people to engage and learn about the recycling process. The recycling station comprises a series of bins in which people can drop off and scavenge recyclable waste.

Architect: Bjarke Ingels Group
Location: Copenhagen, Denmark
Area: 1500 m²
User Group: Neighborhood residents

Figure 7 View into Recycling Center | Bjarke Ingels Group

2 BIG, "GBS Skydhavns Recycling Center"
Figure 8  Section Diagram | By author

Figure 9  Plan Diagram | By author
The design by CEBRA Architects is the winning proposal for the Russian Smart School competition. It is part of an effort to create a new school typology that combines architecture and landscape. The different programs, which include a pre-school, junior school, high school, culture and health centers are organized around a central outdoor space. From this central space, connections are established between the different programs as well as with the surrounding environment. The learning areas are designed to be responsive and will thus incorporate different spatial qualities to accommodate different subjects.

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3 https://www.archdaily.com/773253/cebra-wins-competition-to-design-smart-school-in-russia
Figure 11: Plan Diagram 1 By author
WORKS CITED


Figures


7  https://big.dk/#projects-gbs

10  https://www.archdaily.com/773253/cebra-wins-competition-to-design-smart-school-in-russia
SITE ANALYSIS

NARRATIVE

SITE: ESCUELA ANA GARCIA DE HERNANDEZ
Access to Waste Management System
Site must be within 30km of an entity that either has an existing waste management plan or can be a link to a municipality with a waste management system.

Accessible to Vehicles and Pedestrians
Though most users will be pedestrians, vehicles need to be able to access the site to remove recyclables.

Space for Vegetation
To foster pro-environmental behavior, the site must have space for gardens and other types of vegetation.

Critical State of Existing Infrastructure
The site selected will be an existing school that has either temporary infrastructure or infrastructure in a severely deteriorated state.
**SITE NARRATIVE**

This thesis proposes implementing the new school typology on sites where a school has already been established. In many cases, the current infrastructure is severely compromised, and there is a need to construct a new building or buildings to replace the existing ones. This ensures that the current state of the infrastructure is addressed, thus strengthening the school network in the country. It is also important for the site to have space for vegetation, because it is intrinsically tied to the school curriculum and will be an essential design tool.

This typology will become part of a larger network of schools that is connected to the waste management system. Schools in this network will become the link between waste generation and recycling. Thus, this new typology will create important connections throughout the country that will enable it to establish a more sustainable relationship to the environment.

*Figure 2* Location of potential sites in relation to major cities. By author.
SITE 1: ESCUELA ANA GARCÍA DE HERNÁNDEZ

The site is located on the highway towards the border with Nicaragua. The school was established there in 2014 to serve families who live along the highway and in nearby communities. It is in close proximity to the Uyuca Biological Reserve thus there is a great biodiversity in the area. The borders of the site are not clearly defined, which means there is opportunity for growth. The existing buildings were improvised using unsuitable materials such as corrugated metal. The structures are impermanent and do not provide an appropriate learning environment. The site is accessible to both vehicles and pedestrians, but safety for pedestrians might be compromised due to the high amount of traffic that travels on the highway.

Figure 4: Existing Infrastructure | Images by author

<table>
<thead>
<tr>
<th>Location</th>
<th>CA-6 Highway, Uyuca, Francisco Morazán</th>
</tr>
</thead>
<tbody>
<tr>
<td>Area</td>
<td>Approximately 4,000m²</td>
</tr>
<tr>
<td>Environmental Data</td>
<td>23.8°C average temperature; 1,102mm annual precipitation</td>
</tr>
<tr>
<td>Existing Buildings</td>
<td>3 Classrooms, 2 latrines</td>
</tr>
<tr>
<td>Students</td>
<td>44</td>
</tr>
</tbody>
</table>

Figure 6: Biodiversity at Uyuca Biological Reserve | By

1. Gomez, “Dalia Varela de Vargas; una luz en el camino de los niños y padres de familia de Uyuca“
Figure 5  Context Map | By author
Design Proposal

Figure 2 Axonometric | By author

Figure 3 Sections and Plan | By author
Figure 4 Perspectives 1 By author
Figure 5 Final Board Set-up | By author