The Biophilic Learning Environment

An alternative to the current New Zealand Innovative Learning Environment model

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Explanatory Document

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ABSTRACT

Education in New Zealand is undergoing a sizeable shift towards 21st century innovations; by where child focused flexible learning environments are the new standard. The Christchurch Earthquake of 2011 gave an immense opportunity for the redevelopment of numerous schools; however, the architecture being delivered offers little more than an enclosure to house this new pedagogy within.

Nature is an essential aspect of a child's development and learning, as it is inherent in the human makeup. The environment delivers physical and mental experiences that nothing else can, and separation from the environment is proven to have negative impacts on development, health and well being.

This project addresses the missing link between nature and educational settings in New Zealand. It uses architecture as a mechanism to compose natural experiences in the learning environment to help encourage and facilitate learning. Hence, it proposes an alternate pedagogy: the biophilic learning environment.

This biophilic learning environment will be conceptualised through the complete redesign of a Christchurch primary school. The objective is to harmonise architecture with nature, in which nature becomes the educator, the resource, and the content. An experiential journey becomes the lesson, as like the path that curiosity takes us through nature.
I would firstly like to thank my family for all your support during this year and all previous years, especially for all the trips to and from Christchurch airport. Also, Hugo and Riley for the comfort and distraction when I needed it the most.

Secondly, thanks to my friends for the reassurance and again for the trips to and from the airport. Special thanks to Sam, without you this project wouldn’t exist.

To my supervisor, Annabel Pretty, for your guidance, understanding, and encouraging words of wisdom throughout the year, for which I will be forever appreciative.

Many thanks to Opus Architecture for providing me with this opportunity and continuous encouragement, as well as my colleagues for sharing your invaluable knowledge and providing critique.

Nan, thanks for still watching over me. I hope I’ve made you proud.
1.0
INTRODUCTION
1.1 PROJECT OUTLINE

The biophilia hypothesis describes how humans are genetically built with the desire to be affiliated with nature. Nature provides the critical psychological and physiological processes and effects that enable learning to occur. Thus, interactions with nature are fundamental to a child's development.

Due to the 2010 and 2011 earthquakes, many Christchurch schools were given funding to rebuild or upgrade their buildings. The rebuild of state schools follows the Ministry of Education's guidelines and the National Curriculum. This scheme provides schools with "Innovative Learning Environments" (I.L.E.) that focus on the idea of child-centred, flexible learning spaces that cater for all types of pedagogy and learning styles.

Many Christchurch schools to date have taken the opportunity to implement this I.L.E. scheme. The idea appears to be working well regarding the pedagogy that it targets, however, mostly due to constraints of funding and technologies, it is evident that the built form still operates simply as an enclosure for the learning that occurs within. There is a pronounced delineation between internal and external spaces, and nature merely appears when outdoor and recreational activities are programmed.

The rebuild gave an ideal opportunity for state education to rethink pedagogy, yet this opportunity has been overlooked. Children are suffering from nature deficit disorder, which contributes to poor health, well-being and impacts overall development. It is essential to recover this inherent need for nature and the early years are the most critical time for this to happen.

Architecture can assimilate the boundaries between classrooms and the environment to allow this path of nature derived experiential learning to occur. This project explores the role that architecture has to fulfi l this desire to be connected with nature, and hence to attempt to facilitate the process of learning. The architectural response will propose a biophilic learning environment, an alternative pedagogy to what we see in state schools today.

1.2 ARCHITECTURAL QUESTION

How can architecture provide an alternative learning environment that inspires pedagogy and development through responding to the inbuilt human desire for an affiliation with nature, in a full primary school setting?
1.3 AIMS AND OBJECTIVES

This project aims to:

- Provide an awareness of the current Innovative Learning Environment scheme in New Zealand and other models of education (locally and internationally), allowing an understanding of methodology behind the systems and their impacts on the architectural responses.
- Provide insight into the instinctual methods of children’s development and learning through the natural environment. This insight will raise awareness of the important role of nature in child development and growth.
- Demonstrate methods of embedding principles of nature in pedagogical spaces, with the aspiration to facilitate children’s experiential learning and promote health and well-being in the learning environment.
- Design a primary and intermediate learning environment for an existing earthquake-affected school in Christchurch, New Zealand, offering an alternative model of education from the current innovative learning environment scheme.
- Engage and integrate with the local environment to enhance students’ attachment to place and, therefore, respect and ownership of their learning spaces, while also promoting sustainability and self-sufficiency.

1.4 SCOPE AND LIMITATIONS

This project is to design a full primary school for years 1 to 8 students in St Martin, Christchurch, New Zealand. There will be a projection of the school roll with the intention of accommodating at least 700 students and accompanying staff.

Organised sports activities are assumed to use the council park adjacent to the site and will not be designed for within the school site bounds.

Financial restrictions and budgets in the current education sector will not influence this project. However, the proposal will encourage self-sustainability so that buildings’ running costs will diminish over their life cycles and, hence, make any initial construction costs justifiable and sustainable.

The education method proposed for the school does not follow the current National Curriculum in New Zealand. A new alternative is suggested in response to analysis of the current model and investigation into child development. This proposal does not require digital devices and technologies to deliver education; hence, these items will not be accommodated for in the design.

This proposal focuses on nature and its influence on child development and learning. There is a considerable amount of research in the field of neuroscience and behavioural studies that prove the nature-development dynamic. This project does not delve into particular quantitative or qualitative research in these areas as it is well beyond the scope; rather it looks at nature’s influence as an entirety.

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1.5 METHODOLOGY

The initial part of this project was to research for design, broken down into two research areas. This was followed by research by design, concluding with the final design outcome.

The first section of research for design included an analysis of how the current curriculum has been framed by history and innovations. Consequently, the present New Zealand state educational model (innovative learning environment) has been explored, including the architectural responses that we see today. These responses have been examined in a qualitative approach to establish benefits and lessons learned due to the existing model. Alternative education methods existent in New Zealand and internationally were also studied to determine other opportunities that the state model may have omitted.

The second part of the research for design entailed exploring concepts of how children learn and develop, how the human desire for nature plays a substantial role in this development (biophilia), and how a deficiency of this nature becomes detrimental to health and well-being. Further to this, the design of nature itself was explored to enable understanding of the elements that contribute to the biophilic tendency.

Researching by design was initiated by the state of knowledge at hand. Elements of nature were explored in an architectural sense to provide the design intent of a biophilic learning environment. With the conscious knowledge of the successes and failures of innovative learning environments, understanding of the biophilic elements that contribute to the biophilia hypothesis, and drawing on contextual influences (historical, cultural, social, environmental, site conditions, and site surroundings and movement) design ideas were iterated. Further research became necessary, particularly more detailed biophilic elements, which contributed to additional design iterations and testing until the final design was achieved. This design process was accomplished through 2D and 3D techniques, including various methods of diagramming, sketching, mass modelling, spatial modelling, and modelling form.

1.6 TERMINOLOGY

**Education Terminology**
- M.L.E. – Modern learning environment (precursor of I.L.E.)
- MOE – Ministry of Education
- National Curriculum – Teaching framework for state schools in New Zealand
- Pedagogy – the method/practice of teaching

**Learning and Nature Terminology**
- Biophilia – human affiliation with nature
- Biophilic design – replication of natural experiences
- Biomimicry – mimicking natures design
2.0
THE CURRENT LEARNING ENVIRONMENT
2.1 INTRODUCTION

The current educational model in New Zealand is in a somewhat exploratory phase. There has been a clear development in educational, architectural history in which the principles and concepts are imperative to understanding why education is the way it is today. This section explains this history and explores the principles behind the Innovative Learning Environments that we see appearing and being tested in our schools. There should be a focus on environmental considerations and the integration of nature into the external and internal learning environments as a sustainable necessity and as a learning facilitator (this will be further explored in section 3.0).

2.2 HISTORY OF EDUCATION

British Education

Many educational systems and curriculums were established before New Zealand was settled, yet they still hold an important place in the development of our education system. It is essential to understand the British origins of the pedagogies we see in our past and present schools to understand the successes and failures of the time, and hence design better schools for the future.

The English educational timeline coincides with important historical events that shaped former and current education systems throughout time. Dating back to the sixth century, the church provided English schooling, and from the 15th century, the state began to want full control of the education sector and so the public school was established in England around 1883. The schoolroom no longer was an accessory to the church, rather a standalone single schoolroom. The building followed many principles of the Gothic style – hardly adequate for the programme held inside. There were variations of the single room model to cater for larger pupil numbers, often with the use of soft divisions in one large space with an ancillary classroom for more direct teaching. This model was known as two room schools.

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The late 19th century saw the introduction of smaller and more independent classrooms, as trust and...
responsibility were given to teachers. The central hall plan was devised, in which a hallway fed to many individual rooms and widened to a central hall area.

During World War I health conditions deteriorated, and importance was placed on healthy environments for educational spaces. The ideas of natural lighting and ventilation became apparent as the veranda school was introduced. The veranda school, and its variations between the wars, offered large folding doors and high levels windows to benefit the health of the children. Post World War II student numbers increased and the distinction of subjects was manifesting. The corridor/cluster plan allowed for larger numbers, natural elements that the verandah school introduced, and finally, the division of curriculum into ‘wings’ around a central hall and administrative area. There was a better understanding of the child’s mind in the 1950’s and the realisation that visual stimulation was essential for development meant there was an introduction of colour and textures in the classroom.

A break from traditional classrooms came in the 1960’s. The idea was to create alternative teaching spaces for increased flexibility. Classrooms were directly connected to a shared space, which would act as a single large teaching area with the classroom. Break out spaces were then linked to the full school hall and administrative areas. This model was the compact and open plans. It is a significant origin for the flexible spaces we see today.

Following on from this flexible model was the practical shared classroom. It consisted of a large single shared space surrounded by more dedicated teaching classrooms. The central shared space acted as a zone to bring natural ventilation and lighting into the teaching areas. The classrooms themselves were also flexible as they could be divided or remain open plan according to requirements.

The change of secular to non-secular education, the development of teaching different disciplines independently, and the increasing awareness of the health of children in education were all significant drivers in the timeline of Western education. Their influence on New Zealand schooling is apparent in the next chapter.
New Zealand Education

Schooling in New Zealand existed before the British colonisation in 1840; however, the new state soon altered the teaching methods. Private businesses and churches organised much of the early education, which is where the English attached classroom model can occasionally be seen throughout New Zealand (especially in rural circumstances), yet, Māori were considered as outcasts and didn’t attend these English secular schools.

After the New Zealand land wars, the Native Schools act of 1867 presented the shift to non-secular education for Māori communities in exchange for their land. Following this 1877 saw the first Education Act providing a national state primary education free to all children. The school buildings of this era were often a single hall built to face the road, with small high-level windows, and no consideration of the sun, light, or natural visual connection. Due to financial issues resulting from World War I, no new classrooms could be built and as a result of overcrowding, the introduction of transportable classrooms occurred inter-war period. The classrooms were similar to the single schoolrooms seen in England but built adjacent to each other in blocks or as a single cell. Due to the new interest in child psychology in the 1920’s, a greater emphasis was put on the health of children in education. Consequently, the open-air classroom was established. This model was free standing and designed with substantially larger doors and windows on all four sides of the classroom.

The open-air classroom, however, became costly and the fresh air classroom was proposed and accepted as the new model for schools in the late 1920’s. This slightly differing model boasted mansard roofs with glazing, drop sashes allowing control of air, two exits, and verandahs. This classroom type developed in a variety of ways from its original design, and up until the 1960’s it was typical to see the open-air verandah classroom, which consisted of large glazed concertina type doors facing north and a verandah with clerestory windows above.

Post-1940 saw the development of the open-air classrooms and cheaper modular units. Each regional education board was granted permission in 1954 to develop its own standard type of school. The Canterbury region, for example, had 24 standard types of classroom blocks as of August 2013, including single storey, double storey, and relocatable classrooms. These standard blocks were used abundantly through the 1970’s to the 1990’s, and some are still being used today. As discussed thus far, New Zealand classrooms progressed well for an all-inclusive healthy learning environment; however, they remained single cell and teacher-centred models up until the 20th century. At this point in our timeline we see the change to flexible, student-centred models, as discussed in the next chapter.
2.3 CURRENT STATE OF LEARNING

BEGINNINGS

Scientific developments in the 21st century have provided a superior understanding of the brain and have qualified us to determine what works best for learning to occur. The shift in pedagogical trends reflects these findings. Learning quality has said to be defined by a mixture of the following:

“personalised learning... socially constructed learning... differentiated learning... learning that is initiated by students themselves... learning that is connected to the physical world and authentic contexts...”

These elements determined that a flexible, open, and accessible learning environment was crucial to a child’s learning quality, and thus, flexible learning environments were conceived.

The Ministry of Education’s (MOE) first significant initiative around flexible learning spaces was the “Learning Studio Pilot” in 2008. Five schools throughout New Zealand were engaged in the programme and each school gained a new state of the art (of the time) classroom suite. The suites featured learning studios radiating from a shared learning area of various designs. This pilot programme empowered the research surrounding children’s learning to be tested and it exhibited an overall positive stance in the education system.

From these beginnings, the flexible learning environment evolved into the Modern Learning Environment (M.L.E.) and the present day scheme that MOE provides to assist the National Curriculum is the Innovative Learning Environment (I.L.E.), a successor to M.L.E.

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The current New Zealand government and MOE state that: “An innovative learning environment is an environment where the National Curriculum is being expressed in the way it is intended.”

To understand what this means the learning environment needs to be defined: “…an organic holistic concept that embraces the learning taking place as well as the setting…”

The learning environment is inclusive of the entire ecosystem that affects the learners over time—unlike the traditional cell type classrooms where the setting referred to the physical envelope in which the pupils learn internally.

The learning environment is made up of four crucial elements; learners, educators, content, and resources. Together these items make up the pedagogical core, where all items are as important as each other to achieve effective learning. This shows a definite shift away from the teacher-centric models before the 21st century and a new focus on student-centred learning.

As presented in MOE’s design principles, there are psychological ideas required for effective learning that in turn are reflected in the physical requirements for the learning environment to enable effective learning*. These physical design principles require the spaces to be:

- Flexible – current and new pedagogies
- Sustainable – change and environment
- Creative – stimulation
- Supportive – comfort and security
- Connected – inside and out

These theoretical ideas around learning and the principles regarding the physical learning spaces, which will be discussed subsequently, contribute to the overall organism of the pedagogical core and are essential for an innovative learning experience.

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LEARNING SPACES

The physical design principles of an innovative learning environment group the learning spaces into three different categories: general learning spaces, breakout spaces and outdoor learning spaces.

General learning spaces are required to accommodate a mixture of learning styles varying in collaborative, individual, conceptual, and instructional styles. These styles are represented in the accompanying figures. The general learning spaces are flexible enough to provide a combination of these learning styles to one or multiple classes at a time, hence, the space is often a larger open plan hub that all children can share and complement each other’s learning within.

Breakout spaces are essential to provide guided or direct learning. These spaces are connected both physically and visually to the general learning space. It breaks away from the busier and less structured environment of the general space to provide the opportunity for individual, small group, or specialist activities. The breakout areas often host technological learning or wet area learning. It is important to maintain the connection to the general space for effective learning, but a clear boundary should be formed to ensure its effectiveness is upheld.

Outdoor learning spaces are imperative in I.L.E. for enquiry-based learning and, as like breakout spaces, require connectedness to the general learning spaces. They are often a spill out of the general learning space to an outdoor area that has had its climatic conditions carefully designed to contribute comfortable spaces.

The Ministry of Education also suggest another quality that learning spaces should have:

“Enable all aspects of the buildings, building design and outdoor spaces to be learning tools in themselves.”

The built forms and spaces should be able to assist with the learning as well as providing enclosure and envelope to house the learning.

22 Ibid., 37–40.
24 Ibid., 4.
27 Ibid., 39.
The Ambient Environment

The ambient environment has repercussions on the quality of an I.L.E. space and the health of children. A healthy and comfortable space will facilitate a child's learning and help them perceive the school as a safe and welcoming environment. MOE considers the ambient environment to consist of four main categories; air quality, heating, lighting, and acoustics. These qualities have been developed based on scientific research that proves ideal levels of these features are advantageous for practical learning.

Air quality – Adequate ventilation is required to provide fresh air for breathing, clear odours and pollutants, remove moisture, and remove stagnant air for thermal comfort. It is of particular importance to have satisfactory ventilation in classrooms as children have higher breathing and metabolic rates than adults, and the ratio of children in a classroom is significantly greater than in most other everyday environments. Consideration should be given to:
- Window size and operation
- Room volumes
- Mechanical ventilation (for when the natural air is inaccessible).

Heating – Classroom temperature is important to student comfort and impacts learning. A balance needs to be achieved between heating and air-conditioning, natural ventilation, and thermal gain. Consideration should be given to:
- Window operation
- Solar gain and control
- Thermal mass
- Mechanical heating and cooling.

Lighting – Light improves the learning environment in multiple ways; it is functional to enable children to perform learning tasks, it impacts or hinders the comfort of the space, it affects the health of its occupants, and can influence students’ outcomes. Consideration should be given to:
- Orientation, placement and area of the glazing
- Shape of the room
- Shading or the diffusion of direct sunlight
- Artificial lighting.

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The direction of this project directs towards Biophilia as the compelling driver (as discussed in the next section). However, MOE provides design guidelines for aspects outside of the learning spaces themselves, which could be beneficial to aspects of this project. Some of the elements that could be constructive are:

- **Administration area** – Collaborative, comfortable and welcoming.
- **Arrival and entry** – The primary school entry must be obvious, safe, welcoming, community aware, and culturally sensitive.
- **Teachers’ workspaces** – provide space for resources and storage. Teacher’s areas should be able to passively observe learning spaces.
- **Acoustics** – Background noise and reverberation can be a challenging issue for young children, as it can be onerous distinguishing between background noise and the task at hand. Learning spaces can be impacted by internal and external noise. Consideration should be given to:
  - Location of spaces
  - Noise barriers
  - Material selections
  - Absorptive materials, furniture, and fittings
  - Volume and shape of the space

Incorporating strong visual connections.

- **Halls and multi-purpose areas** – location to outdoor learning, play and community space is imperative. Storage space, inclusive of outdoor equipment is required. Design to promote and encourage outdoor learning.
- **Toilets** – even distribution around the school is obligatory and minimum building code requirements for each building and the entire school must be met. Internal and external accessed is desired and they must be able to be passively supervised. Be sensitive to student age groups. MOE toilet reference designs are available as a guideline.

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Additional I.L.E. Design Elements

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![Fig. 22 - Sound absorption through materials](image-url)

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**Fig. 22 - Sound absorption through materials**

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**Fig. 23 - MOE toilet reference design**
2.4 EXISTING I.L.E. SCHOOL ANALYSIS

WAITAKIRI PRIMARY SCHOOL

Waitakiri Primary School was established in 2013 as a merger of two schools, Burwood Primary and Windsor Primary, as a result of the devastating 2011 Canterbury Earthquakes. Both schools were severely impacted and subsequently, this new purpose built, decile eight school, designed by ASC Architects, was built and completed in 2016.40

Year one to six students are catered for, with capacity for a 700 student roll across six learning studios and two refurbished existing studios. The new learning studios are tailored for 110 students each.41


The studios are laid out around a centralised covered courtyard that provides space for outdoor learning and play, as the cover and the studios shelter the area providing an environment for use all year round.

The interior of each studio contains a large learning area surrounded by the following - a large breakout room, two smaller breakout areas, a specialist area, storage, a teachers’ workroom, and toilets.42 The irregular shape of the open learning space, along with the enclosed breakout spaces, allows for a variety of teaching styles to co-occur as each style can easily define a space fit for its purpose. A distinct visual and physical link is maintained between the breakout spaces and the general learning spaces, and between the interior learning spaces and the outdoor learning spaces.

A large open floor plate results in a deep floor plan; however, plentiful natural light enters the space from opposite ends. These opening ends enable adequate cross ventilation and visual links to the natural environment beneficial to the health of the occupants. Each studio can control the environmental conditions individually, so the comfort is dependent on the occupants within each particular studio.

There is no apparent environmental connection. Outdoor spaces consist mostly of formal, hard landscaped areas with no desire to provide integration with purely natural elements.

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42 Ibid.
Halswell School
Halswell School is another school that was affected by the 2011 Canterbury Earthquakes that resulted in a full rebuild designed by Brewer Davidson Architects. The rebuild was staged to allow occupation during the build and was finally completed in April 2015, making it the first school to be rebuilt in its entirety. The school is a decile ten, full primary school for students from years one to eight and has a roll capacity of 650 students.43

There are five modern learning blocks, which, along with the hall and administrative spaces, frame a central outdoor learning and play area. The outdoor area is vast, so may be exposed to environmental conditions. Nevertheless, each learning block


has a physical and visual connection to this outdoor environment. Each block is open and long in plan containing two undivided ‘learning centres’ that are the general learning space. Framing these spaces are enclosed but permeable breakout spaces. In addition to these flexible spaces there are project areas to support specialist learning and activities. Teachers’ workspaces and toilets are directly accessed from the ‘learning centres’ and external areas.

The two long edges of the buildings have large eaves to deliver shelter to the entry points and cater for overspill of the interior learning spaces, providing a somewhat sheltered space for outdoor learning. Nonetheless, these spaces are narrow and long so any outdoor learning is reliant on suitable weather conditions. Again, there is no natural connection or integration with environmental features. The hard landscaped outdoor spaces are completely detached from nature and the surrounding environment.
M ARSHLAND S CHOOL

Following the trend of rebuilt schools as a result of the Canterbury Earthquakes, the Marshland School full rebuild was opened in February 2016, designed by Stephenson and Turners. The school is a decile nine full primary school, for 400 years one to eight students.44

The school consists of a single building where four learning studios radiate off the administration area in a wing like manner. The school fronts the road on the east and so the entire rear elevation of the building opens to the outdoor learning and play areas on the west.

The learning studios are grouped in pairs, in which a flexible technology area divides each studio. A central learning space defines the studio. Surrounding this are multiple breakout spaces for various learning styles and activities.

Marshland School differs from many other I.L.E. schools, as the open space is divided into differing learning areas with the plentiful use of ‘kitset’ joinery, as opposed to enclosed rooms. The use of joinery allows a variety of levels to be created to define spaces further and create interest amongst the children. The kitset joinery is easily removed or altered, and so, the open plan space in which it exists provides a flexible and sustainable option for future needs as they arise.

Natural light gain is obvious as the spaces are completely uninterrupted by any full height walls. This is also beneficial, in conjunction with the raked ceiling, in providing natural ventilation.

A covered outdoor learning space is provided for each pair of studios. There is also a strong visual connection to the outdoors as the buildings open out to the outdoor play area with lots of glazing, and small breakout areas are positioned to view these natural outlooks. Although there are strong visual connections with nature, there isn’t any integration of nature into the learning spaces.
Hobsonville Point Primary School
Hobsonville Point Primary School, by ASC Architects, was established and constructed to provide education to the new housing development at Hobsonville, Auckland. The school opened in February 2013 and was the first school in New Zealand to be opened under the PPP (Private Public Partnership) model. The decile ten school provides for years one to eight students with around 90 students enrolled by the end of the first year. However, the capacity of the school is close to 700.

The school consists of a single building laid along the length of the road, with some outdoor learning areas on the road front but most of the outdoor learning and play areas behind the building. The learning spaces occupy most of the building with a foyer that separates the learning areas from the hall and administrative areas.

The learning environment has a strong circulation value as a continuous spine runs the length of the space in which storage areas and a ‘learning street’ have been formed to cut down on unused circulation areas. Nine large common areas provide flexible general learning space for up to 60 students at any given time and are supplemented by smaller breakout spaces and enclosed break out rooms. Practical or specialist areas are also catered for within the space and are strongly defined by joinery or materiality change. Having all common areas in one large space allows for wider flexibility between teachers, students, and teaching styles, however, the spaces are indeed suggestive of what activities will happen in each space and would possibly limit future flexibility.

Each common learning area is provided with its own outdoor learning space. It comprises of hard landscaped area with fixed seating. There has not been much consideration into providing shelter to these spaces so would only be usable in satisfactory weather conditions. The use of fixed seating also takes away the flexible element that the outdoors would usually provide, offering more formal outdoor use with no connection to the natural environment or surroundings.

Fig. 36 - Hobsonville School breakout learning
Fig. 37 - Hobsonville School ‘learning street’
Fig. 38 - Hobsonville School outdoor learning
Fig. 39 - Hobsonville Point School floor plan & learning spaces (NTS)
Freemans Bay School

Freemans Bay School is due to receive its brand new I.L.E. classrooms, designed by RTA Studios, ready for the start of the 2018 school year. The school is one of the oldest schools in New Zealand, situated in central Auckland, and is currently being redeveloped to occupy the growing school roll and to replace leaky buildings. The decisive six, years one to six school has a current roll of approximately 420 students with capacity of a 660 student roll.

The redevelopment proposes to retain an existing classroom block and build a new I.L.E. two storey block, a Maori unit, administrative facilities, a hall, and a library, which will all frame a central courtyard for outdoor learning and play. Entry to the school will be under a vast canopy with an uninterrupted view from the street to the outdoor learning area. The proposed I.L.E. spaces will be housed in a two-storey block or a ‘learning house’. The learning spaces will be divided into four learning modules. The stair to the upper floor acts as a clear slit between the purely flexible general learning spaces and the more focused learning and break out spaces. Two enclosed break out rooms are provided for in each module with visibility to the open learning space to ensure the visual connections. Specialist areas sit defined at the back of the space for a more focused environment. Window nooks and spaces around the stair have been proposed to be small break out and reflective spaces.

An underwhelming area of covered outdoor space has been provided at the front and back of the building. There is a missed opportunity in providing natural features in the outdoor learning environment and blurring the lines between indoor and outdoor spaces.
In addition to the state school system, it is important to understand other philosophies that are present in the education of young New Zealand children. The three alternative concepts are Montessori, Steiner (Waldorf), and Reggio Emilia. The Danish educational model of the Forest School could also be of influence in the New Zealand Curriculum.

2.5 ALTERNATIVE EDUCATIONAL MODELS

MONTESSORI

Maria Montessori founded the Montessori education system in the early 1900s and today we can see over 40 centres in New Zealand using her methods. The fundamental principle is that the children are the focus and they guide their own learning. Another important principle is the connection to living things. There is a large emphasis on the design of the environment and the objects within the space, as these are the agents for the discovery and learning process. The space often resembles the physical world, offering a constructivist type model of learning to the children. Hence, a Montessori space would present to us a highly designed and sensory environment in which children interact freely, constructing their own learning methods, curriculum, and pace.

Architectural design needs to reflect the hands on, flexible environment that this method employs. The focus should be given to driving curiosity with ‘learning streets’ and providing areas that can be personalised.

STEINER

Rudolf Steiner’s philosophical views were to bring spiritual knowledge and earthly understanding together as a holistic being. He viewed the holistic being as three entities that interconnect: spiritual quality, psychic quality, and physical quality. Each quality must be nurtured so the soul can obtain the path to spiritual knowledge.

This view is applied to the Steiner or Waldorf education system. The general approach to education ensures structure and well-being throughout life: it nurtures cognitive capabilities, and independence and initiative. This is done in theoretical, physical, and artistic activities, all in balance without any preference towards one particular field. Creativity and open-ended learning appear from this, as the door is not closed on any particular field. Open-ended play is encouraged as this sensory method opens up children’s creative minds.

Steiner saw child development in stages, and at each stage, they experience the world differently. Early years focus on the senses, imaginations, and bodies, and direct stimulation of the intelligence isn’t focused on until teenage years. The learning areas are highly personalised within the envelope that they are provided, without the use of technology, and each space provides direct support to the function held within.

Fig. 44 - Montessori - learning street, flexibility, and outdoor

Fig. 45 - Steiner - creativity and personalisation within "soft" operated learning "cells"
The Reggio Emilia approach was developed in the post World War II era by psychologist Loris Malaguzzi in the villages around Reggio Emilia, Italy, and is regarded as one of the most influential pedagogical systems. Influenced by the Fascist principles of the area and time, Reggio believes in the rights of children and their yearning for a variety of experiences throughout their education.

The system is a constructivist method, where children learn via experience rather than direct information from teachers. Malaguzzi described children having "a hundred languages" that they express their ideas through. Children have freedom of choice and flexibility of time, to encourage independent, creative thinking, and social interaction. Malaguzzi states that:

"The other children are the first educator, the second the teacher, and the third the environment." This means that not only do children learn from collaboration and influence from teachers, but also the environment plays a crucial role in their education. Hence, the classroom needs to be complex and interconnecting to encourage exploration and creativity and provide the means for expression.

The architectural output will follow these general principles:

- Openness to the community for practical experiences.
- A central area to provide a meeting area or "public" space.
- Flow between internal and outdoor spaces.
- Flexibility to allow various activities and learning styles.
- Rich sensory experience to encourage interaction (colour, light, materiality, size, shape, narrative).

Reggio Emilia

Fig. 47 - Reggio - focus, dynamic flexible space, in/outdoor flow


Fig. 48 - Reggio - classroom rich in activities

Udskole & Forest Schools

It can be defined as a constructivist form of education where children "construct meaning through interaction with each other and the natural environment," or learning by play. It is a method that helps child development (personally, socially, and emotionally) by means of stimulation. Some of these principles could play an integral role in New Zealand education.
2.6 REFLECTION

The progression from the classroom ‘cell’ to the Innovative Learning Environment has demonstrated that New Zealand education, as like our British counterparts, is trying to keep up with the forever-evolving understanding and awareness surrounding cognitive development and health benefits in children.

The Innovative Learning Environment scheme declares that it is a holistic approach where the learners, educators, content, and resources are all as important as one another in the pedagogical core. However, considering research around cognitive development has a pronounced influence on this approach, there appears to be a missing link in regards to how nature can facilitate development and the incorporation of it into the pedagogical core.

As previously mentioned, MOE states:

“Enable all aspects of the buildings, building design and outdoor spaces to be learning tools in themselves.”

From investigation of MOE’s design guidelines and analysis of existing I.L.E. schools, this statement only has a small amount of truth. Although classrooms nowadays are more than just an enclosure housing learning, the planning of spaces and use of materials and systems permit little interaction with the built form itself. It is still a model of enclosure that allows for flexibility in learning styles and methods within. The built form or space itself should be an indispensable tool for learning.

Although the I.L.E. model suggests that learning is child-focused rather than teacher-focused, it is still a considerably formal and directed setting, as the National Curriculum is required to be taught. Conversely, many of the Montessori, Steiner, Reggio, and Udeskole concepts become important to this project:

- Self-guided learning
- Connection to environment (natural and cultural)
- Sensory stimulation
- Open-ended learning
- Experiential learning

The following section will discuss nature, its place in the learning environment, and how it is critical to child development. From here, nature becomes the dominant dynamic of this project; nevertheless, the Innovative Learning Environment model still provides some important lessons and concepts.

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3.0
LEARNING AND NATURE
3.1 INTRODUCTION

It has been proven that the exposure to the environment improves physical and mental well-being. Humans also have an innate desire for nature, and children instinctively are driven by curiosity in the natural environment. Therefore, nature is an important contributor to the learning and development process. Biophilic design can respond to this nature-education dynamic. The design of nature can be applied to the built form to satisfy the need for nature in the learning environment. The built form, hence, can become a facilitator of education rather than just the enclosure we so often witness (as discussed in chapter 2.0). This chapter illustrates the importance of nature in education. Afterward, it explains how the integration of biophilic design elements into the architectural design can assist in the learning environment.

3.2 CHILDREN AND LEARNING

EXPERIENTIAL LEARNING

Children are experiential learners. They are innately curious and are driven to investigate, examine, and make sense of their experiences. We constantly hear young children asking “why?” This curiosity is critical in a young child’s learning process as they try to satisfy their curiosity by seeking answers. A feeling sparks curiosity when a child is exposed to an experience they haven’t faced or understood before. Curiosity is the beginning of understanding, an essential biological process that enables children to learn.

The outdoors provides an abundance of experiences for curiosity to pursue. Every form, material, and process found in the natural environment is unique compared to anything found in the built environment. Therefore, the natural world provides an unlimited number of experiences that draw on a child’s curiosity to explore, imagine, create, and ultimately learn. It provides a multi-sensory environment that surpasses anything the built environment could ever offer.

CURiosity

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As children grow in this technology-driven world, a widening disconnect between society and nature is evident. Some causes of this broadening gap are:

- Urbanisation exclusive of nature
- Fear of society and the world
- Faith in technology
- Our mindset that nature is ‘nice to have’ rather than a necessity.

The absence of natural affinity contributes to physical, psychological, and spiritual issues. Research shows that it can lead to a:

"diminished use of the senses, attention difficulties, and higher rates of physical and emotional illnesses." 73

This disconnect is a paramount concern in children’s education where the sensory environment is essential for development. Closing this widening gap between society and nature is critical.

Nature and learning need to be interconnected to support children’s instinctual physical and emotional needs so they can create and learn.

**Nature Deficit**

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**Biophilia**

Humans have a genetic-based desire to be affiliated with nature. From this Biophilia is determined as:

"The life-enhancing rootedness in nature." Throughout evolution, people have been attracted to natural forms and processes to assist survival and reproduction, and psychological nurturing and well-being. Biophilia is instinctual and, so, when we are not affiliated with nature our evolutionary mannerisms and qualities of life are inhibited.

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**The Green Mind Theory**

The Green Mind Theory proves that nature fosters physical, psychological and spiritual health and well-being. It links the mind with the brain and the body.

"...environments shape bodies, brains, mind/body changes..." 73

The brain is described in two parts: the bottom or red brain, and the top or blue brain. The red brain is fast, involuntary, and impulsive, while the blue brain is slower, voluntary, the centre for learning, and a driver of rest and digest. The ideal balance of these two brains gives us a green mind — a state of calm.

A green mind is achieved through nature-based interventions. Without natural interactions, our red brain comes into use, and it becomes detrimental to our health. 73

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**Figs. 51-52: Biophilia**

**Figs. 53-54: Green Mind Theory**


76 Pretty, Rogerson, and Barton, "Green Mind Theory."
There are six values embedded within the Biophilia hypothesis that are crucial to understand in relation to child development, their experiential learning path, and their learning environments.

These values are part of a holistic necessity; as such, each is as crucial as the next. The values are as follows:

- **Utilitarian values** – physical benefits of nature for sustenance and safety.
- **Doministic values** – the challenge of mastering nature for safety and security.
- **Naturalistic values** – satisfaction from direct contact with nature providing awareness, curiosity, creativity and imagination.
- **Symbolic values** – being able to communicate sights, sounds and senses from nature through imagery, language and metaphor.
- **Aesthetic values** – desire for natural beauty through symmetry, balance and harmony to bring tranquillity.
- **Moralistic values** – ethical responsibility to nature to feel belonging to the universe as a whole.

These values interact in an environment and children will have three generic responses:

- **Liking or approaching**.
- **Restoration or recovery**.
- **Enhanced cognition**.

These three biophilic responses are what this project desires for the learning environment to aid children’s education.

The environment and its natural principles will provide these biophilic values, thus, achieve these responses and, furthermore, will put children on the path of experiential learning.

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78 Ibid., 48.
3.4 DESIGN OF NATURE

HISTORICAL CONTEXT
Nature has endlessly been a source of inspiration for architecture and design throughout history:
- The Greek decorated their columns and temples with local plant life.79
- Leonardo da Vinci applied nature’s rules and interconnectedness through geometry from his observations of human creation (the Vitruvian Man)80.
- Frank Lloyd Wright thought of architecture as a unified organism similar to that of natural ecosystems and that architecture should grow naturally from the ground and surroundings.81

80 Ibid., 8–9.
81 Ibid., 11.

HARMONIC GEOMETRIES
Harmonious design reveals our desire for nature. Nature’s forms, structures, systems and processes are often constructed using the Golden Ratio or the Fibonacci sequence.82

The Golden Ratio is a ratio between two elements equating to approximately 1:0.618, which presents a desired aesthetic quality to the elements. The ratio can be seen abundantly in nature (such as in shells) and architecture (examples include the Parthenon and Notre-Dame Cathedral).83

The Fibonacci sequence is a numeric series. Each number is the sum of the previous two. The sequence relates closely to the Golden Ratio where, beyond the 15th number in the sequence, the ratio between the following numbers is equal to approximately 1:0.618. Fibonacci prevails throughout nature (such as flower petals and human composition). As like the Golden Ratio, Fibonacci presents pleasing geometries and is especially effective for rhythm and harmony along repeating elements.84

“The power of the golden section to create harmony arises from its unique capacity to unite different parts of a whole so that each preserves its own identity, and yet blends into the greater pattern of a single whole.” – Gyorgy Doczi85

82 Harris, Fractal Architecture, 58.
84 Ibid., 8.
INTRODUCTION

The design of natural systems can be applied to built forms and spaces. This has become known as biophilic design. Biophilic design can be successful when it meets the following conditions:

- It repeats and sustains engagement with nature
- It focuses on human adaptations to the natural world in enriching health and wellbeing
- It encourages emotional attachment to place
- It promotes positive interaction between people and nature for a sense of relationship and responsibility between the two
- It supports mutual reinforcing, interconnected, and integrated architectural solutions.


BIOPHILIC DESIGN

The previously mentioned biophilic conditions can be achieved with design experiences and design attributes administered to the built form or space. This project places these experiences and attributes into three categories:

- Direct experience of nature: actual contact with nature and the environment.
- Indirect experience of nature: the contact with symbolic representations of nature or exposure to nature’s patterns and processes.
- Experience and sense of place: where the spatial features enable health and wellbeing by ways of nature.

These experiences are shown in the following diagram. Design traits of nature’s shapes and forms, and geometries and patterns have been further explored, as they are necessary elements to apply to spatial planning and the development of the architectural form to ensure an indirect experience of nature.

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DIRECT EXPERIENCE OF NATURE

- Light
- Air
- Water
- Plants
- Animals
- Weather
- Natural landscapes and ecosystems
- Fire
- Views
- Sounds

INDIRECT EXPERIENCE OF NATURE

- Images of nature
- Natural materials
- Natural colours
- Simulating natural light and air
- Naturalistic shapes and forms
- Evoking nature
- Information richness and sensory variability
- Ages, change, and the patina of time
- Natural geometries and patterns

EXPERIENCE OF SPACE AND PLACE

- Motifs (animal and botanical)
- Trees, especially the structural form
- Shells and spirals
- Egg, oval and tubular forms
- Arches, vaults and domes

Hierarchically organised scales
Self repeating but varying patterns
Simuous geometries
Central focal point
Linked series and chains
The “Golden Ratio”
The “Fibonacci Sequence”
At this point biomimicry has been mentioned; thus, it is important to distinguish and define Biophilia, biophilic design, and biomimicry.

Biophilia, as aforesaid, is the inbuilt human need and desire to be affiliated with nature. Biophilic design, hence, is the replication of natural experiences that individuals yearn for.

Biomimicry, however, is a subset of biophilic design. It is one of the possible methods in which we design the experience of nature. It mostly focuses on the process of design. It seeks to emulate nature’s design, as nature’s design trumps all.

Biomimicry may not necessarily look organic or natural, but the process of that design mimics a process from nature.

The direct natural elements of design yield a more sensory experience. They are the sights, sounds, feelings, smells, movements, and even tastes that we experience from nature.

Many of these apply to the learning environment, and some processes of designing for a selection of these elements are as follows:

- **Light**:
  - Creative play with light and shadows
  - Intensity, direction, and colour
  - Inventiveness to the solar path and movement

- **Water**:
  - Views of water
  - Interactions with water
  - In combination with natural systems

- **Plants**:
  - Connection to local plant life
  - Diversity for varying engagement

- **Weather**:
  - Natural systems that cater for weather events
  - Using as a teaching methodology

- **Natural landscapes and ecosystems**:
  - Self-sustaining and diverse
  - Green roofs
**INDIRECT NATURAL DESIGN**

The indirect natural elements of design typically stimulate our visual senses, although some of the other senses can also come into play. They are substantially applicable to this project, as the built environment can easily simulate natural forms and processes, thus, curiosity will arise. Some indirect design methods are as follows:


**Natural materials:**
- Connection to local materials
- Tactility of natural materials
- Visual structure and protection of natural materials

**Naturalistic shapes and forms:**
- Dynamic and diverse forms
- Ambient qualities of forms
- Aesthetically harmonious qualities

**Natural geometries and patterns:**
- Fractals
- Divine proportions
- Organised but chaotic patterns

**Biomimicry:**
- Biclimatic properties
- Structural strengths
- Innovative processes in nature

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**SPACE AND PLACE NATURAL DESIGN**

The experience of space and place is a spatial design element, which can be made up of both direct and indirect natural experiences. All of the senses can be featured to encourage these spatial experiences. Some design methods are as follows:

- **Prospect and refuge:**
  - Visual connection to opportunities
  - Sheltered and enclosed areas
  - Sequential linking of spaces
  - Central focus

- **Integration of parts to wholes:**
  - Obvious and enticing pathways
  - Welcoming
  - Open-ended

- **Mobility and wayfinding:**
  - Indigenous natural selections
  - Cultural and historical linkages
Te Mirumiru Early Childhood Centre

Te Mirumiru Early Childhood Centre is located in Kawakawa, New Zealand, and was completed in 2012. It was designed to have minimal environmental impact, whilst teaching the children cultural values. Maori architecture is immensely symbolic. Thus, this building has many representations of nature and natural processes. The story follows the metaphor of birth, where the building is being delivered from the land and its children enter the world through the light.

The building exhibits aspects of all three categories of biophilic design, which contribute holistically to child development as follows:

Direct:
- Creative patterns in materials to create interesting natural light casts
- Green roof ecosystem
- Local exterior plant life
- Views to surrounding vistas

Indirect:
- Local timbers and stone used for structure and interior linings
- Tactile materials
- Sinuous geometries
- Outdoor area a central focal point
- Womb like form

Place and space:
- Significant cultural attachment to place as the building is a metaphor for the Maori culture and history of the area
- Ecological attachment by use of native ecosystems
- Refuge in the use of furniture
- Wayfinding with lighting and curvature
Fuji Kindergarten

Fuji Kindergarten is located near Tokyo, Japan and completed in 2007. The ambition was to provide an environment that shaped life, activity and personality, rather than ‘hosting’ life. This outcome is comparable to this project where facilitation is key, rather than just enclosure. The project later added an annexe called Ring Around a Tree, which is a tree house structure, and furthermore explores the idea of breaking down the barriers between learning environments and nature. Some biophilic design elements of this project are as follows:

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**Direct:**
- Trees penetrating the building envelope and surround the building
- Trees as play equipment
- Views to environment from all internal spaces
- Water play

**Indirect:**
- Oval form
- Sinuous geometries
- Outdoor areas/ies as a central focal point
- Circular, repetitive movement

---

**Place and space:**
- Ecological attachment by engagement with trees
- Abundant transitional space
- Prospect of exploration and learning from potential danger
- Obvious wayfinding

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Vilhelmsro Skole

Vilhelmsro School was a concept for a primary school in Denmark, focusing on nature and sustainability. Some biophilic design elements of this project that could be influential are:

Direct:
- Variety of light casts
- Green roof terraces

Indirect:
- Form evoking the landscape
- Varying but repetitive ‘peaks’
- Linked series of forms

Place and space:
- Ecological connection throughout
- Integration of splines to a whole


Khoo Teck Puat Hospital

Although Khoo Teck Puat Hospital is not an educational environment, it effectively exhibits biophilic design elements for the health and wellbeing of its occupants. Located in Singapore and completed in 2010, the hospital is abundant in direct natural design elements. The following biophilic elements in the hospital are influential:

Direct:
- Abundant use of plant life
- Water connection
- Rooftop gardens
- Light filtered through vegetation
- Views to pond and nature

Indirect:
- Information richness in plant life
- Courtyard central focal point

Place and space:
- Ecological attachment throughout
- Wayfinding by landscape
- Healing qualities

It is critical to use experiential learning in the education syllabus. It is initiated from curiosity, and, as there is the inbuilt desire for a connection to the environment, nature provides an exceptional environment for this curiosity to thrive. This natural connection is also critical to the health and wellbeing of children. Hence, nature is indispensable in the learning environment.

Biophilic design will provide this nature-education setting critical to learning and development. Direct experience of nature, the indirect experience of nature, and experience of space and place are all compulsory to achieve a holistic nature integrated environment. Spatial planning, form, movement, materials, structure, construction and environmental systems should all be considered regarding biophilic design, as such, all aspects of the design will connect to nature in a physical, experiential, or symbolic manner. This will deliver a learning organism in which children can learn in and learn from.

Sustainable concepts are also important and come hand in hand with biophilic design elements. A nature-oriented approach can educate its occupants about environmental sustainability while contributing a self-sustaining built form in itself. A biophilic learning environment will produce a superior alternative to the existing innovative learning environment model currently used in New Zealand. Nature is fundamental in education and architecture needs to respond to this.
4.0

ST MARTINS SCHOOL AND ITS ENVIRONMENT
It is important to understand and appreciate the school, its site, surroundings and significance before design can initiate. The previous section describes the biophilic connections with nature (direct, indirect, and place) and this chapter will help generate site and contextual principles to integrate into these aspects.

The methodology for choosing a school and its correlating site for this project was firstly established from the Ministry of Education’s Christchurch Schools Rebuild progress report (as at the 31st of January 2017) after the Canterbury earthquakes, of which 115 schools were registered in the programme. The list was distilled to only full primary schools (years 1-8). A preferred school roll of 400-600 students further refined this list down to 10 schools across wider Christchurch. Due to the attributes and drivers for this design, it was paramount to select a site with a natural presence within itself and its surroundings. Therefore, St Martins School stood out as the desired site, as it is nestled in the foothills and bounded by the river, as subsequently discussed.

4.1 INTRODUCTION

4.2 ST MARTINS

LOCATION

St Martins School is located in the southern suburbs of Christchurch. The suburb lies on the boundary of Christchurch and the fringe of Banks Peninsula area. Recreational activity and residential areas frame the suburb, yet a strong connection is maintained to the inner city, central business district, and surrounding suburbs.

Fig. 90 - Site selection methodology

Fig. 91 - St Martins location map
In the 1800s St Martins was originally part of the Sydenham swamp, an optimal location for dairy farming and vegetable growing. The 1850s brought the desire to farm in the area, and it became popular when the first ever bridge over the Heathcote River was built in St Martins. Many European settlers came to St Martins; thus, much of the low-lying land was subdivided and sold in the 1860s. Housing was minimal in the area until the 1920s and 1930s when the quarry and brickworks were established, though, the valley and hill areas remained farmland and market gardens. The 1940s saw another 600 sections settled in the valley and on the hill, and hence, a school was considered for the suburb to cater for the growth.

St Martins is a mid-high socio-economic suburb of Christchurch City. The following statistics describe the demographic of the area:

- Over 4000 people across 1700 homes
- European descent (93% in the 2013 census)
- Only 15% of people don’t have a school qualification or higher
- Unemployment rate of 3.6% (compared to 5.1% for Christchurch City)
- 35% of the suburb’s residents are professionals; other occupations are managers and technical/trade workers
- Over half earn more than $30,000 per year
- Over half of the families have children
- 75% of the residents use a vehicle to travel to work
- 75% of the residents have a school qualification or higher
- 75% of the suburbs residents are professionals; other occupations are managers and technical/trade workers
- Over half earn more than $30,000 per year
- Over half of the families have children

The school itself is decile 9, with nearly 85% of students from European descent. This demographic is reflective of the entire suburb. The socio-economic position is also seen through student engagement, where there were only eight stand-downs and no suspension or expulsions in the 2016 year, presenting that the students are well behaved.
St Martin’s School History

1950s
- Established in 1956
- Four open-air classrooms with boiler house, girls’ and boys’ toilets, cloakrooms, and a staff room
- 73 students up to Year 4

1960s
- 1962 roll of 214 students up to Year 8
- Two new classrooms added with toilets, staff room, headmaster’s office, supply store, medical room, library, and dental clinic
- Two more classrooms added in 1968

1970s
- The school land increased and could now use Centaurus Park for recreational activities
- Roll grew to over 500 students
- Five prefabricated classrooms were added
- An adventure playground was installed
- School hall was built in 1973
- 1978 the school pool was added

1980s
- Library was lifted for storage
- School facilities were too small for roll growth
- 1995, often saw class sizes of nearly 40 students
- New two-storey classroom block built in 1996 (five classrooms, computer suite and resource room)
- 1997 administration building remodelled

2000 onwards
- Roll over 600 students
- Adventure playground remodelled 2004
- 2006: four additional classrooms built on top of existing classrooms
- 2011: the Canterbury Earthquakes damaged most classrooms
- Two-storey classroom block demolished, classes set up in the school hall
- Swimming pool removed 2015; a two-classroom block remodelled as a flexible learning space

102 St. Martin’s School
Environmental Significance

St Martins lies in the Heathcote River catchment area and at the foot of the Port Hills, both providing unique geological and ecological systems. The school is in a transitional zone between the two and, hence, both environments can offer their benefits to the school site.

The Port Hills comprises of volcanic rock (mostly Basalt) in the upper levels and loose silts (Loess soil) in the lower levels. These silts are taken by wind and water networks through valleys and fans, and lastly into the river system. The previously mentioned farming also provides fertile soils in the valley. The plant life of the hills is mostly silver tussock and grassland, while the Banks Peninsula Hebe is found amongst some areas have forests that are remnant from early days; one is located above the school site on Huntsbury Hill and in the valley. These forests consist mostly of kowhai, kamuka, ribbonwood, mahoe, and cabbage trees, and a few native matai and totara trees. Hill wildlife includes the native wood pigeon (kereru), blackbird, chaffinch, and song thrush. The bush areas contain bellbird, fantail, silvereye, and grey warbler.

The Heathcote River meanders amongst the gravel riverbeds and sands of the Canterbury plains, while also containing the run off silts from the hills, and previous minerals from wetlands that once framed the river. The plant life in the river areas consists of some flax (harakeke), toetoe, raupo, and large willow trees that line the banks. River wildlife includes mallards, scaup, bellbirds, bullies, trout, eel, flounder, and whitebait.
4.3 SITE ANALYSIS

SITE CONDITIONS

The site offers differing conditions to that seen across much of Christchurch. Being located at the foot of the Port Hills, the most noticeable difference to many other school sites is the topography. The school slowly rises away from the main road, increasing in elevation at the back of the site. The overall elevation change across the current built areas is approximately 14m. This offers diversity in levels and opportunities for views.

The prevailing northeast winds of Christchurch effect the site, however, most of the cold southerly winds are sheltered by the hill itself, which allows optimisation of the southern end of the site.

Fig. 105 - View of site and surrounds
Fig. 106 - Site topography section (NTS)
Fig. 107 - Environmental analysis

Fig. 106 - Site topography section (NTS)
The disadvantage of being at the foot of the hills is the over shadowing of the site to the west and the south. This means that during winter the natural light and thermal gain is diminished to most of the site from 3 pm onwards. Morning winter sun and sun throughout summer isn’t affected by the hills shadowing.

Situating most of the school at the top end of the site would provide more sunlight hours compared to placing the school at the lower end of the site.
Networks and Connectivity

St Martins is connected to Christchurch by Wilsons Road, which takes the community directly to the CBD. Centaurus Road then links residents to the surrounding suburbs of Cashmere, Beckenham, Opawa, and Heathcote, which, like St Martins, are a gateway to many outdoor, recreational, and cultural activities.

Bus services operate down both of the main roads with a bus stop at the end of Centaurus Park to cater for school users. Private buses use the drop-off zones on Albert Terrace to transfer students to off-site school activities.

The drop-off zones are used in peak times for parents to drop off and pick up their children. There is minimal space provided on the street and there have been many disgruntled residents and parents over the issue. Students and parents cycling to school can use bike lanes on the main roads that offer a direct connection to Centaurus Park. Pedestrians walk along the main roads, where there is a pedestrian crossing on Wilsons Road and Centaurus Road, and a crossing zone on Albert Terrace. These three locations are operated by the student school road patrol in the morning and afternoons to provide and promote safe walking.

The main entry points are on Albert Terrace and through Centaurus Park at the bottom of the school, with two minor entries off Albert Terrace. The entries become pinch points during peak times and, hence, become a dangerous environment for children to use.

The immediate surrounding amenities consist of some commercial shops (cafe, fish and chip shop, hairdresser, petrol station) and a community church. These are on the direct route to the school so are often frequented by parents and students.
4.4 CURRENT BUILDING ANALYSIS

LOCATION
The topography divides the site into an upper level and lower level, which then slopes to the bottom of the site. Hence, two main areas have been established based on these levels. Each level has classrooms located around the hillside perimeter boundaries. Classrooms are located along the typographical divide that defines areas at each level. Other buildings typologies (hall, storage, administration) exist on the street facing boundaries; thus, provide an enclosure for the outdoor spaces, and acts as a receiver for people off the street.

MOVEMENT
At the start of the day, the site sees a filtration of students from the two main entry points to classrooms, mostly across the hard courts and up the driveway. This is mirrored in the afternoon when students funnel through the exits.

The hard courts and playgrounds are the destinations at break times. This happens as a direct movement from the classroom to the outdoor areas.

Site movements can vary during teaching time depending on the day’s curriculum. There is movement between teaching spaces, libraries, the hall, and more organized movement to outdoor spaces as they are used for teaching. This circulation works well due to the layout of the classrooms around the outdoor areas for easy physical and visual connections to all learning environments.
SPACE ENTITLEMENT

The Ministry of Education allocates space entitlements to schools based on their funding decile and student roll numbers. This methodology will be used for this project to enable approximate area calculations for the proposed new school.

The current entitlement for St Martins School has been calculated (as shown in the following table) and a comparison of the property that the school currently holds is shown. Currently, St Martins lacks resource space, administrative space, and hall/multipurpose areas. These spaces would not be able to accommodate roll growth.

The post earthquake trend shows an increase in student population. People are showing more confidence in moving back into Christchurch and the hill suburbs around the site are constantly developing, supporting continual roll growth for the school. This project foresees the roll to grow to 730 students by 2027. These projected figures provide a space entitlement as shown in the table, with a total of 1112m² of space required in addition to St Martin’s existing property.

<table>
<thead>
<tr>
<th></th>
<th>Current Property</th>
<th>Current Entitlement</th>
<th>Difference</th>
<th>Proposed 2027 Entitlement</th>
<th>Additional Space Required</th>
</tr>
</thead>
<tbody>
<tr>
<td># of teaching spaces</td>
<td>23</td>
<td>23</td>
<td></td>
<td>33</td>
<td>+10</td>
</tr>
<tr>
<td>Classroom teaching space</td>
<td>1810 m²</td>
<td>1800 m²</td>
<td></td>
<td>250</td>
<td>+90</td>
</tr>
<tr>
<td>Library space</td>
<td>230 m²</td>
<td>94 m²</td>
<td></td>
<td>106</td>
<td></td>
</tr>
<tr>
<td>Administration space</td>
<td>150 m²</td>
<td>239 m²</td>
<td>▼</td>
<td>274</td>
<td>+44</td>
</tr>
<tr>
<td>Resource space</td>
<td>150 m²</td>
<td>166 m²</td>
<td>▼</td>
<td>216</td>
<td>+17</td>
</tr>
<tr>
<td>Hall/multipurpose space</td>
<td>280 m²</td>
<td>327 m²</td>
<td>▼</td>
<td>617</td>
<td>+177</td>
</tr>
<tr>
<td>Total net area</td>
<td>2650 m²</td>
<td>2620 m²</td>
<td>▼</td>
<td>3483</td>
<td>+532</td>
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<tr>
<td>Total gross area</td>
<td>3415 m²</td>
<td>3402 m²</td>
<td>▼</td>
<td>4527</td>
<td>+112</td>
</tr>
</tbody>
</table>

Fig. 117 - Space entitlement figures provide a space entitlement as shown in the table, with a total of 1112m² of space required in addition to St Martin’s existing property.

Fig. 118 - Projected roll growth
Space Quality

The quality of the current classrooms will be categorised by age and type of building and, subsequently, measured on a scale of 1 (1 = poor, 5 = excellent) based on the following conditions:

- Natural ambient environment principles (air quality, heating, lighting and acoustics)
- The ability for an outdoor learning connection
- The outdoor visual connection
- Flexible learning spaces
- Break out spaces
- The ability for future expansion or change

It is important to note that all classrooms suffered from damage due to the Canterbury earthquakes (none with critical structural damage).

Classroom Type 1
1965 open air verandah block, remodeled into flexible pods

Classroom Type 2
1970s single prefab

Classroom Type 3
1970s double prefab, remodeled into a flexible pod

Classroom Type 4
1960s modular block, remodeled into a flexible pod

All classrooms lack adequate natural environmental design, except the new second storey classrooms. Most classrooms have close access to outdoor learning spaces. However, no instances allow a direct connection to outdoor environments. An overlap of external and internal environments is desired. There is a concerning lack of outdoor visual connection in the older classrooms.

All blocks have flexibility between two teaching spaces only. This allows collaboration to a small extent; however, it would be more beneficial if there were the opportunity for larger collaboration for a wider variety of learning styles. Most classrooms don’t provide break out space. Old locker rooms have been opened up in the modular classrooms to provide an opportunity for some breakout.
As most classrooms are of the small cell origin, there is limited chance for change within the envelopes and expansion of these modules wouldn’t be justified on the site.

The lower library is uninviting and doesn’t contribute successfully to learning. The upper library is more successful as it provides direct outdoor learning, visual outdoor connections, and flexibility for differing learning styles. The music space is in an old 1970’s prefab classroom lacking space and acoustic properties. The hall is also from the same era so is deficient in acoustic design. The staff and administration building is a mismatch of spaces and add-ons, which have some operational flaws, however, it has a great connection to the public interface.

For future growth and the biophilic desire of this project, the retention and refurbishment of most classrooms wouldn’t be feasible as they fail in most of the critical aspects of these ideas. The current property is also severely insufficient for the projected student numbers for 2027. Hence, this project proposes to demolish all buildings on site and an entire new school will be designed.
The location of St Martins School is fundamental in the design of the new school facilities. The Port Hills and the Heathcote River have played a significant role in the history of the suburb and are still environmentally and ecologically critical to the area today. Thus, it is important to respect these elements and use them as drivers of the design. They will also come in valuable for integration of biophilic design elements.

The analysis of the current facilities provided verification that the existing buildings are inadequate for the biophilic principles that this project demands. The site analysis and projected space entitlement will enable quantitative and qualitative needs of the school, which will be seen in the next chapter.
5.0

DESIGNING THE BIOPHILIC
LEARNING ENVIRONMENT
5.1 THE BRIEF

LEARNING ENVIRONMENT

The I.L.E. principles discussed in section 2.0 demonstrate an apparent deficiency of nature in the classroom. Thus, this design proposes an alternative learning environment, abundant with nature for facilitation in learning, differing from the current state curriculum.

As like I.L.E., the learning will be child focused but will break down all formalities and direction that teachers and syllabus currently enforce. It will cater for pedagogies and learning styles over and beyond what is seen today.

Ambient environment principles (air quality, heating, lighting, and acoustics) instructed by the Ministry of Education remain appropriate in this alternative education proposal, as they are crucial for health and function in learning.

Ancillary spaces (hall, administration, teachers workspaces, toilets) can loosely follow the MOE design guidelines, as this project has a greater focus on the learning environment for children.

BIOPHILIC ELEMENTS

Biophilia is the principal and driving component of this design. The school should promote experiential learning, fuelled by curiosity. This curiosity will come from nature.

The design will propose a biophilic learning environment, resulting from the need to provide an alternative from the current I.L.E. model. All three elements of biophilic design are important as one another for a holistic approach to the design. Direct experience of nature, the indirect experience of nature, and experience of space and place will be used throughout the design.

Spatial planning, form, movement, materials, structure, construction and environmental systems should all be designed with a biophilic mindset to ensure that the entire organism provides for the learning environment and can be used as a learning tool in itself.

All these elements will produce sustainable and self-sustaining built environments due to the natural attributes that they contain.
Contextual Influences

Contextual factors, as discussed in section 4.0, are fundamental to provide a biophilic learning environment. The context provides crucial influences for the design of space and place experiences. Attachment to place, refuge, and prospect should be fostered through surrounding environmental connections.

The hill, landform, the nearby river, and ecosystems are important drivers for the biophilic design, directly and indirectly. Historical, social, and cultural influences may also guide the biophilic design elements.

Programme

Programmatic elements provide indications of student numbers and sizes of spaces for the design.

The 730 projected roll allows approximation for areas of spaces using the Ministry of Education guidelines as a basis. This projection caters for general learning spaces, halls, libraries, resource, and administrative spaces. The following diagram shows the overall proportion breakdown of this space allocation.

Toilets are calculated based on building code requirements for the school as a whole. It requires eight female pans, seven male pans, and one accessible unit per building. They are minimum requirements that should be considered but not necessarily exact numbers for this design.

The school will continue to function with the current age groupings of years 0-2, years 3-4, years 5-6, and years 7-8. These quantities and ratios specified are not exact requirements, just merely guidelines for this project.

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5.2 DESIGN APPROACH

Nature and ecosystems consist of organisms. These organisms are made up of many cells. As like nature this design is constructed with the same two scales:

- **The cell** - the classroom ‘pods’ or ‘clusters’
- **The organism** - the holistic school, inclusive of all cells and context

Each scale is designed with the four aspects of the brief integrated:
- The learning environment
- Biophilic elements
- Contextual influences
- Programme

The biophilic elements, being the principal drivers for this design, have further focus which are distinguished by their three broad elements:
- Direct experience of nature
- Indirect experience of nature
- Experience of space and place

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Fig. 128 - Space types and quantities established from MOE guidelines

Fig. 129 - Cells and organism
5.3 THE LEARNING CELLS

ARRANGEMENT

The cell itself has initially been derived from the desire of divine proportions and organic geometries (indirect biophilic elements). Variations of the Fibonacci spiral have been examined and sections have been used to inform the overall arrangement of the cell, providing space with aesthetically and physically pleasing proportions. Further development involves more indirect biophilic design elements. The pattern is repeated but also rotated around a central axis providing a focal point; this in itself creates a chain of geometries. It is important that the arrangement provides for curiosity for children and, hence, the conceptual layout does not allow for direct sight lines or visual connections throughout the whole space. This encourages movement.
A series of different size cells have been provided to cater for different age groups and student numbers. This will also allow varying repetition and movement throughout the site (refer 5.3 the learning organism).

The arrangements maintain patterns, focal points, chains, and curiosity-driven movements as previously discussed. The number of modules within each cell is representative of the number of learning spaces.

Organisation of the modules in the cell provides for well-connected outdoor learning opportunities and chances for superb outlooks. It provides direct views of nature and offers curiosity to see what activities are taking place outside.

The broken up shape gives more opportunity for light further into the floor plate. It also allows for varying paths of cross ventilation and solar gain, while providing less rigid surfaces for sound reverberation.

**FORM**

Initially, the volume of the space was explored. Space opens up from the central focal point, a sort of biomimicry of the petals of a flower. The proportion of the low to high volume is constructed using the rule of thirds, again to provide an aesthetically pleasing experience.

Greater volume at the end of the spaces would give views to nature and hence entice movement towards these views and throughout the space, a method of wayfinding and a sense of prospect.

The high elevation of each tip of the ‘petal’ also creates opportunity for natural light to reach deeper into the floor plate between each module.
The volume evolved into a shell-like form due to its significance in biophilic terms. In nature, the shell protects organisms from threats and weather. In the learning setting, it protects children from weather and external conditions for a safe and sheltered environment. The shell form is also structurally efficient as it mimics the rigidity and strength found in natural curves. The shell provides structure and enclosure. It also offers the chance for a variety of materials to provide transparency or solid elements.

The programmatic guidelines determine that 33 teaching spaces are required totaling 2,510m² of floor area. Consequently, each teaching space is allocated approximately 75-80m² each. The three cell sizes define the number of teaching spaces within the form, by where the number of modules equates to the number of teaching spaces. The scale of the shell form has been adjusted to accommodate the area requirements for each cell. Thus, the floor plates provide over the minimum square area required per student.
The preliminary spatial arrangement design roughly designates areas for learning activities and processes. This layout is universal across all the cells. However, development of the cell design will result in different cell types according to the year grouping/ages of the children (to allow for stages of physical and mental development). This will be shown later in the section.

The preliminary spatial concept consists of:

- Outdoor spaces
- Exploratory zones
- Discovery zones
- Bounded spaces

**Outdoor spaces**
Integration with the built form is essential for intimate and more direct nature-based learning in the education setting. The outdoor opportunities that the form arrangement provides, encourages interactions at the long edge of the module. There is the opportunity to blur the line between external environment and built form, whilst encouraging nature to enter the form.

**Exploratory zones**
Exploration is essential in this proposal, as such, the general learning area provides for plenty of exploration to encourage curiosity. These spaces tie the series of modules together for exploration of the cell as a holistic entity. They provide way-finding between spaces and have the ability to link to other cells in the organism.

**Discovery zones**
Discovery has a more guided approach than exploration. These areas allow for more focus on learning from natural aspects. The zone is nestled into the safety of the lower shell form to provide refuge, while outlooks and other visual connection provide prospect. There should be varying sizes and shapes in the area to provide for different learning types, sizes and activities.

**Bounded spaces**
Bounded spaces consist of teachers’ workrooms and toilets. They are required to be enclosed spaces and aren’t part of learning. They are centrally accessible and visible from all parts of the plan, including indoor and outdoor access. Teachers can passively observe both internal and external learning from this selected area.
Access and Circulation
Initially, access and circulation are looked at based on the conceptual spatial arrangement. It is important to have frequent direct access to the outdoor environment and the option of bringing the outdoors in the form is also considered. Access to the cell-specific outdoor learning areas and the external learning corridors through the site are both essential. Physical connections are provided between the large modules and the outdoor learning spaces. This area is where the indoor/outdoor line becomes obscured. Access is also provided at the top end of the modules to provide connection to the rest of the school organism, which is repeated in both small and large module sizes.

A central circulation spline connects the modules like a chain. This provides condensed movement in the central area that then opens out into the wider parts of the modules. From this spline, passage is possible through the bounded spaces, linking these to the outdoor learning areas.

Space and Plan
Development of the programmatic floor plan looks closer at the four conceptual spaces, their relationship together functioning as a holistic cell, the biophilic elements driving the design, and the experiential learning that takes place within each area.

Outdoor spaces
The form was revisited with the desire to connect the external shell form with the internal environment. The concept of the lower end of the module flowing down into the spacious end of the module is proposed to bring that connection to the external form. This allows the opportunity for a natural corridor to utilise the roof and to become a learning opportunity internally and externally. Additionally, curiosity will come into play, as children will want to explore this green path.

The direct outdoor learning space intends to be an extension of the movement from the internal environment and then back into the form again, making the overall journey around the learning environment open-ended and forever continuous. Organic curves and varying patterns define this movement by using different materiality (natural and artificial) and changes in levels to provide a rich sensory experience. The delineation between internal and external space becomes blurred at the voluminous end of the modules, which again encourages exploration of the outdoor environment. Greenery, water, and natural ecosystems will feature as direct biophilic elements within the outdoor learning spaces, as well as providing natural views and sounds.
Exploratory zone

The exploratory zone intends to provide children with free reign over their learning, allowing them to take their own direction. It offers an environment rich in information and experiences.

Exploratory ribbons provide direction to other spaces within the cell. The ribbons rise from the ground in organic arch forms creating a multitude of spaces, all varying in size and elevation, offering prospect and refuge. Curiosity will thrive in these spaces, as exploration is compulsory, weaving horizontally and vertically through the space is unavoidable.

Views appear as children meander around the curves provided by the cell layout, additionally linking to the outdoor spaces, creating the open-ended learning experience. A hierarchy further influences this wayfinding, as the highest and most open arches are the central point of the cell, allowing children to easily find this focal point and, hence, other spaces within the cell.

The ribbons present the opportunity for learning surfaces, making them tools, resources, and educators in themselves. They have the capacity to embrace direct natural plant life and ecosystems.
Discovery zone

The discovery zone, while still permitting children to direct their own education, promotes an environment with more focus and direction. It is a place for concentration, encouraging children to master their skills and build confidence. Individual and collaborative learning is accommodated for, as well as instruction from teachers.

Like the exploratory zone, a ribbon-like form defines this area. It is much more solid than the exploratory area, providing a sense of groundedness and security. The ribbons wrap up and blend into the shell form, providing unity with the enclosure.

Located in the less voluminous side of the shell form and with varying heights, different levels of prospect and refuge are offered. Prospect is furthermore offered by the location of this space. It is located with direct outlooks to the external environment, with a different view seen at each ribbon level and, thus, encouraging movement towards the views.

The diversity in heights, lengths and curvatures demonstrates indirect biophilic design and, hence, provides an information-rich space to further inspire curiosity. A variety of activities can be hosted in the multitude of spaces that this zone creates. A playful transition to an open learning area encourages experiential movement beyond the space.

Light is a key direct biophilic element within this space. The locality permits ample natural light into the space through the facade. The shell form also offers a surface to diffuse or permit light from overhead, creating interest and visual links to the sky above. Containing direct plant life and natural systems within the space is imperative to provide tools and resources for discovery.
**Bounded spaces**

Staff workspaces are centrally accessible and visible from all parts of the plan, including indoor and outdoor access. Teachers can passively observe both internal and external learning from this selected area. The teachers are also exposed to the biophilic design of the cell; the curvaceous space, their location along the spine of the chain, and of course direct natural elements in the space will make it a welcoming and healthy environment to work in.

The toilets are located between the outdoor learning space and the large module, allowing both internal and external access. Passive monitoring of the toilets is achieved by the proximity to the teachers’ space.

This proposed overall conceptual floor plan supports a holistic cell. The space unites with the form to provide enclosure as well as education. A complete continuation throughout the spaces delivers a truly open-ended experience fuelled by curiosity.

To cater for differing ages groups this conceptual plan will be further developed into a series of cell types. The variations of this plan will better suit the developmental stages of children at each age group, and each type will be adapted to different cell sizes. The cell types proposed are:

- **Explorers Cell**
  - Years: 0-2
  - Ages: 0-7 years

- **Discoverers Cell**
  - Years: 3-4
  - Ages: 7-9 years

- **Navigators Cell**
  - Years: 5-6
  - Ages: 9-11 years

- **Conquerors Cell**
  - Years: 7-8
  - Ages: 11-13 years
Selections and Systems

The selections and systems integrated into design are essential to provide a holistic learning cell. Materiality influences direct biophilic experiences, indirect biophilic experiences, and satisfies the experience of space and place. Sustainability is a key driver for many selections to ensure a minimal carbon footprint, self-sustenance of the built form, and to provide a teaching tool to the students.

Structure and enclosure

The shell form will be constructed with locally sourced timbers that have a low environmental impact. Zinc cladding will be used to enclose the form—chosen for its ability to wrap around organic forms, low-energy consumption in production, nearly 100% recyclable content, and capacity to accommodate energy generation systems. Openings are easy to construct in the zinc cladding to permit light penetration at high levels. Established on the shell is a green roof system. The green roof will host local hill plant life and will blend into local river plant life as it approaches the ground, mimicry of the local environment to provide an attachment to the surroundings. The green roof teaches children about local biodiversity while contributing to stormwater control, thermal performance, acoustic insulation, and air quality.

The importance of blurring the lines between interior and exterior learning environments means transparency in the facade is essential; it enables visual and physical connection for curiosity between the spaces, hence, plenty of glazing will be used in these areas. Environmental issues become apparent with large glazing areas, consequently, thermal and solar issues will be addressed with passive elements. Green facades or living walls will be used to combat harsh solar gain, by providing varying levels of density for different light diffusion.

Green facades will also strengthen the connection to the surrounds, while also reducing the visual impact on the environment. Technical aspects in the facade will contribute to the solar control and will also provide ventilation control.

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Linings and finishes
The interior finishes will present an abundance of natural materials, colours, textures, and motifs. These are important indirect biophilic elements that provide a symbolic association to nature and an information-rich setting, and will also provide for the experience of space and place by integrating to the site as a whole and providing ecological attachment to the surroundings. A focus will be given to using materials that already occupy the area and locally sourced materials for their sustainability aspect.

Walls will consist of local timbers or basalt stone, with the prospect of internal green/living walls. These will enhance education, health and wellbeing, as well as air and acoustic ambient environment issues. Floor finishes will vary in materiality. The exploratory zone will feature a rich palette of finishes to construct an environment that encourages curiosity and experience. These finishes will consist of local timbers, local stones, and carpets in natural colours. The discovery zones will comprise of similar variability, however, will have a greater connection to the outdoor learning environment finishes. Therefore, this zone may comprise of more natural corridors blending into the man-made materials.

As the learning environment is an open-ended and experiential pedagogy, there will be a copious amount of movement throughout the spaces. Thus, the floor becomes an opportunity for kinetic energy generation, adding to the self-sustenance story and having children engage with the floor as an educator.115


Joinery and Furniture
The joinery and furniture, as like the interior finishes, will present an abundance of natural materials, colours, textures, and motifs. Additionally, the joinery will host a wealth of plant life and natural systems for exploration, discovery, and furthermore, education. These direct natural components also go beyond just curiosity driven learning by helping cleanse the air and by providing additional acoustic properties for the environment.116 The plant life will consist largely of local plants, from the Port Hills and the Heathcote River ecosystems (as discussed in section 4.0). The joinery will host play and learning, with children being able to use the spaces to learn on, in and with. The interaction with the joinery and furniture itself ensures that the built form is going beyond just being an enclosure. There is opportunity for integration of kinetic energy generation within the joinery and furniture, so children are generating energy as they play and learn.

5.4 THE LEARNING ORGANISM

CELL ARRANGEMENT

Teaching space requirements were forecasted using student roll averages from the previous five years, resulting in the following requirements:

- Years 0-2: 9 teaching spaces
- Years 3-4: 9 teaching spaces
- Years 5-6: 8 teaching spaces
- Years 7-8: 7 teaching spaces

Larger pods are desired for more open-ended learning, especially for younger, underdeveloped minds. However, ambient environment principles become harder to control over large areas. Therefore, the year groups have each been divided into two cells resulting in groupings shown in the adjacent diagram.

The arrangement of the organism on site was first considered separate from the form. The existing school's division of 'junior' (years 0-4) and 'senior' (year 5-8) students has been maintained as it acknowledges age group oriented educational and play areas. Grouping of each age group provides connected and personalized external spaces for those students.

The junior and senior school has been divided by the prominent level change in the landform. Each part features a central outdoor area; this delivers physical and visual connections to 'hearts' of outdoor learning while providing a sizeable area for collaboration and events.

The juniors are nestled into the hill at the top of the site, offering protection in a sheltered and less open environment, while also providing prospect as they look down upon the rest of the school. The seniors are situated at the bottom of the site that is more open and less protected. Older students development would suggest that they are confident in a more vulnerable environment.

Other aspects considered in the site arrangement are:

- Offering a journey through the site
- Addressing the only two entry points to the school and ensuring the public interface will be in a prominent location
- Placement of learning spaces to ensure natural light and solar gain

[Ministry of Education, "St Martins School"]
Ancillaries
The hall, library, and administration also comprise as cells of the organism, without them the school wouldn’t function.

The forms of the spaces are variations of the learning cell forms. They offer the repetition of the shapes to provide unity to the holistic organism, yet they differ to make them symbolic of another use, a wayfinding method. These forms provide for some direct and indirect biophilic elements as aforementioned in the learning cell design.

These ancillary cells are designed with three factors in mind:
- Programmatic characteristics
- Biophilic design elements
- Integration as part of the organism

Hall Cell
The hall is located at the public interface of the organism, noticeable by the public eye to draw the community in. It is central to all students, providing visual and physical connection. It consists of a multipurpose space large enough for half court sports activities and performance space. Other spaces include a public foyer, toilets, changing rooms, storage, and kitchen facilities.

A repetition of features from the learning cells provides indirect biophilic elements. Direct natural integration needs to be considered with a different approach, as the space requires more flexibility as it is used by the wider community. Experience of space and place is critical to be designed for both students and community users in mind, to enable both groups to have a sense of attachment to the space.

Library Cell
Universal student accessibility to the library is crucial; thus, it is located at the topographical divide in the site. Positioning of the library partially in the public eye allows for the community also to use the space.

Similarities to the learning cell are evident in the library, by where the experiential learning path is important. In addition, resources beyond nature directed learning are catered for (library books). This requires more direct spaces for these resources and their organisation.

It is important to treat the library as a variant of a learning space; thus, the same biophilic principles are used. Though, more discovery type learning is required, which compels a greater focus on intimate and directed spaces, providing refuge and safety.

Administration Cell
Administration is situated at the main entrance to the school. It is the first point of contact for staff, parents, and students arriving from the drop off areas and pathway. It gives opportunity for passive observation over a large portion of the outdoor areas and the main entrance to the school.

Programmatic aspects of the administration space include a foyer, reception, office, principal and deputy principal offices, meeting room, staffroom and amenities, nurse, and storage.

The biophilic design of the administration differs from the learning cell as the occupants aren’t in a developmental stage of their lives. However, there is still a requirement for biophilic principles to cater for the health and well-being of staff members. This can be designed through all three biophilic principles.
Organism Features

The organism boasts many features that unite the cells and context in a holistic approach. The following concepts have been designed to achieve this universality.

Drop-off area

As discussed in section 4.0, there is no off-street drop-off zone; accordingly, this proposal addresses this. The drop-off area is situated along Albert Terrace, adjacent to the administration cell, and at the public interface ad main entry of the school. This location allows for passive observation of the drop-off area by staff and also allows for safe, direct access to the school grounds.

Sports fields

As mentioned in the scope, the fields will be situated at the lower end of the site and will be used in conjunction with the council owned Centaurus Park. The fields offer for sports, play, and learning activities, thus, will fuel children’s curiosity as like the rest of the organism. The process of arriving at the fields is an experience in itself, as movement and exploration are essential to reach the area.

Green roofs

As shown in the learning cell chapter, green roofs comprise part of the form and learning environment. They exist in all of the cell types, providing a varied repetition throughout the site. Hence, ensuring all of the cells are integrated altogether as parts into the entire organism. The green roofs also endorse a sense of groundedness to the context, as the natural landscapes wrap up the organic forms, providing an attachment to the area and its environment.
Energy generation
As the central portions in each cell host the green roofs, there is a multitude of opportunity for energy generation across the entire organism. The remaining modules of the cells can host this energy generation, enabling each cell to have self-sustaining features. It is crucial for all cells to contribute sustainable principles to the organism, to ensure a universal approach to reducing the school’s carbon footprint. The energy generated on these roof forms can comprise of solar, wind, and water generation.

Light permeation
The forms, furthermore, allow for light penetration into the learning spaces. As like the green roofs and energy generation areas, these permeable portions are located consistently throughout all of the cells, ensuring a consistent repetition to tie all the cells together. Bringing natural light in through the roof form encourages a physical connection with the sky, not often offered through vertical openings. It is an alternate environment to connect to that ties the entire organism and surroundings together.

Water catchments
The shell-like form dictates water to fall as shown in the diagram. The form also generates an empty space where the shell curves back under the discovery zone. This space acts as a catchment for rainwater from the roof. It provides a direct connection and learning method for the interior learning environment, as the rainwater falls between the modules. It also allows for direct learning in the external learning environments as the water flows over the end modules. These catchments will provide natural treatment and storage of rainwater for self-sustenance, also providing a sustainable learning story for the students. There is also opportunity for the water to be a source of energy generation.

Waterways
The Heathcote River is a prominent feature of the suburb and many waterways meander down the valley into the river system, including one that follows the eastern boundaries of the school site (at one point piped under the existing driveway). It is vital to affiliate the organism with this waterway as it provides connection to a key aspect of the environment. Two new branches of the waterway have been proposed to meander through the school grounds. They provide an environmental corridor link amongst the junior and senior cells and the unified school. The waterways provide direct natural corridors enabling learning and play, while enticing movement around the site.
Outdoor learning areas
The outdoor learning areas are one with the forms and with the natural landscape. The green roof amalgamates the outdoor space with the form by way of organic flowing curves. The outdoor space then integrates with the organism as a whole with curvaceous movements encouraging exploration to other spaces, yet remaining defined as a direct outdoor learning space for each cell. The repetition of outdoor spaces throughout the cells ensures the belonging of each outdoor area to its learning cell.

Main organism corridor
Four main points define the main organism corridor: the main entry, the secondary entry/fields, the junior school, and the senior school. The corridor enhances the connections between these points and enriches the wholeness of the organism. The exploration of the corridor enables wayfinding throughout the site while invoking curiosity and hence, learning. The corridor will provide open and sheltered spaces, with all three biophilic design elements integrated. Other learning and play spaces will emerge from this corridor, such as terraces, courtyards, edible gardens, sandpits, rain gardens, and embankments. The main corridor and emergent spaces will all articulate with the local ecology, plant-life, wildlife, and geologies.

Fig. 171 - Outdoor learning and organism corridor
6.0
CONCLUSION
Review and Reflection
This research project presents an approach of how architecture can be implemented to provide an educational setting that uses the inbuilt biophilic desire to drive children’s learning. It throws away the standard curriculum currently in New Zealand state education and re-invents pedagogy; taking from the successes and failures of the current Innovative Learning Environments and the knowledge surrounding nature and its positive influence on development and learning. This project provides an alternative architectural solution, a biophilic school, for New Zealand education.

The literary component of this project was critical to prove the missing link between nature and education and understanding of why the widening gap between the two is concerning. An understanding of biophilia and the biophilic elements associated with the hypothesis enabled the design to commence. All three elements of biophilic design (direct experience of nature, indirect experience of nature, and experience of space and place) and factoring them in with the contextual surroundings provided a strong basis for conceptual design. Altogether, the elements deliver a holistic experience that fosters physical and mental development and well being.

The architectural outcome provides a learning experience. It contrasts from the outputs we see today, especially in Christchurch where the educational setting is an enclosure for the pedagogy within. The architecture exists as the content, the resource, and the educator, by where the learners’ curiosity engages with the built form and natural environments to drive their learning through experience. The architecture is an open-ended path of exploration, discovery, mastery, and confidence. The natural affiliation drives the experience; hence, nature encourages and, perhaps (although not measurable by this project), facilitates learning.

Environmental awareness in this project is also a key feature in the architectural proposal. The rich natural features promote sustainable systems with little carbon footprint, and a self-sustaining built form means its life cycle has little impact on the environment. This awareness is crucial in today’s society as global warming becomes a threatening issue. More weight needs to be put into reducing the carbon footprint in architecture, and presenting the concept in an educational setting allows it to be passively and directionally taught to the students within.

Future Research and Discussion
It is relatively unheard of in New Zealand to combine education so strongly with biophilic design, which is why this project is worth further investigation as environmental design becomes ever more important in our world. As this project had to narrow its focus, the following could be aspects of further research and development.

The investigation into the neuroscience and behavioural traits of the nature-development dynamic could expand initial research. This could provide insight into the particular aspects of nature that facilitate learning and, hence, be more stringently applied to the built form. Biomimicry would be a strong focus in advancing this project. The technologies seen in nature could be applied to this design to provide even more efficient systems and structures, further enabling its sustainable and self-sufficient characteristics.

Further design development might consider a modular or universal approach for this project, whereby the design can be used on any given site or location. This could allow a national holistic approach to education. The necessity to educate with nature and to educate about nature will become increasingly fundamental in young children, and the school environment needs to be reassessed to achieve this. Projects like this showcase how our schools could do this, and why future educational projects should start to implement this research.

Environmental awareness in this project is also a key feature in the architectural proposal. The rich natural features promote sustainable systems with little carbon footprint, and a self-sustaining built form means its life cycle has little impact on the environment. This awareness is crucial in today’s society as global warming becomes a threatening issue. More weight needs to be put into reducing the carbon footprint in architecture, and presenting the concept in an educational setting allows it to be passively and directionally taught to the students within.
6.2 FINAL PRESENTATION

Fig. 172 - Site location model
Fig. 173 - Site and context model
Fig. 174 - Site location model
Fig. 175 - Site Plan (not to scale)
Fig. 190 - Junior discovery zone

Fig. 191 - Junior exploratory zone

Fig. 192 - Senior outdoor and discovery zone

Fig. 193 - Senior exploratory zone
7.0
REFERENCES
9.0

APPENDICES
10.1 LITERATURE

The Hundred Languages of Children

No Way, The Hundred is There.

Fig. 194 - No Way, The Hundred is There

Biophilic Design Elements

Fig. 195 - Dimensions, Elements, and Attributes of Biophilic Design
Natural forms and shapes

The formal design element for natural shape is the concept of "form" in nature that is so often found in the natural world. The natural world is full of forms and shapes, such as the shapes of leaves, flowers, and insects. These forms and shapes are often irregular and asymmetrical, but they are still beautiful and appealing to the eye. The natural world is also full of patterns and rhythms, such as the patterns of waves and the rhythms of the tides. These patterns and rhythms are often complex and intricate, but they are still beautiful and appealing to the eye. The natural world is also full of colors and textures, such as the colors of the leaves and the textures of the bark. These colors and textures are often bright and vibrant, but they are still beautiful and appealing to the eye. The natural world is also full of movement and growth, such as the movement of the plants and the growth of the animals. These movements and growths are often slow and subtle, but they are still beautiful and appealing to the eye.

Natural patterns and processes

A key design element is the concept of "pattern" in nature. Pattern is the repetition of a design element, such as a shape or a color, in a regular or irregular manner. Patterns can be found in the natural world, such as the patterns of the leaves on a tree or the patterns of the waves on the sea. Patterns can also be found in the design world, such as the patterns of the tiles on a floor or the patterns of the wallpaper on a wall. Patterns are often used to create a sense of harmony and balance, as well as to create a sense of order and structure. Patterns can also be used to create a sense of rhythm and movement, as well as to create a sense of repetition and sameness.
Declaration

Name of candidate: Sarah Rigden

This Thesis/Dissertation/Research Project entitled: The Biophilic Learning Environment

is submitted in partial fulfillment for the requirements for the Unitec degree of Master of Architecture (Professional)

Principal Supervisor: Annabel Pettig
Associate Supervisor/s: Hamish Foulke

CANDIDATE’S DECLARATION

I confirm that:

• This Thesis/Dissertation/Research Project represents my own work;
• The contribution of supervisors and others to this work was consistent with the Unitec Regulations and Policies.
• Research for this work has been conducted in accordance with the Unitec Research Ethics Committee Policy and Procedures, and has fulfilled any requirements set for this project by the Unitec Research Ethics Committee.

Research Ethics Committee Approval Number: ________________________________

Candidate Signature: ________________________ Date: 11/10/17

Student number: 1046916
Full name of author: Sarah Rigden

ORCID number (Optional): ............................................................

Full title of thesis/dissertation/research project ('the work'):

The Biophilic Learning Environment

Practice Pathway: Architecture

Degree: Master of Architecture (professional)

Year of presentation: 2017

Principal Supervisor: Annabel Pretty

Associate Supervisor: Hannish Foote

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