The use of biomimicry in interiors with a focus on the South African residential industry

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Abstract

The main point of this research paper is to see whether or not biomimicry is being used in interiors with a focus on the South African residential industry and what the benefits of biomimicry are using specifically a qualitative methodology approach. The problem is that it isn't being used enough in residential design, specifically in a South African context. The researcher has decided that the only solutions to solving this problem is by educating both homeowners and people within the building industry on the advantages and disadvantages of biomimicry and showing how it can be implemented and what benefits it will have, not only for the user but the environment for years to come. The key discoveries were that biomimicry has been used for a long time but not as effectively as one would hope, everyone needs to understand that it can be more functional and not just simply mimicking nature. As of yet there isn't any large implications that have been discovered but the researcher hopes that this study will show people the importance and beauty that is biomimicry and how using it can really have a positive input for the environment and overall well being for the user. This study hopes to help homeowners and designers to create better more regenerative buildings that will create healthier and better living spaces for users with biomimicry principles in mind.

Key words: Biomimicry, Biophilia, Regenerative design, Sustainability, Evidence based design, Well-being, Place context and healthy living spaces.

Declaration

I , Alexia Morezzi, hereby declare that the Research Report submitted for the Module RESE8419 a component of the qualification of B.A. Interior Design Honours Degree to The Independent Institute of Education (IIE), at Vega School of Design, Pretoria Campus is my own original work and has not previously been submitted to another University or Higher Education Institution for degree purposes. I further declare that all sources have been cited, quoted, or acknowledged by an inclusive list of references in accordance with the IIE's Referencing Guide.

Signature: 

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Buildings are part of everyday lives and are constantly needing to change and adapted to the way humans behave and live. The question we need to understand is why do some buildings get better and others don't, the simple answer could be that the long term use of the building is not thought about in the beginning phases. Glass is the building material of the late 20th century but it's also a problem material. Concrete, steel, and glass are the big carbon culprits. The primary way of assessing the carbon footprint of buildings is through a life cycle assessment, and therein lies the problem because the life cycles of architecture and interiors are completely different (chasefukuoka61. 2017) , however, designers should be looking for a way to work together through this problem or at least coming up with a possible compromise.

People always look and think about the final facade of a building, but no one every thinks about the maintenance, wear and tear of the building. In fact some architects pride themselves on the fact that their buildings are dysfunctional. Some architects even advertise that they don't expect their buildings to work because they are a work of art, this is okay to some extent but it doesn't help if the building will start to harm the user and the environment later on. Too often the focus of architecture is on the aesthetics of the building rather that the functionality and long- term impact. Sustainable design is a tool used to make a reduction of the negative impacts on the environment along with the users of the space, their health and overall comfort, this is done through the improvement of the performance of the building. To design sustainably is to be able to utilise the potential of the site, reduce energy intake of non-renewable energy, conservation of water, improving practices of operation and maintenance, enhancing the indoor environmental quality and environmentally friendly considerations (GSA, 2021).

Climate change refers to human-produced emissions of greenhouse gases that results in global warming and changes in the worldwide or regional climate patterns (Nasa, 2014). Renovations are said to be a problem on continuing to release a carbon footprint from buildings but this issue can be resolved through providing knowledge and training on climate change, recycling and sustainable entrepreneurship. It has been reported by Chouinard (2020) that the building and construction industry makes up 40% of the worlds carbon emissions. Reconciliatory design is reconciling the relationship between humanity and nature included by creating cultures that can work creatively with disruptions rather than to avoid them to be resilient to change. It is regenerating the patterns of life (chasefukuoka61. 2017). As according to Hutton, (2021: para 5) "Regenerative design seeks to not merely lessen the harm of new development, but rather to put design and construction to work as positive forces that repair natural and human systems."

Interior designers can have a much bigger impact on climate change than they ever imagined. In 2018 the United Nations' Intergovernmental Panel on Climate Change had released an alarming

report marking 2030 as a point of no return for global warming caused by the emission of greenhouse gases. It is therefore important that sustainability is understood as it leads us into an era of regenerative design that works hand in hand with biomimicry and will lessen the need of maintenance and renovations to a building and this is why the researcher believes the South African residential industry needs to make use of biomimicry for long term benefits. According to the Biomimicry Institute, (2020: n.p) “Biomimicry is a practice that learns from and mimics the strategies found in nature to solve human design challenges — and find hope along the way”. Biomimicry does not simply mean to mimic the look of an animal but its learns and mimics strategies that nature and particular animals use to survive and grow, for example you wouldn’t just design a building to look like a chameleon, but you would rather design a building that could camouflage into its surroundings, bringing the outdoors indoors.

The researcher has define and outline the topics along with additional information to contribute to the research problem and questions. We always need to build with purpose and function and understand the long term effects a building will have to the environment and the general consumer using it, therefore, this study tries to incorporate every aspects of designing with biomimicry and to show what the importance of it could be for generations of building techniques to come.

1. CHAPTER ONE- Orientation of study

1.1 INTRODUCTION

In this chapter the researcher has briefly discussed the orientation of the study but will further explain each heading in chapter three so that the reader has a clearer understanding of what the rest of the chapters are all about. The researcher has defined the research approaches, paradigms, data collection and analysis, in a practical process as the study applies to the primary research questions and objectives that have been answered by the four respondents as well as the researchers own understanding.

1.2 BACKGROUND

The purpose of this study is to determine how biomimicry will be beneficial in residential homes and how the utilisation of Biomimicry in residential buildings is relevant as it can promote a more sustainable and healthier way of living. The “Supertrees” in Singapore are an excellent example of Biomimicry because it represent rainforests. Lauren Moorhouse (2015) from CNN describes the trees and how they attract people to see and learn more about the climate change and how Biomimicry can solve it. Biomimicry is often only found in commercial design, it is not know exactly why this is and therefore four respondents have been specifically chosen to gain better insight into this mystery. Basic ways of using biomimicry could be, mimicking dragonfly wings to create lightweight structures, mimicking photosynthesis to capture solar energy or even building wall systems that mimic the homeostasis in organisms which allows them to regulate their internal conditions such as temperature. These concepts can easily be used in both commercial and residential design, therefore there is no reason for it not to be used all the time.

1.3 PROBLEM, QUESTION & OBJECTIVES

1.3.1 Problem statement

Is biomimicry being used in interiors with a focus on the South African residential industry?

The researcher has explored how biomimicry within a residential context is being utilised using place context and Evidence based design theories for a better understanding on how it could affect climate change and/or any long term effects of maintenance on the buildings and if certain renovations will even need to be made further on down the line of the building. According to Zari, (2014) we need to look to plants and animals that are highly adaptable or ones that survive in extreme climates and through climatic changes will provide insights into how buildings could or should function, as well as design that mimics ecosystems could be a beneficial long-term biomimetic built environment response to climate change, this is all an important part of place context as well, because you'll need to know which plants grow in the specific areas you will be building for before you can use biomimicry.

1.3.2 Purpose statement

The purpose of this study is to understand whether or not Biomimicry is being used in residential designs specifically in South African. By using this study the researcher wants to make it clear why biomimicry should be used more in residential design as there is not evidence to why it shouldn't be used. Research has been done on biomimicry and therefore, it has been broken up with the use of other theories within a residential context to see why it would benefit the homeowners living conditions and the environment for the entire human race.

1.3.3 Research questions

Main research question;

Is biomimicry being used in interiors with a focus on the South African residential industry?

Secondary research questions;

1. *Is there a basic understanding of what biomimicry is?*
2. *What are the advantages and disadvantages of using biomimicry and why could this change peoples perception of using it?*
3. *Can aspects of well-being and healthy living be seen through biomimicry?*

1.3.4 Research aims

The aim of this project is to determine whether or not Biomimicry is being used in residential designs in South African, using a qualitative methodology approach. The researcher will then be discussing why Biomimicry is not being used enough in residential interiors and what the benefits of using it could be for the homeowners and the overall environment. This will all be further discussed in chapter four, the findings.

1.3.5 Research objectives

Main research objective;

To determine the utilisation of biomimicry in interiors with a focus on the South African residential industry.

Secondary research objective;

1. *To determine, how and why people will be more comfortable in biomimicry houses and how this could have a global impact further down the line.*
2. *To show the long term effects the residential buildings will have on the homeowners and the environment.*
3. *To describe how it can be implemented to maximise the full healthy living space for homeowners through human centred design.*

1.4 OVERVIEW OF RESEARCH DESIGN & METHODOLOGY

The paradigm chosen for this research paper is Interpretivism. This paradigm is relevant to the study as the data collected is of an ontological and subjective experience of homeowners and how they would feel in a home designed through biomimicry and what they think the long term effects could be on the environment. It is also the subjective experience of the interior designer and the architect and how they would design a house through biomimicry and what they think the long term effects could be on the environment if more residential designs were built with biomimic principles. It is then perceived from an axiology point of view to understand the study of the nature of value and valuation of the kinds of things that are valuable to each homeowner to allow for the home to still be personalised and created according to the clients specifications. (Methodological Frameworks and Sampling in Qualitative Research)

A qualitative data collection method through a questionnaire has been given to two homeowners, interior designer and one architect on the utilisation of biomimicry in the South African residential design industry and then a hermeneutical framework has been used to explore the respondents views. Ethnography and content analysis have been used by means of an open-ended questionnaire to fully understand the homeowners understanding and interpretation of biomimicry in residential design, through an electronic google forum. Catherine Palmer (2001) believes the importance of ethnography is a tool for understanding and interpreting the users behaviour (*Ethnography: a research method in practice*).

1.4.1 Rationale and Relevance

This study was selected to understand exactly what biomimicry is and how it can create a healthier way of living. The purpose is to determine how biomimicry will be beneficial in residential homes and how the utilisation of Biomimicry in residential buildings is relevant as it can promote a more sustainable and healthier way of living. In the researchers view biomimicry used in residential buildings will be a way to educate and better the users well-being and the environment as it is personal and experienceable, therefore, nature-inspired design should be a new design trend that

is used not just in buildings but in every aspect of a persons life. Therefore the ones that would benefit the most from this researcher paper would be the homeowners and anyone that is part of the building industry, other designers could also benefit from this paper if they learn how its applied and then they could apply it anywhere. The researcher believes that academically it could be relevant to existing studies that are being conducted on biomimicry or even new ways to build sustainable. Although there is much research on biomimicry and sustainable building practices the researcher believes that the two should be combined and with that there is not much research. The researcher hopes to aid or inspire other researchers to also combine the two ideas and perhaps a possible solution can accrue.

1.4.2 Key theories & concepts

The key theories that have been used in this research paper are Biomimicry, Evidence based design and placed context. These theories will work hand in hand with biomimicry as EBD deals with the process of constructing a building or physical environment to better the occupants physical and mental needs within the space and placed context deals with where and why a building should be placed in that specific area to give it meaning for its existence as well as understanding the land before construction takes place. The three concepts that have been chosen are well-being, healthy living space and biophilia as each also form part of the key theories mentioned, allowing for the research paper to be based of specific context as no hypotheses could be created with a qualitative study.

1.4.3 Literature identified

The researcher has chosen the following seminal authors for the research paper as they use a subjective design approach and have broaden the researchers knowledge on each specific theory that was purposefully chosen.

The literature sources are as follows:
Source 1: D. Kirk Hamilton, David H. Watkins- *Evidence-Based Design for Multiple Building Types.*
Source 2: Michael Pawlyn- *Using Nature's Genius in Architecture*
Source 3: Reap, J. Baumeister, D and Bras, B.- *Holism, Biomimicry and sustainable engineering.*
Source 4: Tavsan,C. Tavsan,F. and Sonmez, E.- *Biomimicry in Architecture Design Education.*
Source 5: Janine Benyus- *Biomimicry: Innovation Inspired by Nature.*

1.4.4 Research design & approach

The proposed research has been conducted through a theoretical approach of qualitative methodology. Intern, the researcher hopes to better societies way of thinking and living, as well as help designers to further their design thinking and create buildings with a stronger functionality and not just a home but rather a healthy beneficial home. The specific approach to this will be further discussed in chapter three of the methodology section.

1.4.5 Selected paradigm

The paradigm chosen is Interpretivism. Interpretivism has been influenced by several intellectual traditions, among which the dominant ones are hermeneutics, phenomenology and symbolic interactionism (Du Plooy-Cilliers, F., Davis, C. and Bezuidenhout, R., 2014). This paradigm is relevant to the study as the data collected will be the ontological subjective experience of homeowners, an interior designer and architect to understand the human behaviour more clearly.

1.4.6 Population & sampling

For this study, the researcher has only used human participants but has used examples of existing buildings for respondents to analyse so that there can be a clear understanding between a regular modern building and a building design with biomimic principles. There are two homeowners, one interior designer and one architect. The primary observation will be seen through the survey if homeowners and designers know what biomimicry is and whether they have and would use it so that the questions and objectives can be answered.

1.4.7 Data collection & analysis methods

A qualitative data collection method through an online questionnaire have be given to four respondents. The questions have been signed off and accepted by the researchers supervisor for ethical clearance as well as a better understanding of whether or not the questions asked were good enough to get specific results back.

1.4.8 Ethical considerations

The questionnaires were anonymous and each respondent was above the age of 21 with at least 10 years of owning a home and each designer had at least three years of industry experience for better and concise answer so that a more accurate ethical finding through a subjective viewpoint could be achieved.

1.5 CONCLUSION

This chapter briefly discusses the orientation of the research paper under each heading so that the rest of the chapters would be understood better. A further detailed explanation of each heading will be discussed later on in chapter three, but the objective was merely to allow for the reader to have a basic understanding of the research paper before going into depth with the literature review discussed in chapter two.

2. CHAPTER TWO- Literature review

2.1 INTRODUCTION

Residential spaces are spaces that human beings spend the majority of their times at, if they aren't at work, schools or shops. It should be a break away from life, where they can do normal daily tasks, relax and get away from the busy life outside their walls. The purpose of this chapter is to analyse specific literature and get a deeper understanding into the theories and concepts chosen so that the researcher questions and objectives answers can have some form of backing up. An

understanding of well-being, healthy living, biophilia, Evidence-based design, place context and biomimicry will all be discussed in the research paper as these are the starting points for the literature, to further understand the research. The findings from the literature have then been concluded to see if they support the research objectives and will be rediscussed later on in chapter four of the findings.

The figure below (figure one) displays the three theories; EBD, Place context and biomimicry and three concepts; Healthy living space, well-being and biophilia and lastly it shows how the five literature are divided specifically into each theory but that the three concepts are always evident because everything falls within EBD and human-centred design. It is there to make it more clearer to the reader what the chosen literature is all about and what the reader should expect in each book.

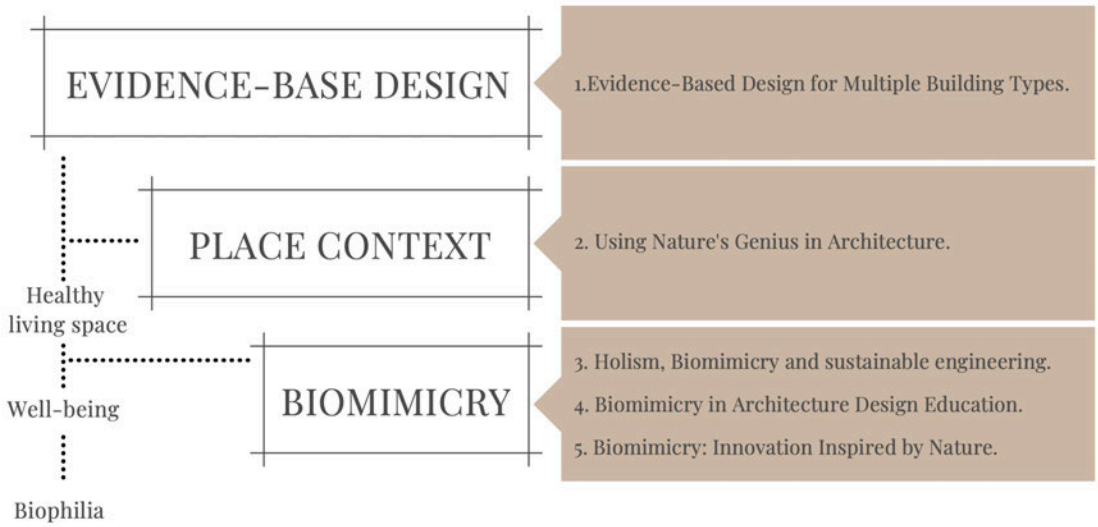


Figure 1: Morezzi, A. (2021) Diagram of how the theories, concepts and literature review work together.

2.2. THEORETICAL FOUNDATION

The project aims to determine if biomimicry is being used in interiors with a focus on the South African residential industry as well as to see how it could be beneficial to the occupants of the home as well as the long term effects it can have towards the environment. There are three theories that the researcher has looked at to better understand this problem and hopefully gain better insight into what good sustainable and regenerative healthy living spaces look like and what they entail. The three key theories that have been used in this research paper are Biomimicry, Evidence-based design and placed context. These theories work hand in hand because biomimicry and place context both fall under evidence-based design but can each be split up to be defined separately but then all come together in the end to create a good and healthy design scheme.

The frameworks mentioned above are as follows;

2.2.1 Evidence based design

Evidence based design deals with the process of constructing a building or physical environment to better the occupants physical and mental needs within the space. It is the attempt to base building decisions on the best research to improve humans way of living (Moores, R. & Moores, J. S.A). This is important for the research as the researcher needs to understand if biomimicry interiors will be beneficial for the occupants physical and mental well-being in their homes and what principles of EBD can be used in a residential context, since evidence based design is mostly used for commercial use.

2.2.2 Place context

Place context deals with where and why a building should be placed in a specific area to give it meaning for its existence as well as understanding its surroundings to build it for the specific climate and the users in the area. The IEE is a group that educates and believes context helps to situate themselves in the world and to feel a sense of belonging through engaging with the context of the place and involving a feeling close to nature and knowing about the soil underfoot, the flora, fauna, sources of water and rock structures. The IEE believe, “A sense of place is valuable not only for the knowledge one gains of context but, perhaps more importantly, for the emotional bond that can form. It is this emotional bond that may inspire people to live sustainably.” (Imaginative ecological education. 2018: n.p). Therefore, it is important the researcher uses place context as a theory because it gives meaning to why something should be built in that area. It also has the same values of biomimicry because both use nature to understand and create a safe and healthy space, therefore if the place is understood then the object that will be mimicked can be decided based off the context of the place the building is situated. For example if you were designing in Namaqualand, Northen Cape then you would probably study exactly what flowers grow such as daisies, lilies, aloes, and perennial herbs and then you would study those flowers and use them as inspiration for the building or the landscape design around the building.

2.2.3 Biomimicry

Biomimicry is a practice that learns from and mimics the strategies used by species alive today. Areas of Biophilia can also be seen through biomimicry. The goal of using biomimicry is to create new healthier ways of living that can solve humankind greatest design challenges of designing sustainably and in solidarity. It brings relief, can design generously and gets us to sustainable solutions faster. The Biomimicry institute says, “Biomimicry is about valuing nature for what we can learn, not what we can extract, harvest, or domesticate.” (2021: n.p). The microbiome is the entire collection of microorganisms, such as the human gut (Nature portfolio. 2021). Plants also have microbiomes and this is why it is important to understand microbiomes within a biomimicry context, especially as microbiomes are a new upcoming way of design thinking. Understanding all of this will help the researcher be able to educate homeowners that don’t know what biomimicry is and hopefully they will see the benefits and will want a more sustainable way of living, it can also encourage designers to use biomimicry principles more in their designs.

2.3 CONCEPTUALISATION

Conceptualisation is important as it stems from the key theories but allows for more research to be conducted for a better understanding when looking specifically at the literature and how all the research questions and aims can be answered and justified. The three sub-questions of the study were used with the three themes that work within the researched literature. The concepts are well-being, Healthy living space and biophilia. All three of these concepts have to do with the human's way of living as well as living or designing sustainable. Although the researchers main aim is to move away from the word sustainability to regenerative design, it is still important to keep the principles of sustainability in mind as they are the stepping stones to move forward. The concepts will be supported by the literature review under each key theory and, therefore, the following definitions of the concepts have been provided to inform the reader about key terms that will come up through out this research paper.

2.3.1 Well-being

Well-being in short is the experience of health, happiness and prosperity. It is having a good mental health, high life satisfaction, a sense of purpose and managing stress. It comes from thoughts, actions and experiences happening in everyones daily lives. Physical well-being looks specifically at healthy living and that's why it is important to understand how they can both be used in a design space (Drevitch, G. 2019). Looking specifically in a design context, we have to think more about the experiences and how a building or interior surroundings can creating well-being for the occupants, therefore, the researcher believes using healthy living and well-being with biophilia/ biomimicry can create the perfect ideal place for residences, especially if regenerative design is included because than they wont need to always seek medical tension when they are feeling down but they can rather just enjoy their home whether it be from more natural light or more ventilation in the space.

2.3.2 Healthy living space

Healthy living spaces are referred to as the practices of population groups that support, improving, maintaining and enhancing ones overall health. It implies the physical, mental and spiritual capacity to make healthier life choices (Government of Canada. 2013). When making healthier choices one should remember that their living space should be their number one priority as humans spend most of their time indoors and that just eating healthy and meditating isn't always enough. It is specifically how the homeowners are currently living and if they would like to live in a more healthy and regenerative house. Well-being and healthy living space are similar as they both deal with human-centred design as mentioned previously. Sick building syndrome is often a reason for buildings not creating a healthy space for occupants and often leave the user very ill after time and, therefore, it and healthy living principles should also be considered together when designing regardless of it been a residential or commercial building.

3.3.3 Biophilia

Biophilia is defined as the human connection with nature and other living beings. It is known to support the function, physical health, and psychological well-being of people. There are three categories of biophilia, a) Nature in the space; The direct presence of nature in a space, b) Natural analogues; The representational presence of natural materials, patterns, objects, colours, and shapes incorporated into building design, facade ornamentation, decor, and furniture and c) Nature of the space; The incorporation of spatial elements commonly found in nature (McCain, M. 2020). Biophilia is not just imply adding a plant to ones house but it is about the materiality and the feeling that certain colours, textures, images and plants can create. This is why biomimicry is a part of biophilia and it is extremely detailed and specific as it uses all the biophilic categories mentioned above and this is the soul reason why the researcher has chosen it for the research paper because it brings a larger meaning to biophilia and allows for nature to be brought back into humans lives through simple things such as creating a specific roof style that will allow for better ventilation to create good thermal comfort for the house that has mimicked the way termites build their mounds. An example of this can be seen below in figure two of a schematic diagram showing the natural ventilation used in the Eastgate building in Harare though Passively Cooled Buildings.

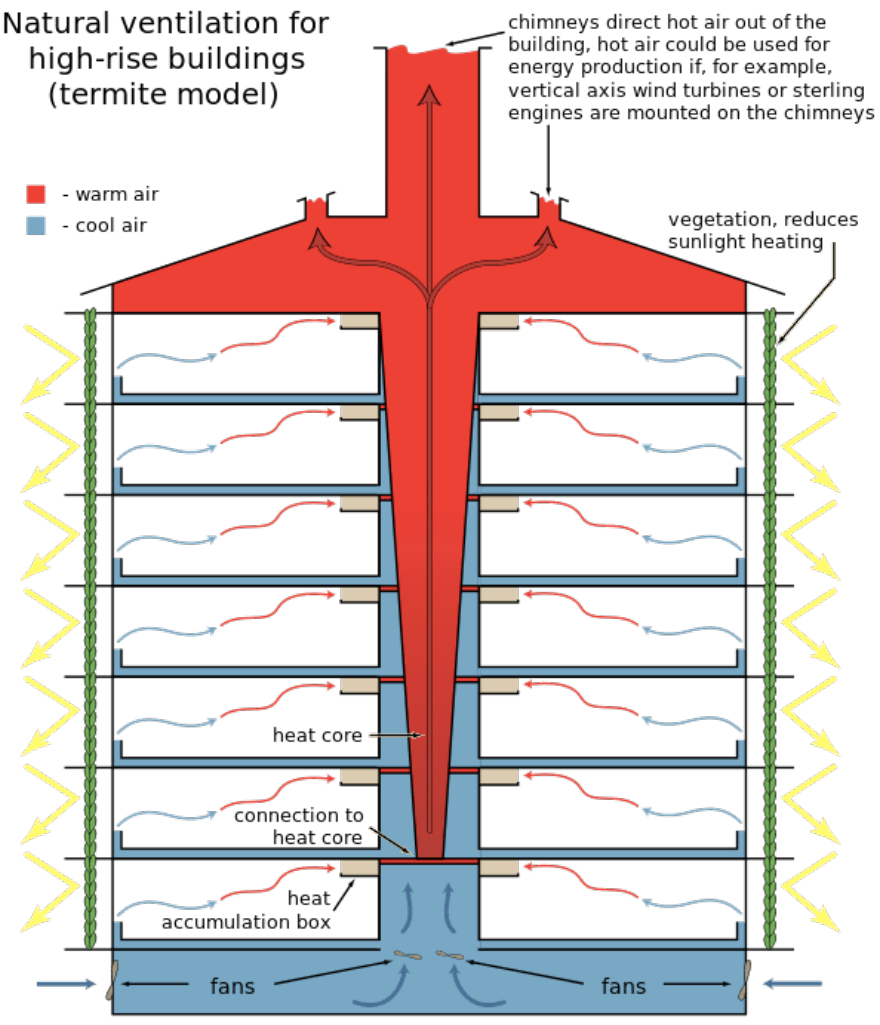


Figure 2: Mick Pearce. (1996) A schematic diagram showing the natural ventilation used in the Eastgate building in Harare though Passively Cooled Buildings Inspired by Termite Mounds

2.4 LITERATURE REVIEW

In the literature review, the current literature reviewed has been divided under three headings and the sub-questions have then be individually discussed under each heading. These three headings have each been discussed to support the research objectives and aims. The researcher has chosen the following seminal authors for the research project as they use a subjective design approach and will broaden the knowledge of the research paper. The purpose of the literature review is to provide evidence that the study is relevant and could have positive long term effects on the environment. This literature should provide the reader with a general understanding of the main research problem and will be further looked at in chapter four of the findings.

2.4.1. Evidence based design

2.4.1.1 The book 'Evidence-based design for multiple building types' starts with who and what an architect and designer is and why clients would rather use cheaper and more affordable ways of getting plans and render images. This is because clients often doubt the capabilities of architects. Therefore a new way of thinking has to be considered and this book looks specifically at evidence-based design and how it benefits the client. Evidence-based design according to Hamilton is understanding the user and creating a space that will improve the mental and physical well-being of the user. One must also remember that research and design are continually evolving and is, therefore, impossible to see design based on the best available evidence as fixed and static, but this can still be a foundation for designing and that EBD does not mean rigid rules and standards or loss of creativity (Hamilton, D. and Watkins, D. 2009).

The key things Hamilton says a designer must do is have meaningful collaborations with the clients and users, must use the best available credible evidence from a variety of sources, must recognise and respond to the unique context of each project, requires critical thinking and must have a moral obligation to honour their sacred trust to protect public safety and health of the client (Hamilton, D. and Watkins, D. 2009). These key things are very usefully to designers and researches because it helps show how designers should be designing but also how and what kind of research will be beneficial. Well-being and healthy living are also equally important when using evidence-based design. Thus, with all this knowledge it is show that EBD is an important way of designing for all living beings and that it can benefit residence as much as it benefit patiences in hospitals that have been designed with EBD.

2.4.2 Place context

2.4.2.1 Michael Pawlyn in his TED talk talks about using Nature's Genius in Architecture, (2021) In this talk, he describes how designers could transform architecture and save resources and energy using biomimicry. He explains that in order to make progress with sustainability, designers need to have a radical increase in resource efficiency, a shift from a wasteful, polluting way of using resources to a closed-loop model and changing from a fossil fuel economy to a solar economy. The researcher agrees that biomimicry could help with this, but first, it is important to understand the place the designer will be designing for because if you don't even understand the area you are

building for then how will you be able to know the surrounding vegetation that you will be mimicking and taking inspiration from. Michael uses an example of the Eden project where they had to create a greenhouse in a sight that wasn't only irregular but also continually changing, and it was soap bubbles that helped them generate a building form regardless of the final ground levels and studying pollen grains to create the best structural vision using hexagons and pentagons (Pawlyn, M. 2021). This wouldn't have been possible if they didn't study their sight and understand the place they had to design for during the first design phase.

2.4.3 Biomimicry

2.4.3.1 In the journal on 'Biomimicry in Architectural Design Education' (2015) it is explained that in sciences, nature is used as a guiding spirit and that biomimicry is a domain that exists through the imitation and observation of nature. Architectural design behaviour is seen to imitate nature and with this aim to consider in design and nature about architectural design education. At Karadeniz Technical University, the Department of Architecture there has a courses on biomimicry and how it includes the relationship of nature and design and how this allow for a correlation between design and biomimicry. Both biomimicry and biomimetic are new sciences that observe the materials in nature and then aim to produce solutions for humans by imitating these designs or by taking inspiration from them. An example is buildings that use passive cooling systems designed by using ant nests and the example above in figure 2 with the termite Mounds. This point of inspiration shows that biomimicry is in the field of architecture, with form, structure and texture (Tavsan, C., Tavşan, F. and Sonmez, E. 2015). It is therefore strange that it isn't being used more often and that it seems to not be used in residential designs enough.

2.4.3.2 The journal 'Holism, Biomimicry and Sustainable Engineering' (Reap, J., Baumeister, D. and Bras, B. 2008) discusses the socially beneficial and profitable products of biomimetic design that restore and leaves the environment undamaged and inherently creates a healthy regenerative living world. "Examination of research and practice reveals a reductive mindset that limits biomimicry's applicability within the context of sustainable engineering." According to Reap, J., Baumeister, D. and Bras, B. (2008: n.p) This is why the article proposes a holistic view of biomimicry. The holistic view of biomimicry involves the incorporation of life's general characteristics in design and application. The journal initiates a guiding framework for designers interested in the utilisation of biomimicry's potential as a sustainable design tool and encourages designers and engineers to make use of it. So, biomimicry is something that is continually being encouraged to use, yet designers aren't making use of it enough.

2.4.3.3 Janine Benyus is known for her research and ideas on biomimicry and, therefore, looking specifically at her book 'Biomimicry: Innovation Inspired by nature' it can clearly be see that biometrics is a new science that observes nature's best ideas and adapts them for human use. Janine Benyus talks about how designers can learn from a spider that manufactures a waterproof fibre five times stronger than steel or how electrons in a leaf cell can converts sunlight to fuel in trillionths of a second. This is why biomimicry doesn't necessarily have to be for structural and architectural design, but it can be products that we can all use, eg. Medicines, smart computers,

super-strong materials, profitable and earth-friendly business. She says, “Nature, imaginative by necessity, has already solved the problems we are struggling to solve” (1997: p.230).

Animals and plants have a natural survival instinct and have learnt to adapt to their changing surroundings so much that they only rely on each other and themselves to live, but humans need nature and animals to survive but humans should be learning from nature and these creatures on how to survive by ourselves and protect our resources as this will lead to a healthier and more sustainable future. Janine Benyus believes there are four steps to a biomimetic future, a) Quieting: Immerse ourselves in nature, b) Listening: Interview the flora and fauna of our planet, c) Echoing: Encourage biologists and engineers to collaborate, using nature as a model and measure and d) Stewarding: Preserve life’s diversity and genius (1997).

Biomimicry falls under evidence-based design but it is also part of biophilia and that is why it was important to show in this research paper that biomimicry is so much more than just putting a random plant in an open space. Michael Cavanaugh, LEED AP, vice president and sustainability leader of Cannon design, (2017: n.p) is very interested in biomimicry and he explains how “One thing we did with Novartis is daylight harvesting as a type of real-time post-occupancy evaluation. We designed a prototype of an intelligent building where sunlight comes in and creates a glare situation, and the daylight harvesting sensors will, in turn, roll the shades down and cause LED lights to dim in real-time.” This is such an innovative way of using blinds in an interior that all interior designers could apply this simple method inside homes and then benefit from it and learn how to use this method but to a much larger scale that even walls are made from biometric principles.

2.5 CONCLUSION

In conclusion, the interpretivism paradigm, with the qualitative data collection method best suits this study. The three theories and concepts are all relevant to each other and the research problem. The literature so far shows how important evidence-based design and place context is when building for people and how biomimicry is linked and can be a huge contributing factor to this understanding and a wider solution to most problems. The three concepts also form part of each understanding of the literature because at the end of the days it’s making sure the design benefits the human the most and if protecting nature and the environment can be part of that then everyone can be happy and live in peace with each other. However, there is still no clear understanding of whether or not biomimicry is being used in interiors specifically for a South African residential context. Thus, it is important to continue investigating this further as the research continues.

Holistically the researcher wishes to explore evidence based design and place context in collaboration with biomimicry; it is worthy to research this problem further and identify how each framework can be blended within a unified context to really understand why biomimicry isn’t being used more in South African residential homes and hopefully the survey can help with this.

3. CHAPTER THREE- Methodology

3.1. INTRODUCTION

The researcher has defined and outline the topics along with additional information to contribute to the research problem. In the chapter of this study, the researcher has defined the research approaches, paradigms, data collection and analysis, in a practical process as the study applies to the primary research question. The Researcher has given four surveys out to, two homeowners, one interior designer and one architect to understand their knowledge of biomimicry in a residential context and formulate their reality of the phenomenology, therefore, an ontological position of interpretivism is the correct research method for this study (Du Plooy-Cilliers, et al, 2014).

Additionally, an inductive approach has been included, as theoretical ideas have been discovered and a cross-sectional study has been applied.

3.2 RESEARCH PARADIGM

A research paradigm is how research is formulated and collected to show how it should be interpreted (du Plooy-Cillers, 2014). For this study the paradigm chosen is Interpretivism. Interpretive leads to a subjective, participatory role, often rejecting the standard methods of natural science and an interpretive paradigm is a view of what social science is, it's how you examine the practice of research (Cohen et al. 2001). This paradigm is relevant to the study as the data collected is the ontological subjective experience of homeowners and how they would feel in a home designed through biomimicry and what they thought the long term effects could be on the environment, as well as the interior designer and architects view and their thoughts on why biomimicry isn't been used in interiors and whether they would make use of it or not. This has all be done through individual online surveys.

The main idea of interpretivism is that people are fundamentally different from objects because people and the environment are change all the time and the environment they live in can also influence their ways of living, hence why place context is so important. This is why hermeneutics and phenomenology have also been used to study humans way of living (du Plooy-Cillers, 2014). The researcher is merely trying to understand human's behaviours within their homes and if biomimicry could make a difference, how would they react and benefit from it. Qualitative research is often associated with interpretivism and has, therefore, been the best research methodology to use for this specific subjective study.

From an ontological point of view, the nominalist stance in the respondents' internal and subjective experiences are important and from an epistemological point of view, the Interpretive paradigm is used because the researcher is empathetically and inter-subjectively immersed in the research (Maree, K. 2019). The research approach is inductive as it does not require a theory or hypotheses to collect data as it works largely with an emerging theoretical framework. It starts from specific observations to broader generalisations and theories (Maree, K. 2019).

3.3 DESIGN APPROACH

The proposed research has been conducted through a theoretical approach of qualitative methodology. Methodology, according to Dew (S.A, p. 6), refers to 'the principles underlying particular research approaches, as distinct from “methods”, which are ways of collecting data’. Methodological frameworks and sampling in qualitative research has been used through a qualitative questionnaire for two homeowners, one interior designer and one architect, about the utilisation of biomimicry in the South African residential design industry and a hermeneutical framework has been used to explore the respondents views.

The figure below (figure three) is an adapted onion diagram from Saunders and breaks down all the research methods and paradigms. It shows the methodology, data collection, analysing methods and how the study has used a hermeneutical framework approach.

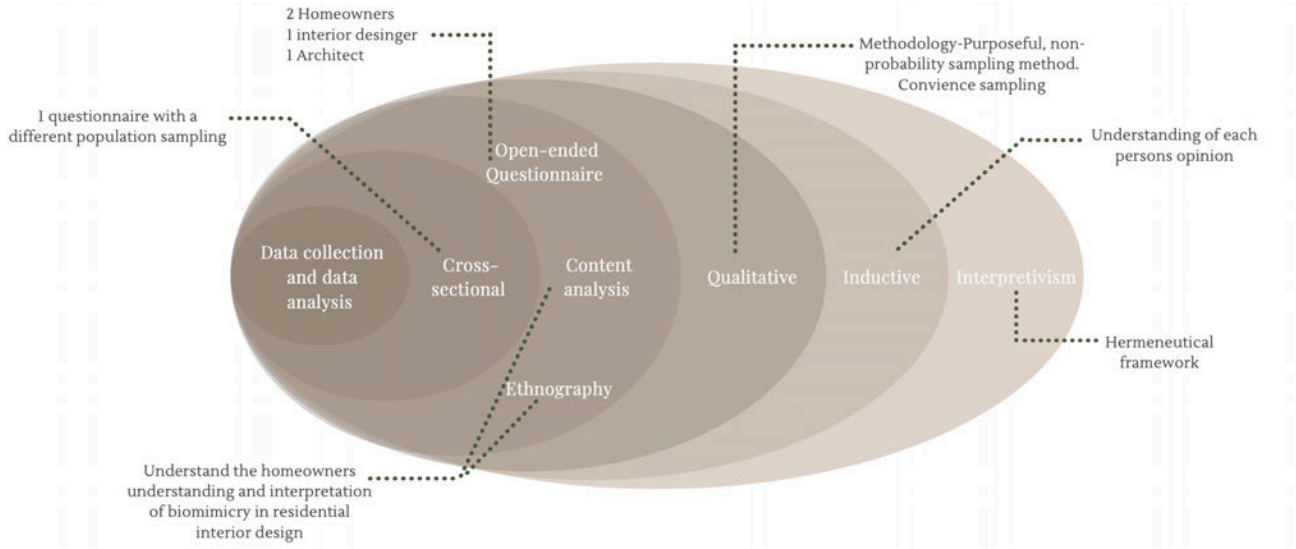


Figure 3: Adapted from the Saunders, M. & Lewis, P. & Thornhill, A. Onion diagram (2007)

3.4 POPULATION

A population is a collection of individuals or objects from who, the researcher chooses to acquire information (Du Plooy- Cilliers, et el, 2014). For this study, the researcher has only used human participants but has given examples of existing buildings for respondents to analyse. The respondents consisted of two homeowners that have owned their own homes for at least 10 years with a background in the building industry and have been chosen to get a deeper and clear understanding on what they believe biomimicry is and whether they would want to live in a biomimicry house. The other respondents were one interior designer and one architect with at least three years of industry experience that have also been chosen to understand from a designers point of view why they think biomimicry isn’t being used in South African homes and if they would or have ever consider using the principle of biomimicry in their own designs.

Figure four below is a table of the population group and why they were chosen.

Respondents	Qualifications	Method	Homeowner/Designer
Respondents 1	National Higher Diploma in Building Management	Google survey	Owned a home for 10+ years.
Respondents 2	Owner of manufacturing company in steel and aluminium fenestration in both domestic and commercial projects.	Google survey	Owned a home for 10+ years.
Respondents 3	Director of an Interior Design Company	Google survey	Been an interior designer for 3+ years.
Respondents 4	Doctorate Architecture, Senior Researcher, Principle Architect and owner Studio Konstruk	Google survey	Been an Architect for 3+ years.

Figure 4: Morezzi, A. 2021.Table of number of surveys given out and the sample group. (Table by author)

3.5 SAMPLING

A purposeful and non-probability sampling method has been choose for two homeowners, one interior designer and one architect that have filled out the survey based on the utilisation of biomimicry in residential design and the respondents have been specifically chosen for convince of the study and the researcher for maximum credible responses. Convince sampling according research methods in education, (2001) is a method that refers to situations where population elements are selected based on the fact that they are easily and conveniently available. It is usually quick and cheap, but does not result in representative samples. “It is useful in exploratory research where the researcher is interested in getting an inexpensive, quick approximation of the truth, and in pilot studies where a few respondents are necessary to test the questionnaire.” (2001: pp.198). The primary observation has been seen through the survey if homeowners and designers know what biomimicry is and whether they have and would use it.

3.6 DATA-COLLECTION METHOD

A qualitative data collection method through an online survey was given to four respondents. The questions have been signed off and accepted by the researchers supervisor and was conducted through an electronic google forum. It is important to know that there are advantages and disadvantages to this data collection method, because although it is effortless and quick to acquire the information, the information collected might not have been completely credible.

<u>Advantages are as follows;</u>

It is relatively cheap and easy to do.

Respondents can complete the questionnaire at a convenient time.

Respondents can check personal records if necessary.

There is no interviewer whose presence may affect the respondent.

<u>Disadvantages are as follows;</u>

Low response rates are very common.

The conditions under which the questionnaire is completed cannot be controlled.

No one can assist with problems the respondent may experience.
The respondent can give the questionnaire to someone else to complete.
Respondents must be literate.
(Research methods in education. 2001)

The design of the survey was an important part of the research process since this is the instrument with which the data is generated. The designing of a questionnaire requires the researcher to give attention to the appearance of questionnaire, question sequence, wording and response categories. The instructions and questions of the questionnaire were simple, clear and concise.

The collection of the data was as followed in the steps below.

Step 1: An email was sent to the four respondents as follows;

“Hello (Respondent name),

I was wondering if you would be interested in helping me out with my honours research project for varsity? All you would need to do is sign a consent form and fill out a quick survey.

If you don't have time I completely understand.

Kind regards
Alexia Morezzi”

Step 2: When the respondents all agreed the consent form and a link to the online survey was then sent to all of them.
Step 3: Consent firms were then collected after signed and the online surveys were completely shortly after.

Step 4: A friendly email thanking all the respondent was then sent out as follows;

“Hello (Respondent name),

Thank you so much for taking the time to help me.

Kind regards
Alexia Morezzi”

The researcher then moved forward with the data and started to dissect each answer in a hermeneutical method.

3.7 DATA ANALYSIS METHOD

Catherine Palmer (2001) believes the importance of ethnography is a tool for understanding and interpreting the users behaviour (*Ethnography: a research method in practice*). Ethnography and content analysis have been used by means of an open-ended online questionnaire to fully understand the homeowners and designers understanding and interpretation of biomimicry in residential design. Qualitative data analysis is a deconstructed methodology to the interpretation of the information collected and accumulated (Du Plooy-Cilliers, et el, 2014). The observations of the surveys then followed a hermeneutic and subjective approach. Figure five explains the data analysis process that the researcher needed to follow when starting to code all the data. According to Maree, K (2019) “Coding is the process of reading carefully through your transcribed data, line by line, and dividing it into meaningful analytical units."

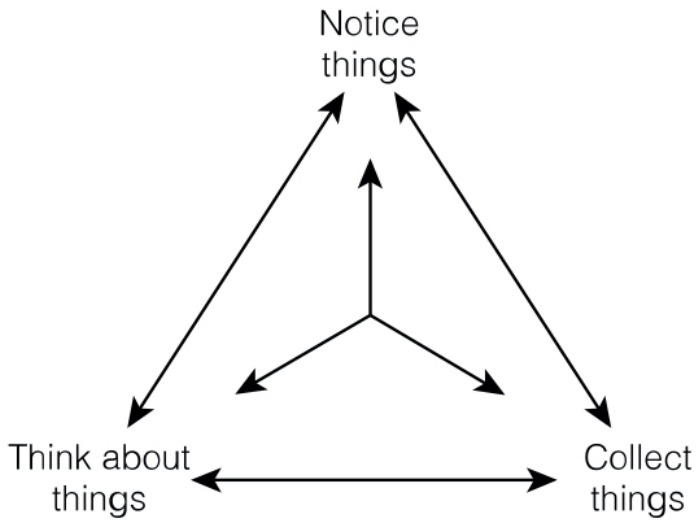


Figure 5: Data analysis process. Maree, K. 2019. *First Steps in Research*

3.8 VALIDITY , RELIABILITY & TRUSTWORTHINESS

In accordance with the qualitative research design of this study, trustworthiness requires an established characteristic to be supported. These characteristics are defined as follows credibility, dependability, transferability, and confirmability. (Du Plooy-Cilliers, et el, 2014).

Validity refers to the extent to which it measures what it is supposed to measure, specifically human emotions. According to research methods in education, (2001: pp239) “Reliability is if the same instrument is used at different times or administered to different respondents from the same population, the findings should be the same.” Therefore, reliability is the extent to which a measuring instrument is repeatable and consistent.

<u>The different types of reliability are:</u>

Test-retest reliability

Equivalent form reliability

Split-half or split-halves reliability

Internal reliability

(Research methods in education. 2001)

Credibility discusses the accuracy with which the researcher interprets the data (Du Plooy-Cilliers, et el, 2014). The researcher has prepare an in-depth description of the collected data and a review of the primary data has been shared with the researcher's supervisor to gain insight into the information collected and further receive and alternative perspective to the trustworthiness of the interpretations of the findings, please refer to annexure E, J and X for more clarity.

3.9 ANTICIPATED CONTRIBUTION

This study will hopefully add to the existing theories on what biomimicry is and how it should be used to add to the body of this knowledge. The researcher anticipates that the findings of this study can further add to the body of knowledge and interior design phenomenology. Therefore, the researcher hopes the study can explain why biomimicry isn't being used in residential homes specifically looking at a South African context.

3.10 ETHICAL CONSIDERATIONS

The questionnaire were first shown to supervisor for ethical clearance and to gain an alternative perspective. The primary ethical consideration for this study was that the research conducted was in a subjective view without the limitations of bias with, the research conducted with integrity to all institutions involved (Du Plooy-Cilliers, et el, 2014).

According to Laerd Dissertation the five principles of ethics that need to be followed are;

1. Gain confirmed consent.
2. Don't harm the participant.
3. Make it confidential and anonymous
4. Avoid using deceitful practises.
5. Give right to withdraw.

(2012. *Principles of research ethics)*

Written consent from the respondents were needed before moving forward with the questionnaire and under the observation of the researchers supervisor. A request of ethical authorisation for this study has been provided, please refer to annexure E, J and X for more clarity.

3.11 LIMITATIONS

The limitations of this research are that it would be hard finding residential buildings in South Africa that use biomimicry correctly. The researcher is also limited to go around South Africa and find buildings since the 2020 COVID-19 Pandemic has made the south African government create many restrictions of where people are allowed to go. It is, therefore, safe to say that the researcher was only able to conduct online surveys and online case studies were needed for this research paper.

3.12 CONCLUSION

Now that the methodology of the research paper has been discussed in great depth it should be clear for the reader to move on to the findings in chapter four and to gain a better understanding of the subjective opinion of the respondents along with the literature that will be rediscussed with the questions and objectives in mind.

4. CHAPTER FOUR- Findings

4.1 INTRODUCTION

The purpose of chapter four is to interpret the data that has been collected and essentially, report on the findings so that the primary and secondary research questions and objectives can be answered. This study is to determine the use of biomimicry in interiors with a focus on the South African residential industry. Four participants were given a survey based on biomimicry to determine their understanding and knowledge of what biomimicry is and if they would make use of it either in their designs or homes. The data was analysed using content analysis and was then compared to the related academic journals and articles that were used in the literature review to see if the findings are supported by the literature. This was a small-scale qualitative research study where there were 4 responses to the open-ended questionnaire that was completed. The surveys were conducted through a google forum and the questions were asked so that the primary and secondary questions could be understood better.

The Researcher has given four surveys out to, two homeowners, one interior designer and one architect to understand their knowledge of biomimicry in a residential context and formulate their reality of the phenomenology, therefore, an ontological position of interpretivism was the correct research method for this study (Du Plooy-Cilliers, et al, 2014). Additionally, an inductive approach has been included, as theoretical ideas have been discovered and a cross-sectional study has been applied. The researcher has grouped the questions in the table below, figure six, but the full questions can be seen in Annexure Y.

Primary Question	Secondary Questions	Questions
Is biomimicry being used in interiors with a focus on the South African residential industry?	Is there a basic understanding of what biomimicry is?	1. Do you know what the term biomimicry is and if so, please explain what your understanding of it?
		2. This is a basic description of biomimicry, with his what were the key things you took from it?
	What are the advantages and disadvantages of using biomimicry and why could this change peoples perception of using it?	3. Both homes have a similar design, but with the information given on each home which would you rather want to live in and why?
		4. Do you know of any residential or commercial designs that make use of biomimicry, if you do know any designs that made use of biomimicry, please explain what you thought of it and how it made you feel?
		5. Would you implement biomimicry in your own house or designs and please explain why?
		6. If more homes around you were designed through biomimicry making them different and unique, would you be comfortable living in that neighbourhood and please explain why?
		7. Why do you think Biomimicry hasn't been used more in residential homes?
	Can aspects of well-being and healthy living be seen through biomimicry?	8. With he knowledge you have now obtained of what biomimicry is please explain if you think biomimicry can create a healthier and more sustainable way of living?

Figure 6: Morezzi, A. 2021.Grouped questions. (Table by author)

4.2 PRESENTATION AND INTERPRETATION OF FINDINGS

4.2.1 Characteristics of respondents

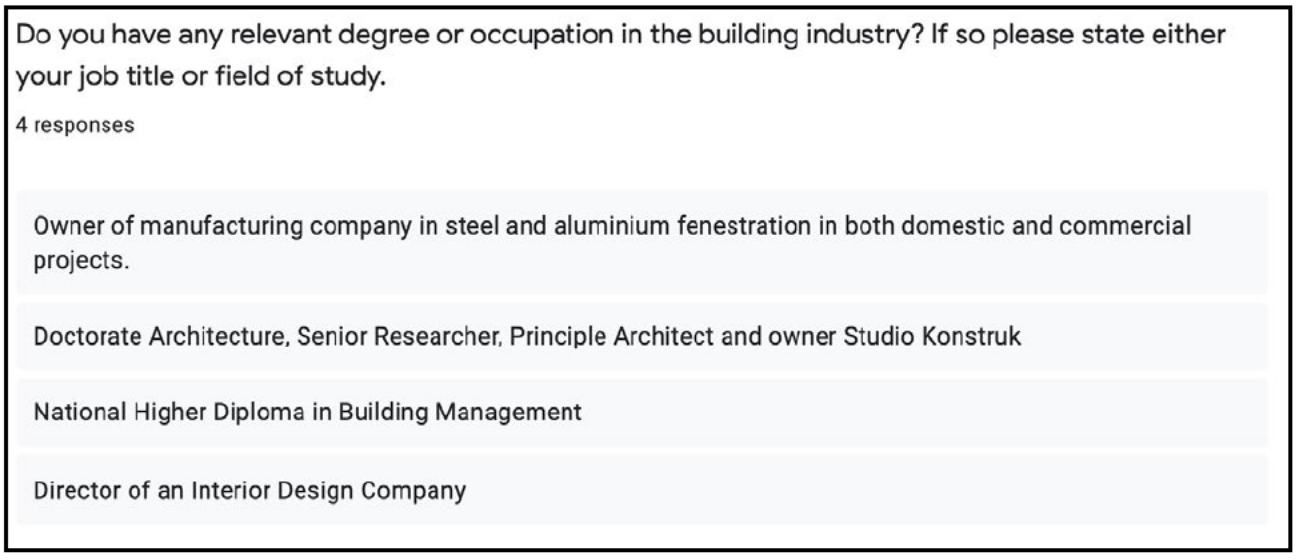
A total number of four respondents took part in the survey with each having some understanding and connection to the building industry. Respondents were made up of an Interior Designer, Architect, Building manager and a steel and aluminium manufacture. The criteria to participate in the survey was that respondents one and two had to be homeowners for more than 10 years and respondents three and four had to have more than three years of experience, this can all be seen again in figure four below.

Respondents	Qualifications	Method	Homeowner/Designer
Respondents 1	National Higher Diploma in Building Management	Google survey	Owned a home for 10+ years.
Respondents 2	Owner of manufacturing company in steel and aluminium fenestration in both domestic and commercial projects.	Google survey	Owned a home for 10+ years.
Respondents 3	Director of an Interior Design Company	Google survey	Been an interior designer for 3+ years.
Respondents 4	Doctorate Architecture, Senior Researcher, Principle Architect and owner Studio Konstruk	Google survey	Been an Architect for 3+ years.

Figure 4: Morezzi, A. 2021.Table of number of surveys given out and the sample group. (Table by author)

The following provides an exact description of respondents qualifications directly taken from the google survey.

QB:



Question B shows that each respondent has a different area of qualification but they are all still within the building industry as requested from the beginning.

4.2.2 Sub-Question 1

Is there a basic understanding of what biomimicry is?

This secondary question is particularly aimed at question one and two from the survey.

Q1:

Question 1: Do you know what the term biomimicry is and if so, please explain what your understanding of it?

4 responses

Yes, it is using natures natural methods and technics and adopting them in development and construction , such as thermal control , natural lighting and sound and many more.

IN context to the Built Environment: Modelling design or systems based on biology and nature - in architecture it is often merely matching form rather than function or value

No

Biomimicry refers to "copying" or taking inspiration from systems in nature to aid design

Q2:

Biomimicry: It is a practice that learns from and mimics the strategies used by species alive today. The goal is to create new ways of living that solve our greatest design challenges sustainably and in solidarity. It brings relief, can design generously and gets us to sustainable solutions faster. The Biomimicry institute says, “Biomimicry is about valuing nature for what we can learn, not what we can extract, harvest, or domesticate.” (2021: n.p). An example is how airliners were inspired by the eagle. Question 2: This is a basic description of biomimicry, with this what were the key things you took from it?

4 responses

shape and design, proportions , wing span and aerodynamics.

Biomimicry is about valuing nature for what we can learn, not what we can extract, harvest, or domesticate.” - I agree with that, however by merely copying the form of a subject and applying it to architecure does not add any intriic value to product. It is only an image of a working biological fact. We mist move beyond copy ad paste of form but integrate the function behind the form.

We can learn from nature and live a more sustainable way.

It allows us to get to sustainable solutions faster

Questions one and two showed that most respondents had a good idea of what biomimicry is and was also able to find keys components of it from question two very easily. They were able to explain and understand that it uses and mimics biology and nature to improve design as well as

living a more sustainable life. The second response from question two stood out the most, because the respondent says, “merely copying the form of a subject and applying it to architecture does not add any intricate value to products- we must move beyond copy and paste of form but integrate the function behind the form.” Therefore, it is a debate over 'form follows function’ or ‘function follows form.’

4.2.3 Sub-Question 2

What are the advantages and disadvantages of using biomimicry and why could this change peoples perception of using it?

This secondary question is particularly aimed at question three to seven from the survey.

Q3:

Below are two homes. Home 1 and home 2. Both are equally beautiful, modern and simple. Home 1: Designed by Openideas Architects as an intelligent, adaptable, and sustainable family home. Architecture features a solar sensor-based façade inspired by hexagonal structural patterns found in nature such as honeycombs and carbon crystals. Casting patterns that change with the path of the sun, the unique opening mechanism of the façade responds to light exposure and thermal comfort levels within the house. The entrance creates a bridge and valley experience, with a sunken court and stepped garden, a linear arrival corridor and a walkable green roof with varying slopes. The roof technically acts as thermal insulation itself, lowering the overall temperature of the interior while functionally doubling up as an area for social gathering. Inside, the spatial arrangement is open and fluid with minimal partition walls. Instead, a series of public, private, and semi-private zones are modulated within the outer envelope, along with a bespoke sculptural entrance vestibule. Materiality includes metal with SS powder coating for the façade, and wood and stone in the interior to bring a sense of warmth (Openideas Architects, 2020). Home 2: Lake Huron Modern Home in Ontario, Canada was designed by world-famed SAOTA and ARRCC in Modern style offers luxurious living 1,600 square meter from high-end finishes and luxurious amenities. This dream house was built from excellent home design combined by wonderful living room idea, dining room idea, kitchen idea, bedroom idea, bathroom idea, outdoor living idea and other great ideas (SAOTA, 2021). Question 3: Both homes have a similar design, but with the information given on each home which would you rather want to live in and why?

4 responses

Home no 1 , the thought functionality of 1 is better than no 2.

1 - sustainable approaches, carefull cosnideration to nature and material vs opulance

I like the look of home 2 but prefer the way building 1 has had more thought in the overall function and what it has to offer. It would also depend on the cost of each home.

Home 1 because it passively adapts to the enviroment which means it will be more comfortable and reduce energy expenses

Questions three had two images of two homes, home 1 made use of biomimicry and home 2 did not, but this information was not given to the respondents and was up to their interpretation. The question that was asked was which home they would rather live in and why. All respondents chose home 1 for its perfect functionality and passive adaption to the environment which could show a massive advantage to why people would use biomimicry principles over standard buildings principles. The only stand out point that was made, was that choosing the homes would depend greatly on overall costs.

Q4:

Question 4: Do you know of any residential or commercial designs that make use of biomimicry, if you do know any designs that made use of biomimicry, please explain what you thought of it and how it made you feel?

4 responses

Have not encountered or experienced such designs.

Not in South Africa - but international especial Asia ie. Beijing Stadium (birds nest) the aquatic centre etc... the ly in Asia

No I don't no any.

The olda sage builidng in Menlyn Maine (now currently called Aramist Place). It has louvres on the east and west side which react to the sun, sheilind direct sunlight from entering the building. It feels cool and comfortable inside.

Q5:

Question 5: Would you implement biomimicry in your own house or designs and please explain why?

4 responses

Yes, in nature most have a purpose and a valuable function.

I will consider the concept, but will only apply it where there is functional value and not mere aesthetic or feeling

Yes I would but would depend on building and long term costs and maintance.

Yes, because it will result in energy savings and a more comfortable living enviroment

Q6:

Question 6: If more homes around you were designed through biomimicry making them different and unique, would you be comfortable living in that neighbourhood and please explain why?

4 responses

Yes,

it will most likely be a more environmental considered area, so yes... but it is also likely to end meing more "POPART" copy paste... so a carefull mid way is crtical

Yes, as long as the buildings appearance were pleasing to the eye.

Yes, because I will have neighbours that value the environment

Q7:

Question 7: Why do you think Biomimicry hasn't been used more in residential homes?

4 responses

not very cost effective.

See my previous answers

I don't think many people know about it and I assume it would be expensive.

It's not standard practice because it is more expensive initially. It is difficult to convince developers to spend a lot in the construction phase to reduce running costs since often the developers are not the people occupying the space after it has been built so the cost saving will not be passed onto them

Questions four showed that most of the respondents, except for one, did not know of any buildings in South Africa that made use of biomimicry showing us that it's not a very common technique used in South Africa because even the mentioned example of the Aramist place wouldn't be easily distinguished as biomimicry unless one was extremely experienced in it. Question five however showed that the respondents would make use of biomimicry in their own homes and designs because it will be more energy effective and create a comfortable living environment that learnt from nature, but it must follow function more than aesthetics and the cost and maintenance must be reasonable. In question six the respondents all agreed that they would live in an area that made use of biomimicry because they would live in an area that people valued the environment but the major concern was that it would need to be aesthetically pleasing and functional not just tacky or marked by lack of style, copy and paste. Question seven shows all the disadvantages of what people believe biomimicry to be, such as, copy and paste of design not function, lack of knowledge and most important not being cost-effective.

4.2.4 Sub-Question 3

Can aspects of well-being and healthy living be seen through biomimicry?

This secondary question is particularly aimed at question eight from the survey.

Q8:

Question 8: With the knowledge you have now obtained of what biomimicry is please explain if you think biomimicry can create a healthier and more sustainable way of living?

4 responses

Yes, you will be using natural elements such as the sun or wind to generate electricity, warmth etc.
it can cause more focused and concerned environmental approaches, but not necessary healthier buildings perse.
Yes, I think it can definitely have a huge positive impact on the environment.
Yes it can. It makes sense to use systems that nature has designed to design our houses

Questions eight showed that everyone believes biomimicry can create a more suitable way of living because it is important to use systems that nature has designed and possess to create a positive impact on the environment, however response two does not necessarily believe it can create healthier buildings necessary, therefore, that is definitely something the researcher can look into further.

4.3 FINDINGS IN CONTEXT

This study contributes to the existing literature on specifically Evidence-based design, Place context and biomimicry. It examines the principles and a basic understanding of each heading. The current literature was divided under three headings and the sub-questions were then individually discussed under each heading. These three headings will each be discussed to support the research objectives and findings. The researcher has chosen the following seminal authors for the research project as they use a subjective design approach and have broadened the knowledge of the research paper. The purpose of this section is to provide evidence that the study is relevant and could have positive long term effects on the environment. The results of this study primarily conform to other existing studies, however, it provides new explanations for the residential industry. The literature has already been discuss in chapter two but will be briefly discussed again but this time with the findings in mind. Figure one has been updated to show how the questions correlate with the literature and theories.

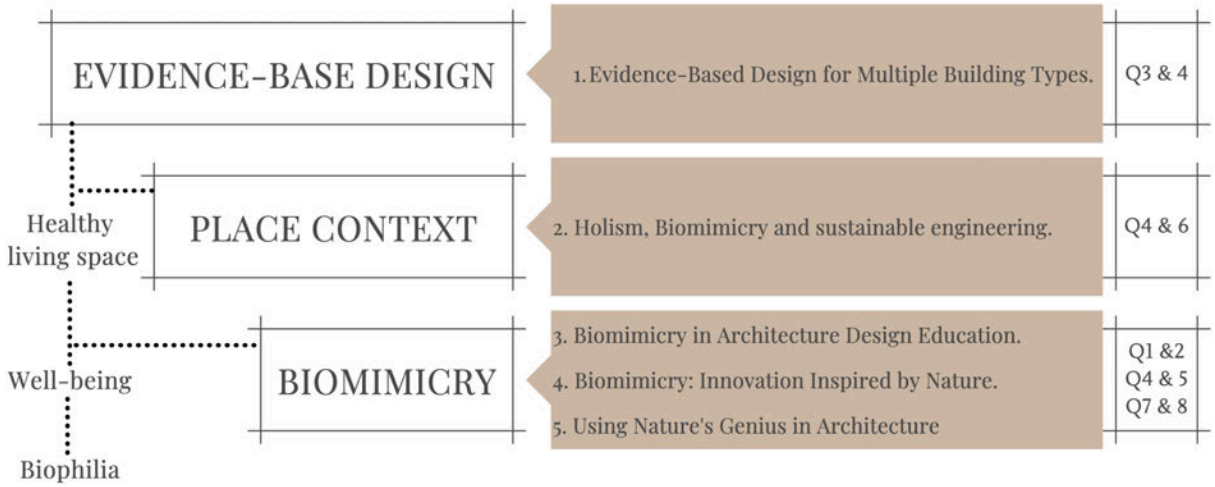


Figure 1B: Morezzi, A. (2021) Diagram of how the theories, concepts and literature review work together with the questions asked. (Table by author)

4.3.1 Evidence based design

4.3.1.1 The book 'Evidence-based design for multiple building types' starts with who and what an architect and designer is and why clients would rather use cheaper and more affordable ways of getting plans and render images. This is because clients often doubt the capabilities of architects. Therefore a new way of thinking has to be considered and this book looks specifically at evidence-based design and how it benefits the client. Question three and four were asked to get an understanding of the users/respondents and see how biomimicry makes them feel and if they believed it could improve the mental and physical well-being of people. Each respondent did believe that it could be more sustainable and healthier, therefore, linking it with what Hamilton says a designer must recognise and respond to the unique context of each project, require critical thinking and must have a moral obligation to honour their sacred trust to protect public safety and health of the client (Hamilton, D. and Watkins, D. 2009).

4.3.2 Place context

4.3.2.1 Michael Pawlyn in his TED talk talks about using Nature's Genius in Architecture, (2021) In this talk, he describes how designers could transform architecture and save resources and energy using biomimicry. He explains that to make progress with sustainability, designers need to have a radical increase in resource efficiency, a shift from a wasteful, polluting way of using resources to a closed-loop model and changing from a fossil fuel economy to a solar economy. Question four and six were asked to see if people knew of any biomimicry designs in South Africa and if they would be comfortable with more homes around them. Most respondents didn't know of any in South Africa and all the respondents said they would be comfortable with living in a biomimetic neighbourhood because it goes back to place context where the area would become a more environmentally considered area and the designers would have to study the land so that the buildings could adapt better. Michael uses an example of the Eden project where they had to create a greenhouse in a sight that wasn't only irregular but also continually changing, and it was soap bubbles that helped them generate a building form regardless of the final ground levels and studying pollen grains to create the best structural vision using hexagons and pentagons (Pawlyn, M. 2021).

4.3.3 Biomimicry

4.3.3.1 In the journal on 'Biomimicry in Architectural Design Education' (2015), it is explained that in sciences, nature is used as a guiding spirit and that biomimicry is a domain that exists through imitation and observation of nature. Question seven and eight were asked to see why people biomimicry isn't being used more in homes and if they believe it can have a positive effect and the respondents believe biomimicry can sometimes just be a copy and paste of design, not function, that there is a lack of knowledge on it, that it is not cost-effective and that it can be sustainable, but both biomimicry and biomimetic are new sciences that observe the materials in nature and then aim to produce solutions for humans by imitating these designs or by taking inspiration from them. This point of inspiration shows that biomimicry is in the field of architecture, with form, structure and texture (Tavsan, C., Tavşan, F. and Sonmez, E. 2015) to create better-living conditions not simply just copying it.

4.3.3.2 The journal 'Holism, Biomimicry and Sustainable Engineering' (Reap, J., Baumeister, D. and Bras, B. 2008) discusses the socially beneficial and profitable products Page 18 of 28 of biomimetic design that restores and leaves the environment undamaged and inherently creates a healthy regenerative living world. Question four and five were asked to see how they felt in buildings that used biomimicry and why they would use it in their own homes and design. The respondent that had seen a biomimetic building said it made them feel cool and comfortable and all the respondents agreed that it would create a green and more sustainable way of living. This is why the journal initiates a guiding framework for designers interested in the utilisation of biomimicry's potential as a sustainable design tool and encourages designers and engineers to make use of it.

4.3.3.3 Janine Benyus is known for her research and ideas on biomimicry and, therefore, looking specifically at her book 'Biomimicry: Innovation Inspired by nature' it can be seen that biometrics is a new science that observes nature's best ideas and adapts them for human use. Janine Benyus says, "Nature, imaginative by necessity, has already solved the problems we are struggling to solve" (1997: p.230). Question one and two were asked to get an understanding of what the respondents knew and thought about biomimicry and what most of them said was also what Janine Benyus speaks about but they can also learn more from her book specifically the four steps to a biomimetic future, a) Quieting: Immerse ourselves in nature, b) Listening: Interview the flora and fauna of our planet, c) Echoing: Encourage biologists and engineers to collaborate, using nature as a model and measure and d) Stewarding: Preserve life's diversity and genius (1997).

4.4 RESEARCH QUESTION / OBJECTIVES ADDRESSED

The purpose of this study was to see if biomimicry was being utilised within the South African residential industry. This section includes how the findings have answered the research questions and how the research objectives have been somewhat reached.

4.4.1 Primary Question

Is biomimicry being used in interiors with a focus on the South African residential industry?

In the findings, it was found that many people either didn't know much about biomimicry or that they believe it is too expensive, complicated and copies and pastes. A full explanation of this can be found above in the previous section.

4.4.2 Secondary Questions

1. *Is there a basic understanding of what biomimicry is?*
2. *What are the advantages and disadvantages of using biomimicry and why could this change peoples perception of using it?*
3. *Can aspects of well-being and healthy living be seen through biomimicry?*

The findings show that majority of respondents have a positive attitude toward Biomimic design and know the advantages and disadvantages that come with it. They also believe that it can lead to a more sustainable way of living which could later create better well-being and healthy living for the users. The only problem that puts the respondents against biomimicry was the lack of knowledge on buildings in South Africa that use it and that the process can be an expensive one.

4.4.3 Primary Objective

To determine the utilisation of biomimicry in interiors with a focus on the South African residential industry.

The survey showed that out of the four respondents only one knew of a building that makes use of biomimicry the others did not, therefore, this could show a lack of biomimicry being used at all throughout of South Africa not just in the residential industry.

4.4.4 Secondary Objectives

1. *To determine, how and why people will be more comfortable in biomimicry houses and how this could have a global impact further down the line.*
2. *To show the long term effects the residential buildings will have on the homeowners and the environment.*
3. *To describe how it can be implemented to maximise the full healthy living space for homeowners through human centred design.*

Fundamentally, this study wishes to explore why biomimicry isn't being used in South African residential design as well as looking at the benefits it could have on the users well- being and the overall environment of the planet now and even years down the line. This is why designers should be educating and encouraging their clients to consider using biomimicry.

4.5 CONCLUSION

This chapter provides insight into peoples understanding of what biomimicry is and how and why it should be used more in the South African residential industry. Throughout this chapter, the data that was collected was by means of an open-ended survey. Thereafter the data findings were presented, interpreted and reported on. The findings found within the data were expanded on and linked to the literature review. The research findings can help designers and homeowners to be more interested in biomimicry and implement it more in their homes and designs for a more regenerative way of design thinking. The findings of this study, therefore, should inspire the design industry to be proactive in using biomimicry principles in South African residential design. However, there is still no clear understanding of whether or not biomimicry is being used in interiors specifically for a South African residential context.

B. OVERALL CONCLUSION

A new study shows that interior designers have a major impact on climate change as it's been widely reported that the building and construction industry makes up about 40 percent of the world's carbon emissions, but interiors have largely been thought to make up only a small part of that percentage. Over the course of an average building's life span, the carbon footprint of its interiors will equal if not exceed that of the structure's construction. "It isn't just that you complete a building and then the carbon footprint stays the same for the 60 years it's used," says Anderson (2020: n.p). The building will always have a high maintenance percentage because the wear and tear will continuously increase as the building gets older. This is why either the building should be built with regenerative principles from the start or adaptive reuse should become a number one priority.

"People are renovating the interiors much more often than that, and that has its own impact each time. Overall, when you combine the A&D industry coupled with the building industry, it has the same impact on climate change as the oil industry. That's a massive footprint, and we need to take responsibility for." (2020: n.p). Companies like Microsoft pledged to become carbon negative by 2030. Salesforce has also committed to undertaking zero-carbon certification for all its workplaces, but this might not be enough if more companies don't start doing the same thing. According to Chen (2020), FF&E tends to have the shortest life cycle of any aspect of a building, as well as the highest amount of embodied carbon. Refurbishing existing pieces or sourcing vintage items locally can add tremendously to the life cycle of furniture and cut down on a product's overall carbon footprint.

In conclusion, the research has show how biomimicry in residential design can better the users well-being in the space as well as the long term effects it could have on the environment. Buildings are an element that need to continuously change and be adapted according to humans and their needs, but it needs to be consider why there or some building that constantly improve and others that don't, there is always a focus on the final façade of a building and not often enough on the maintenance and actual functionality, it is important that buildings always have a purpose and a

function, there needs to be an understanding of what the long term effects buildings will have on users and the environment and the research survey has now help contribute to the understanding of this and whether or not it can be possible. However, after all of the extensive research done by the researcher, it still is not clear whether biomimicry is being used in residential designs in South Africa. All that is know is that biomimicry is not being used enough and that not many people can actually name a building in South Africa that makes use of biomimicry unless it is a new commercial building. If commercial buildings can make use of biomimicry than so can any other buildings or even design and it shouldn't just stop at buildings if we can stop the short life cycle of FF&E by creating better biomimic designs with recycled materials that can also have a major impact on the overall decrease of the carbon footprints being released from the building then the user and the environment will benefit from it greatly, not just now but for many years to come.

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Annexure A: Concept Document Template
Provisional title: The use of biomimicry in interiors with a focus on the South African residential industry

Research Purpose/ Objective	Primary Research Question	Research Rationale	Seminal Authors/ Sources	Literature Review – Conceptual Framework	Paradigm	Approach	Data Collection Method(s)	Ethics	Anticipated Findings	References
The purpose of this study is to understand whether or not Biomimicry is being used in residential interiors specifically in South African. By using this study I want to make it clear why biomimicry should be used more in homes and not just commercial design.	Is biomimicry being utilised in the interior design industry within a South African context?	It is of logical opinion that the potential of Biomimicry in residential design buildings can promote healthy living spaces and just be a more sustainable way of living and building.	Hamilton and Watkins. Michael Pawlyn. Tavsan and Sonmez. Reap, Baumeister and bras. Janine Benyus	Evidence-based design for multiple building types. Nature's Genius in Architecture. Biomimicry in Architectural Design Education. Holism, Biomimicry and sustainable engineering Biomimicry: Innovation Inspired by Nature.	Interpretivism Critical Realism Subjective Ontology Axiology Historical hermeneutic science	Qualitative Population A survey will be given to three homeowners and three interior designers to understand what they believe biomimicry is and if they would make use of it.	A qualitative data collection method with the use of a questionnaire.	The questionnaire will be anonymous and shown to the supervisor for an alternative perspective before given to the respondents.	Whether biomimicry is used in interior design residential buildings in South African?	El-Zeiny, R. Rossin, K. CengizTavsan Assoc.Prof & FilizTavsanAssoc.Prof Weston.R, (2012) Biomimicry Institute (2006) Palmer, C Benyus, J Du Plooy-Cilliers, F., Davis, C. and Bezuidenhout, R., 2014. Laerd dissertation. 2012. Maree, K. 2019. Marina, C., 2017
Research Problem	Secondary Questions/ Hypotheses/ Objectives	Key Concepts	Key Theories			Sampling	Data Analysis Method(s)	Limitations	Anticipated Contribution	
Biomimicry isn't used enough in residential buildings, but mainly in commercial design and I want to discover why that is and how it can be more beneficial to use it in both designs.	What is biomimicry in a design context? How do biophilia and biomimicry work together. Which aspects of well-being can be seen through biomimicry?	Well-being Healthy living space Biophilia	EBD-Evidence based design Placed context Biomimicry			Non-probability sampling. Purposeful Sampling method. Survey with homeowners and interior designers.	Content analysis will be used along with the use of a survey to fully understand individuals opinions on biomimicry and how it is used in residential design.	Finding residential buildings in South Africa that use biomimicry correctly.	This study will hopefully add to the existing theories on what biomimicry is and how it should be used to add to the body of this knowledge.	

ANNEXURE E – RESEARCH REQUEST FORM (IIE007)

REQUEST TO CONDUCT RESEARCH ON OR ABOUT STUDENTS, STAFF, SITES OF ARTEFACTS OF THE INDEPENDENT INSTITUTE OF EDUCATION (THE IIE)

General instructions:

- This is a non-editable form; only ungreyed fields in the tables can be filled in. Some fields provide spaces for ticks, while others provide spaces for text to be entered or dates to be selected.
- Context-specific instructions appear in some sections.
- Only tick relevant boxes. All relevant dates must be selected by those and only those to which the date selection is relevant. Not all text fields will be relevant to all candidates. Where a text field is not, please mark it with an 'N/A' to indicate that the empty field was not overlooked.
- Text fields, though small in appearance, automatically expand as required by the text. Tables are also adjusted accordingly as a result.
- Headings and contextual delimitation appear in black text in the tables. The text you insert in the applicable fields in the tables will appear in blue. This cannot be changed.

Note for candidates who are not affiliated to The IIE as a student, staff member or contractor:
This form, and all other relevant documentation, should be completed and forwarded electronically to research@iie.ac.za and marked for the attention of the Dean: Research and Postgraduate Studies. Where applicable, you must provide the required accompanying documentation with this form, such as an ethics clearance certificate, a participant or respondent consent form and your measurement instrument.

Note for candidates affiliated to The IIE as a student, staff member or contractor:
Find out who the person responsible for managing research is at your campus. It is their job to send your completed research request form to the office of the Dean: Research and Postgraduate Studies. Where applicable, you must provide the required accompanying documentation with this form, such as an ethics clearance certificate, a participant or respondent consent form and your measurement instrument.

About the researcher												
Title	Prof	☐	Dr	☐	Ms	☒	Mrs	☐	Mr	☐	Mx	☐
First name(s)	Alexia											
Last name	Morezzi											
Student number *(if applicable)*	[redacted]											
SA ID number	[redacted]											
Passport number *(if applicable)*	Not applicable											
Home address							Postal address					
[redacted]							*Tick if same as home address*	☒				
[redacted]							Click or tap here to enter text.					
Code:	[redacted]						Code:	Insert code.				
Telephone number	Not applicable						Cell phone number	[redacted]				
Email	[redacted]											

About the researcher's affiliations

Institutional affiliation *If research forms part of a qualification or institutionally sanctioned research project*													
Institution enrolled at	Vega, Pretoria.												
Qualification name	BA Honours Interior Design												
Faculty or area of study	Art & design												
About the supervisor or promoter													
Title	Prof	☐	Dr	☐	Ms	☐	Mrs	☐	Mr	☒	Mx	☐	
First and last names	JD Eksteen												
Email address	[redacted]												
Corporate or organisational affiliation *If the research forms part of a project sanctioned by a company or association or organisation*													
Employer	Vega												
Physical address	[redacted]												
	Code [redacted]												
Contact number	[redacted]												
Researcher's position or designation	Honours Student												
About the head of the company, association or organisation													
Title	Prof	☐	Dr	☒	Ms	☐	Mrs	☐	Mr	☐	Mx	☐	
First and last names	Ria Van Zyl												
Email address	[redacted]												
Researcher's position or designation	Head of research committee/ Honours coordinator												

About the research		
Purpose of the proposed research *Tick the appropriate option*	Undergraduate study	
	Postgraduate study	
	Private company or agency	
	IIE Celebrate Teaching and Learning	
	Other *(if other, explain below)*	
	Postgraduate study	
Qualification or output type *For example, a Master's degree or a journal article*	Honours Research paper	
Full title of the research	The use of biomimicry in interiors with a focus on the South African residential industry.	
Value of the research	To understand why Biomimicry isn't being used in residential design	
Proposed date of completion	2021/11/29	
Proposed date of submission of research findings to The IIE	2021/09/13	

About the methodology *Indicate by ticking the appropriate block and answering the relevant sections.*					
Questionnaire	☒	***Interviews***	☐	***Observations***	☐
Existing	☐	Structured	☐	*Number of observations*	...
Own	☒	Semi-structured	☐	*Note what will be observed.*	

Open-ended	☒	*Number of interviews*	1	Click or tap here to enter text.	
Number of respondents	6	Focus group or workshop	☐		
Briefly identify, describe or explain the questionnaire. The questionnaire/survey will be used to understand why biomimicry isn't be used and if people understand what it is.		*Participants per focus group*	...		
		Number of focus groups	...		
		Briefly expand on the interview, workshop or focus group questions. Click or tap here to enter text.			
Purposive	☒	Random	☐	Snowball	☐
Convenient	☒	Stratified	☐	Census	☐
Other *(if so, state)*		Not applicable			
Other methods *If so, state the method and expand on how it will be used*		Not applicable			
List of the student or staff groups, sites or artefacts under study		Not applicable			
Average time participants or respondents will be involved in research activities		Three homeowners and three interior design professionals.			

About the ethics considerations for the research						
Aspects considered	Informed consent	☒	Anonymity	☒	Confidentiality	☒
	Committed to give feedback on the study	☒	Voluntary participation	☒	Vulnerable group involved	☐
	Elaborate on vulnerable groups		Not applicable			
Documentation submitted with proposal* *Select the applicable options*	Ethics clearance certificate or letter					☒
	Instrument(s) (interview schedule or questionnaire)					☒
	Participant or respondent consent form that includes information sheet for participants or respondents					☒
	Audio-visual consent form (if applicable)					☐

Conditions for conducting research on or about students, staff, sites or artefacts of The Independent Institute of Education

1. A copy of the final paper must be submitted electronically to The IIE's Dean for Research and Postgraduate Studies at research@iie.ac.za no later than 30 days post finalisation.
2. The researcher(s) is not permitted to either refer to The IIE or any of its educational brands or to the name, logo, brand or any other identifiers of The IIE or any of its educational brands in any way, including, but not limited to, in questionnaires, surveys, interviews, proposal or research reports. The IIE or educational brand in question must be referred to in a generic manner, for example, 'A private provider'.
3. The researcher(s) will need to obtain informed consent in writing from all of the participants in his/ her sample if the study is not anonymous.
4. If the Learning Management System (LMS) of The IIE is used, the researcher(s) is not permitted to refer to it by name. Learn needs to be referred to in a generic manner, for example "the Learning Management System of a Higher Education provider."
5. A copy of this letter must be forwarded to the relevant person(s) at the brand or The IIE that would be involved in the study.
6. Research must be conducted in such a way that the normal programme and operations of the site/ offices is not interrupted.

7.	The principal/ manager of a site must be consulted about an appropriate time when the researcher(s) may carry out the research at the site.
8.	The researcher(s) may only use this data for these research purposes and in no other way.
9.	Should the researcher(s) wish to publish this research or in any way make the results public, for example by publishing the results on a social media platform, this committee will need to approve a request to this end first.
10.	No names or identifying information of participants may be used within the research and the research must be voluntary.
11.	Photographs of human subjects may only be taken if relevant to the research and informed consent from the participants or respondents was obtained, and, even with informed consent, the photographs may not be published.
12.	The researcher is responsible for supplying and utilising his/ her own research resources, such as stationery, photocopies, transport, faxes and telephones and should not depend on the goodwill of the institutions or the offices visited for supplying such resources.
13.	If any of The IIE reports or policies are used as part of the research, all identifying information needs to be removed.
14.	Please make it clear that the information will not be used punitively in any way and participants may in no way be counselled or advised based on this.
15.	The reference number of the permission letter, if permission is granted, must appear, in one format or another, on all research documentation distributed amongst IIE staff or students.

Declaration by the researcher	
1. I declare that all statements made by myself in this application are true and accurate; and 2. I accept the conditions associated with the granting of approval to conduct research and undertake to abide by them.	
X _____	2021/06/17
Signature of the researcher	**Date**

Declaration by the supervisor/promoter/lecturer	
I declare that	
1. the above researcher is enrolled at the institution/ employed by the organisation to which the undersigned is attached; 2. and that the research proposal and or study has been approved by the Ethics Committee of The Independent Institute of Education; and 3. and that the questionnaires/structured interviews/tests meet the criteria of: • Educational accountability; • Proper research design; • Sensitivity towards participants; • Correct content and terminology; • Acceptable grammar; and • Absence of non-essential/superfluous items.	
X _____	Click or tap to enter a date.
Signature of the supervisor/promoter/lecturer	**Date**

THE INDEPENDENT INSTITUTE OF EDUCATION

CONSENT FORM

Explanatory information sheet and consent form for participants
To whom it may concern, My name is Alexia Morezzi and I am a student at Vega, Pretoria. I am currently conducting research under the supervision of JD Eksteen about the utilisation of biomimicry in interiors with a focus on the South African residential industry. I hope that this research will enhance our understanding of what biomimicry is and how and why it should be used not only for the occupants well-being but the overall difference it can make towards the environment. I would like to invite you to participate in my study. In order to explain to you what your participation in my study will involve, I have formulated questions that I will try to fully answer so that you can make an informed decision about whether or not to participate. If you have any additional questions that you feel are not addressed or explained in this information sheet, please do not hesitate to ask me for more information. Once you have read and understood all the information contained in this sheet and are willing to participate, please complete and sign the consent form below.
What will I be doing if I participate in your study?
I would like to invite you to participate in this research because I would like to see if homeowners know what biomimicry is and how they would like it applied to their homes. If you decide to participate in this research, I would like to ask if you could please just fill out an online survey. You can decide whether or not to participate in this research. If you decide to participate, you can choose to withdraw at any time or to decide not to answer particular interview questions.
Are there any risks/ or discomforts involved in participating in this study?
Whether or not you decide to participate in this research, there will be no negative impact on you. There are no direct risks or benefits to you if you participate in this study. You might, however, indirectly find that it is helpful to talk about your responses. If you find at any stage that you are not comfortable with the line of questioning, you may withdraw or refrain from participating.
Do I have to participate in the study?
• Your inclusion in this study is completely voluntary; • If you do not wish to participate in this study, you have every right not to do so; • Even if you agree to participate in this study, you may withdraw at any time without having to provide an explanation for your decision.
Will my identity be protected?
I promise to protect your identity. I will not use your name in any research summaries to come out of this research and I will also make sure that any other details are disguised so that nobody will be able to identify you. Nobody else, including anybody at Vega, Pretoria, will have access to your

interview information. I would like to use quotes when I discuss the findings of the research, but I will not use any recognisable information in these quotes that can be linked to you.

What will happen to the information that participants provide?

Once I have finished all interviews, I will write summaries to be included in my research report, which is a requirement to complete my BA Honours in Interior Design. You may ask me to send you a summary of the research if you are interested in the final outcome of the study.

What happens if I have more questions about the study?

Please feel free to contact me or my supervisor should you have any questions or concerns about this research, or if there is anything you need to know before you decide whether or not to participate.
You should not agree to participate unless you are completely comfortable with the procedures followed.

My contact details are as follows:
Alexia Morezzi
[redacted]

The contact details of my supervisor are as follows:
JD Eksteen
[redacted]

Participant or respondent consent

I, [redacted], agree to participate in the research conducted by Alexia Morezzi about the utilisation of biomimicry in interiors with a focus on the South African residential industry.

This research has been explained to me and I understand what participation in this research will involve. I understand that:

- I agree to be interviewed for this research.
- My confidentiality will be ensured. My name and personal details will be kept private.
- My participation in this research is voluntary and I have the right to withdraw from the research at any time. There will be no repercussions should I choose to withdraw from the research.
- I may choose not to answer any of the questions that are asked during the research interview.
- I may be quoted directly when the research is published, but my identity will be protected.

[redacted]	8/08/2021
Signature	**Date**

THE INDEPENDENT INSTITUTE OF EDUCATION

CONSENT FORM

Explanatory information sheet and consent form for participants
To whom it may concern, My name is Alexia Morezzi and I am a student at Vega, Pretoria. I am currently conducting research under the supervision of JD Eksteen about the utilisation of biomimicry in interiors with a focus on the South African residential industry. I hope that this research will enhance our understanding of what biomimicry is and how and why it should be used not only for the occupants well-being but the overall difference it can make towards the environment. I would like to invite you to participate in my study. In order to explain to you what your participation in my study will involve, I have formulated questions that I will try to fully answer so that you can make an informed decision about whether or not to participate. If you have any additional questions that you feel are not addressed or explained in this information sheet, please do not hesitate to ask me for more information. Once you have read and understood all the information contained in this sheet and are willing to participate, please complete and sign the consent form below.
What will I be doing if I participate in your study?
I would like to invite you to participate in this research because I would like to see if homeowners know what biomimicry is and how they would like it applied to their homes. If you decide to participate in this research, I would like to ask if you could please just fill out an online survey. You can decide whether or not to participate in this research. If you decide to participate, you can choose to withdraw at any time or to decide not to answer particular interview questions.
Are there any risks/ or discomforts involved in participating in this study?
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You should not agree to participate unless you are completely comfortable with the procedures followed.

My contact details are as follows:

Alexia Morezzi

[redacted]

The contact details of my supervisor are as follows:

JD Eksteen

[redacted]

Participant or respondent consent

I, [redacted], agree to participate in the research conducted by Alexia Morezzi about the utilisation of biomimicry in interiors with a focus on the South African residential industry.

This research has been explained to me and I understand what participation in this research will involve. I understand that:

- I agree to be interviewed for this research.
- My confidentiality will be ensured. My name and personal details will be kept private.
- My participation in this research is voluntary and I have the right to withdraw from the research at any time. There will be no repercussions should I choose to withdraw from the research.
- I may choose not to answer any of the questions that are asked during the research interview.
- I may be quoted directly when the research is published, but my identity will be protected.

[redacted]	09/08/2021
Signature	Date

THE INDEPENDENT INSTITUTE OF EDUCATION

CONSENT FORM

Explanatory information sheet and consent form for participants
To whom it may concern, My name is Alexia Morezzi and I am a student at Vega, Pretoria. I am currently conducting research under the supervision of JD Eksteen about the utilisation of biomimicry in interiors with a focus on the South African residential industry. I hope that this research will enhance our understanding of what biomimicry is and how and why it should be used not only for the occupants well-being but the overall difference it can make towards the environment. I would like to invite you to participate in my study. In order to explain to you what your participation in my study will involve, I have formulated questions that I will try to fully answer so that you can make an informed decision about whether or not to participate. If you have any additional questions that you feel are not addressed or explained in this information sheet, please do not hesitate to ask me for more information. Once you have read and understood all the information contained in this sheet and are willing to participate, please complete and sign the consent form below.
What will I be doing if I participate in your study?
I would like to invite you to participate in this research because I would like to see if homeowners know what biomimicry is and how they would like it applied to their homes. If you decide to participate in this research, I would like to ask if you could please just fill out an online survey. You can decide whether or not to participate in this research. If you decide to participate, you can choose to withdraw at any time or to decide not to answer particular interview questions.
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I promise to protect your identity. I will not use your name in any research summaries to come out of this research and I will also make sure that any other details are disguised so that nobody will be able to identify you. Nobody else, including anybody at Vega, Pretoria, will have access to your

interview information. I would like to use quotes when I discuss the findings of the research, but I will not use any recognisable information in these quotes that can be linked to you.

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Once I have finished all interviews, I will write summaries to be included in my research report, which is a requirement to complete my BA Honours in Interior Design. You may ask me to send you a summary of the research if you are interested in the final outcome of the study.

What happens if I have more questions about the study?

Please feel free to contact me or my supervisor should you have any questions or concerns about this research, or if there is anything you need to know before you decide whether or not to participate.
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My contact details are as follows:
Alexia Morezzi
[redacted]

The contact details of my supervisor are as follows:
JD Eksteen
[redacted]

Participant or respondent consent

I, [redacted], agree to participate in the research conducted by Alexia Morezzi about the utilisation of biomimicry in interiors with a focus on the South African residential industry.

This research has been explained to me and I understand what participation in this research will involve. I understand that:

- I agree to be interviewed for this research.
- My confidentiality will be ensured. My name and personal details will be kept private.
- My participation in this research is voluntary and I have the right to withdraw from the research at any time. There will be no repercussions should I choose to withdraw from the research.
- I may choose not to answer any of the questions that are asked during the research interview.
- I may be quoted directly when the research is published, but my identity will be protected.

[redacted]	13-08-2021
Signature	**Date**

THE INDEPENDENT INSTITUTE OF EDUCATION

CONSENT FORM

Explanatory information sheet and consent form for participants
To whom it may concern, My name is Alexia Morezzi and I am a student at Vega, Pretoria. I am currently conducting research under the supervision of JD Eksteen about the utilisation of biomimicry in interiors with a focus on the South African residential industry. I hope that this research will enhance our understanding of what biomimicry is and how and why it should be used not only for the occupants well-being but the overall difference it can make towards the environment. I would like to invite you to participate in my study. In order to explain to you what your participation in my study will involve, I have formulated questions that I will try to fully answer so that you can make an informed decision about whether or not to participate. If you have any additional questions that you feel are not addressed or explained in this information sheet, please do not hesitate to ask me for more information. Once you have read and understood all the information contained in this sheet and are willing to participate, please complete and sign the consent form below.
What will I be doing if I participate in your study?
I would like to invite you to participate in this research because I would like to see if homeowners know what biomimicry is and how they would like it applied to their homes. If you decide to participate in this research, I would like to ask if you could please just fill out an online survey. You can decide whether or not to participate in this research. If you decide to participate, you can choose to withdraw at any time or to decide not to answer particular interview questions.
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What will happen to the information that participants provide?
Once I have finished all interviews, I will write summaries to be included in my research report, which is a requirement to complete my BA Honours in Interior Design. You may ask me to send you a summary of the research if you are interested in the final outcome of the study.
What happens if I have more questions about the study?
Please feel free to contact me or my supervisor should you have any questions or concerns about this research, or if there is anything you need to know before you decide whether or not to participate. You should not agree to participate unless you are completely comfortable with the procedures followed. My contact details are as follows: Alexia Morezzi [redacted] The contact details of my supervisor are as follows: JD Eksteen [redacted]

Participant or respondent consent	
I, [redacted], agree to participate in the research conducted by Alexia Morezzi about the utilisation of biomimicry in interiors with a focus on the South African residential industry. This research has been explained to me and I understand what participation in this research will involve. I understand that: • I agree to be interviewed for this research. • My confidentiality will be ensured. My name and personal details will be kept private. • My participation in this research is voluntary and I have the right to withdraw from the research at any time. There will be no repercussions should I choose to withdraw from the research. • I may choose not to answer any of the questions that are asked during the research interview. • I may be quoted directly when the research is published, but my identity will be protected.	
[redacted]	17/08/2021
Signature	**Date**

Annexure X

THE INDEPENDENT INSTITUTE OF EDUCATION

Vega Ethics checklist: RESE8419/p/w

Student Details												
Title	Prof	☐	Dr	☐	Ms	☒	Mrs	☐	Mr	☐	Mx	☐
First name(s)	Alexia											
Last name(s)	Morezzi											
Title of study	BA Interior Design											
Qualification	Honours											

Supervisor Details												
Title	Prof	☐	Dr	☐	Ms	☐	Mrs	☐	Mr	☒	Mx	☐
First and last names	JD Eksteen											
Co-supervisor Details (if applicable)												
Title	Prof	☐	Dr	☐	Ms	☐	Mrs	☐	Mr	☒	Mx	☐
First and last names	Armand Meyer											

Explaining your research process						
Philosophical paradigm	Positivism	☐	Interpretivism	☒	Constructivism	☐
	Realism	☐	Objectivism	☐	Pragmatism	☐
	Functionalist	☐	Subjectivism	☒	Humanist	☐
	Other:					
Research design:	Interview	☐	Questionnaire (self administered)	☒	Focus group	☐
	Ethnography/ Observation	☐	Artefact analysis/website/ social media analysis	☐	Action Research	☐
	Case Study	☐	Design Research (Practice based)	☐		☐
	Other *(if so, state)*	☐	Click or tap here to enter text.			
Brief explanation of the population and number of participants/items	Three homeowners that have a background in the building industry and three interior design professionals.					
Target group sampling methods/artefact (No under 18's or vulnerable groups allowed)	Purposive	☒	Random	☐	Snowball	☐
	Convenient	☒	Stratified	☐	Census	...
	Explain selection process		The selection of the respondents to get the best results that will benefit my research paper the most.			

Ethics		
Documentation submitted with proposal	Gatekeeper's letter (institutional consent)	☐
	Completed Annexure E if you conduct research on IIE sites/students/staff	☒
	Instrument(s) (interview schedule or questionnaire)	☒
	Participant or respondent consent form	☒
	Audio-visual consent form (if applicable)	☐

Campus ethics committee recommendation	
Proposal has been reviewed by the supervisor and necessary ethics considerations have been included. ☐ Accepted as is and provide letter ☐ Accepted with provisions: Nature of provision: e.g. Instrument is not sufficient / included and need to be signed off by the supervisor ☐ Major issues: Student should not continue with fieldwork. Actions to be taken: Click or tap here to enter text.	
Supervisor signature	
	Click or tap to enter a date.
Co-supervisor/Campus ethics panel member signature	
	Click or tap to enter a date.

Annexure Y:
Survey questions

By completing this questionnaire, you agree to the information to be used for this research paper. You understand that your confidentiality will be ensured and that your name and personal details will be kept private. You understand that your participation in this research is voluntary and that you have the right to withdraw from the research at any time. You may choose not to answer any of the questions.

Question A:
Do you give permission for this survey to be used in Alexia Morezzi's research project?

Question B:
Do you have any relevant degree or occupation in the building industry? If so please state either your job title or field of study.

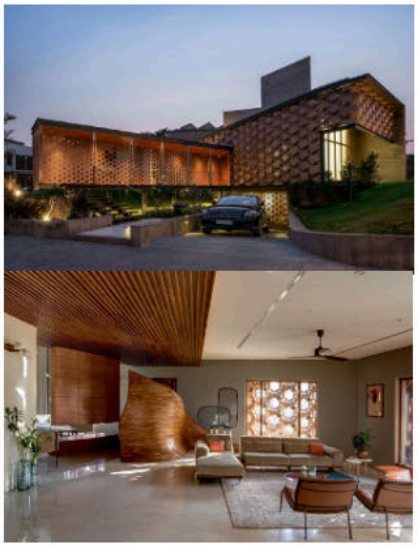
Question One:
Do you know what the term biomimicry is and if so, please explain what your understanding of it?

Question Two:
Biomimicry: It is a practice that learns from and mimics the strategies used by species alive today. The goal is to create new ways of living that solve our greatest design challenges sustainably and in solidarity. It brings relief, can design generously and gets us to sustainable solutions faster. The Biomimicry institute says, "Biomimicry is about valuing nature for what we can learn, not what we can extract, harvest, or domesticate." (2021: n.p). An example is how airliners were inspired by the eagle.

This is a basic description of biomimicry, with this what were the key things you took from it?

Question Three:
Below are two homes. Home 1 and home 2. Both are equally beautiful, modern and simple. Home 1: Designed by Openideas Architects as an intelligent, adaptable, and sustainable family home. Architecture features a solar sensor-based façade inspired by hexagonal structural patterns found in nature such as honeycombs and carbon crystals. Casting patterns that change with the path of the sun, the unique opening mechanism of the façade responds to light exposure and thermal comfort levels within the house. The entrance creates a bridge and valley experience, with a sunken court and stepped garden, a linear arrival corridor and a walkable green roof with varying slopes. The roof technically acts as thermal insulation itself, lowering the overall temperature of the interior while functionally doubling up as an area for social gathering. Inside, the spatial arrangement is open and fluid with minimal partition walls. Instead, a series of public, private, and semi-private zones are modulated within the outer envelope, along with a bespoke sculptural entrance vestibule. Materiality includes metal with SS powder coating for the façade, and wood and stone in the interior to bring a sense of warmth (Openideas Architects, 2020). Home 2: Lake Huron Modern Home in Ontario, Canada was designed by world-famed SAOTA and ARRCC in Modern style offers luxurious living 1,600 square meter from high-end finishes and luxurious amenities. This dream house was built from excellent home design combined by wonderful living room idea, dining room idea, kitchen idea, bedroom idea, bathroom idea, outdoor living idea and other great ideas (SAOTA, 2021).

Both homes have a similar design, but with the information given on each home which would you rather want to live in and why?



Home 1

Home 2

Question Four:
Do you know of any residential or commercial designs that make use of biomimicry, if you do know any designs that made use of biomimicry, please explain what you thought of it and how it made you feel?

Question Five:
Would you implement biomimicry in your own house or designs and please explain why?

Question Six:
If more homes around you were designed through biomimicry making them different and unique, would you be comfortable living in that neighbourhood and please explain why?

Question Seven:
Why do you think Biomimicry hasn't been used more in residential homes?

Question Eight:
With the knowledge you have now obtained of what biomimicry is please explain if you think biomimicry can create a healthier and more sustainable way of living?

Honours research survey

Questions Responses 4

Honours research survey

The use of biomimicry in interiors with a focus on the South African residential industry.

By completing this questionnaire, you agree to the information to be used for this research paper. You understand that your confidentiality will be ensured and that your name and personal details will be kept private. You understand that your participation in this research is voluntary and that you have the right to withdraw from the research at any time. You may choose not to answer any of the questions.

Description (optional)

Do you give permission for this survey to be used in Alexia Morezzi's research project?

- ○ Yes
- ○ No

Do you have any relevant degree or occupation in the building industry? If so please state either your job title or field of study.

Short answer text

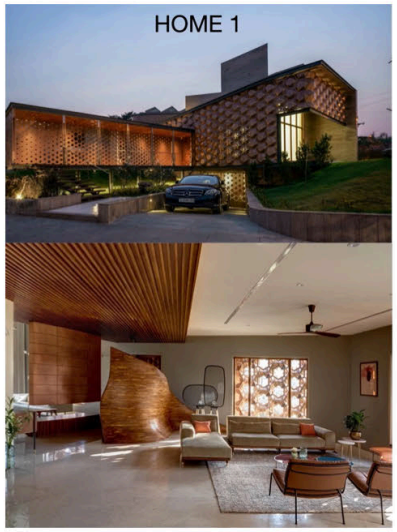
Question 1: Do you know what the term biomimicry is and if so, please explain what your understanding of it?

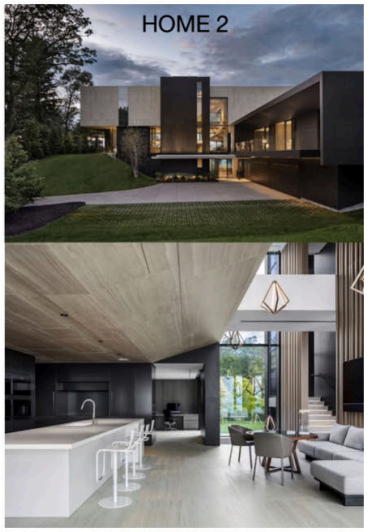
Short answer text

Biomimicry: It is a practice that learns from and mimics the strategies used by species alive today. The goal is to create new ways of living that solve our greatest design challenges sustainably and in solidarity. It brings relief, can design generously and gets us to sustainable solutions faster. The Biomimicry institute says, “Biomimicry is about valuing nature for what we can learn, not what we can extract, harvest, or domesticate.” (2021: n.p). An example is how airliners were inspired by the eagle. Question 2: This is a basic description of biomimicry, with this what were the key things you took from it?

Short answer text

Below are two homes. Home 1 and home 2. Both are equally beautiful, modern and simple. Home 1: Designed by Openideas Architects as an intelligent, adaptable, and sustainable family home. Architecture features a solar sensor-based façade inspired by hexagonal structural patterns found in nature such as honeycombs and carbon crystals. Casting patterns that change with the path of the sun, the unique opening mechanism of the façade responds to light exposure and thermal comfort levels within the house. The entrance creates a bridge and valley experience, with a sunken court and stepped garden, a linear arrival corridor and a walkable green roof with varying slopes. The roof technically acts as thermal insulation itself, lowering the overall temperature of the interior while functionally doubling up as an area for social gathering. Inside, the spatial arrangement is open and fluid with minimal partition walls. Instead, a series of public, private, and semi-private zones are modulated within the outer envelope, along with a bespoke sculptural entrance vestibule. Materiality includes metal with SS powder coating for the façade, and wood and stone in the interior to bring a sense of warmth (Openideas Architects, 2020). Home 2: Lake Huron Modern Home in Ontario, Canada was designed by world-famed SAOTA and ARRCC in Modern style offers luxurious living 1,600 square meter from high-end finishes and luxurious amenities. This dream house was built from excellent home design combined by wonderful living room idea, dining room idea, kitchen idea, bedroom idea, bathroom idea, outdoor living idea and other great ideas (SAOTA, 2021). Question 3: Both homes have a similar design, but with the information given on each home





Short answer text

Question 4: Do you know of any residential or commercial designs that make use of biomimicry, if you do know any designs that made use of biomimicry, please explain what you thought of it and how it made you feel?

Short answer text

Question 5: Would you implement biomimicry in your own house or designs and please explain

Short answer text

Question 6: If more homes around you were designed through biomimicry making them different and unique, would you be comfortable living in that neighbourhood and please explain

Question 7: Why do you think Biomimicry hasn't been used more in residential homes?

Short answer text

Question 8: With the knowledge you have now obtained of what biomimicry is please explain if you think biomimicry can create a healthier and more sustainable way of living?

Short answer text

Annexure Z

THE INDEPENDENT INSTITUTE OF EDUCATION

Date: 07 July 2021

Student name: Alexia Morezzi
Student number: [redacted]
Campus: IIE Vega Pretoria Campus

Re: Approval of RESE8419 Proposal and Ethics Clearance

HONOURS ETHICAL CLEARANCE LETTER

Your research proposal and the ethical implications of your proposed research topic were reviewed by your supervisor and the campus research panel, a subcommittee of The Independent Institute of Education's Research and Postgraduate Studies Committee.

Your research proposal posed no significant ethical concerns and your supporting documents and instruments are in order to proceed. We hereby provide you with permission to proceed with your research.

In the event of you deciding to change your research methodology in any way, kindly consult your supervisor to ensure all ethical considerations are adhered to and pose no risk to any participant or party involved. A revised ethical clearance letter will be issued.

We wish you all the best with your research!

GENERAL CONDITIONS TO BE FULFILLED IN RELATION TO RESEARCH

Permission is granted to proceed with the above study subject to the conditions listed below being met and may be withdrawn should any of these conditions be flouted.

Please note: The panel has not considered the merits, accuracy or ethical soundness of the research. The only merits examined are the use of The IIE as a sample.

Permission is granted subject to the following conditions:

1. The researcher(s) will need to obtain informed consent in writing from all of the participants in his/ her sample if the study is not anonymous.
2. The researcher(s) may only use the data collected for research purposes and in no other way.
3. Photographs of human subjects may only be taken if relevant to the research, informed consent was obtained, and even with informed consent, the photographs may not be published on any online platforms.

4. The researcher is responsible for supplying and utilising his/her own research resources, such as stationery, photocopies, transport, faxes and telephones and should not depend on the goodwill of the institutions and/or the offices visited for supplying such resources.
5. No names or identifying information of participants may be used within the research and the research must be voluntary.
6. Please make it clear that the information will not be used punitively in any way and participants may in no way be counselled/advised based on this.

Supervisor name: JD Eksteen

[redacted]

Campus Postgraduate Coordinator (CPC) name: Dr SC Engelbrecht

Signature: [redacted]