# DEVELOPMENT OF A BIOMIMETIC WOOD FURNITURE PROTOTYPE

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## DECRALATION

I hereby declare that the thesis entitled **"DEVELOPMENT OF A BIOMIMETIC WOOD FURNITURE PROTOTYPE"** is the results of my own research except as cited in the references.

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## ABSTRACT

Biomimetic, the practice of drawing inspiration from nature's designs and processes, offers innovative solutions in various fields. This study explores the design and evaluation of a seashell-inspired biomimetic wood bookshelf, aiming to assess its functionality, material efficiency, and aesthetics. The research employs SPSS 25.0 to analyze data collected through questionnaire surveys, investigating user perceptions and acceptance of the biomimetic bookshelf. All respondents mostly chose the biomimetic bookshelf, indicating a strong preference for this innovative design. The study emphasizes the importance of biomimicry in furniture design and highlights the potential of biomimetic wood furniture prototypes to offer functional, aesthetically pleasing, and environmentally conscious solutions. Acceptance of the biomimetic bookshelf is examined, reflecting the broader interest and receptiveness towards biomimetic designs in contemporary furniture. Ultimately, this research contributes to the growing body of knowledge on biomimetic design principles and their application in creating innovative and sustainable furniture solutions.

Keywords: Biomimetic design, seashell-inspired, wood furniture, bookshelf, aesthetics

## ABSTRAK

Biomimetik, amalan menarik inspirasi daripada reka bentuk dan proses alam, menawarkan penyelesaian inovatif dalam pelbagai bidang. Kajian ini meneroka reka bentuk dan penilaian rak buku biomimetik daripada kayu yang terinspirasi daripada cangkerang, dengan matlamat untuk menilai fungsionalitinya, kecekapan bahan, dan estetika. Kajian ini menggunakan SPSS 25.0 untuk menganalisis data yang dikumpulkan melalui soal selidik, menyiasat persepsi pengguna dan penerimaan rak buku biomimetik. Kesemua responden kebanyakannya memilih rak buku biomimetik, menunjukkan keutamaan yang kuat terhadap reka bentuk inovatif ini. Kajian ini menekankan kepentingan biomimetik dalam reka bentuk perabot dan menggariskan potensi prototaip perabot kayu biomimetik untuk menawarkan penyelesaian yang fungsional, estetika yang memikat, dan sedar alam yang berkesan. Penerimaan rak buku biomimetik diselidik, mencerminkan minat yang lebih luas dan penerimaan terhadap reka bentuk biomimetik dalam perabot kontemporari. Pada akhirnya, kajian ini menyumbang kepada pengetahuan yang berkembang mengenai prinsip reka bentuk biomimetik dan aplikasinya dalam mencipta penyelesaian perabot yang inovatif dan mampan.

Kata kunci: reka bentuk biomimetik, inspirasi kerang laut, perabot kayu, rak buku, estetika

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# CHAPTER 1

# INTRODUCTION

## 1.1 Background on wood furniture design

Wood furniture design has a rich history that spans centuries, deeply rooted in human culture and craftsmanship. From the earliest rudimentary forms to the intricate masterpieces of today, wood furniture has evolved to reflect the changing needs, aesthetics, and technological advancements of different eras. Understanding the background and context of wood furniture design provides valuable insights into the principles, traditions, and innovations that have shaped this art form.

The natural characteristics of wood, such as grain patterns, texture, and color variations, have made it a highly desirable material for creating functional and aesthetically pleasing furniture pieces. Wood furniture has adorned homes, palaces, places of worship, and public spaces, representing both utilitarian and artistic expressions of human culture. The history of wood furniture design is closely intertwined with cultural, social, and technological influences. Different regions and civilizations have developed their unique styles and techniques, reflecting their values, beliefs, and available resources. From the intricately carved furniture of ancient

Egypt to the minimalistic elegance of Scandinavian design, wood furniture has served as a canvas for cultural expression and craftsmanship.

Wood has been used as a material for furniture for centuries, and its popularity can be attributed to its abundance, versatility, and natural beauty. Throughout history, different cultures and periods have developed their unique styles and techniques in wood furniture design. Ancient civilizations such as the Egyptians, Greeks, and Romans used wood to create furniture pieces characterized by simplicity, durability, and functional design. During the Middle Ages, furniture design became more ornate, reflecting the influence of Gothic and Renaissance styles. (vintage, 2023)

In the 17th and 18th centuries, furniture design saw significant developments, particularly in Europe. The Baroque and Rococo styles introduced elaborate ornamentation, while the Neoclassical style drew inspiration from ancient Greek and Roman designs, focusing on clean lines and symmetry. In the 19th and early 20th centuries, the Arts and Crafts movement emerged as a reaction to industrialization, emphasizing craftsmanship, simplicity, and natural materials. This movement had a profound impact on wood furniture design, with notable figures like Gustav Stickley and Charles Rennie Mackintosh contributing to its development.

## 1.2 Importance of sustainable design practices

Sustainable design entails a holistic approach that goes beyond mere aesthetics or functionality. It involves a conscious effort to minimize the negative impacts on the environment and promote practices that contribute to a more sustainable future. By integrating sustainability into the development of biomimetic wood furniture, we can address critical challenges such as resource depletion, deforestation, waste generation, and climate change.

One of the primary environmental concerns associated with the furniture industry is the sourcing of wood materials. Unsustainable logging practices, including illegal deforestation and habitat destruction, pose significant threats to global forests. By adopting sustainable design practices, we can ensure responsible sourcing of wood from certified forests or reclaimed timber. This not only helps preserve natural ecosystems but also promotes the conservation of biodiversity and the reduction of carbon emissions.

Furthermore, sustainable design principles advocate for resource efficiency throughout the entire lifecycle of a product. In the case of biomimetic wood furniture, this involves optimizing material use, reducing waste, and embracing the concept of a circular economy. Design features that enable disassembly, repair, and reconfiguration can extend the lifespan of furniture, reducing the need for replacements and minimizing waste generation.

Sustainable design also considers the health and well-being of users. By using eco-friendly materials, such as low VOC finishes and adhesives, in the production of biomimetic wood furniture, we can create a healthier indoor environment. Additionally, ergonomic design considerations enhance user comfort and productivity, promoting well-being in both residential and commercial settings.

By embracing sustainable design practices in the development of biomimetic wood furniture, we can foster innovation and creativity. Biomimicry, drawing inspiration from nature's designs and processes, provides a rich source of inspiration for functional and sustainable solutions. This approach not only encourages environmentally responsible design but also pushes the boundaries of what is possible, leading to innovative and visually captivating furniture designs.

Ethical considerations are also central to sustainable design. The fair treatment of workers, responsible supply chain practices, and promoting inclusivity throughout the production process are vital elements of sustainability. By adhering to ethical principles, the development of biomimetic wood furniture can contribute to a more equitable and socially responsible industry.

Sustainable design practices play a crucial role in the development of biomimetic wood furniture. By incorporating sustainability into every aspect of the design and production process, we can create furniture that is not only visually striking and functional but also environmentally friendly and socially responsible. Embracing sustainability in the development of biomimetic wood furniture sets the stage for a more sustainable future, where nature-inspired design harmonizes with ecological balance and human well-being.

## 1.3 Biomimetic as an innovative approach in wood furniture design

In today's world, where environmental concerns and sustainability have taken center stage, the importance of incorporating sustainable design practices cannot be overstated. This is particularly relevant in the development of biomimetic wood furniture, which seeks inspiration from nature to create functional and aesthetically appealing pieces. By embracing sustainable design principles, we can ensure that the development of biomimetic wood furniture aligns with ecological balance, resource conservation, and long-term environmental well-being.

Biomimetic, also known as biomimetics or bio-inspired design, is an innovative approach that draws inspiration from nature's designs, processes, and systems to solve human challenges. When applied to wood furniture design, biomimicry offers a wealth of possibilities for creating innovative, functional, and sustainable pieces. Here, we explore how biomimicry serves as an innovative approach in wood furniture design.

Nature has evolved over millions of years, resulting in incredibly efficient and adaptive designs. By studying and emulating these designs, biomimicry allows us to harness nature's solutions and apply them to furniture design. Wood, as a natural material, is particularly well-suited to draw inspiration from the patterns, structures, and properties found in nature.

One of the key aspects of biomimetic in wood furniture design is the replication of natural forms and patterns. For example, the branching structures of trees can inspire the creation of unique, interconnected furniture pieces that maximize material efficiency and strength. Mimicking the spiral growth patterns found in tree rings can lead to visually captivating and structurally sound furniture designs.

Biomimetic also focuses on replicating the functional properties of natural materials. Wood itself exhibits remarkable properties such as strength, flexibility, and lightweight construction. By understanding and replicating these properties, designers can create furniture that is not only visually appealing but also durable and resilient.

Furthermore, biomimicry extends beyond the aesthetics and structure of wood furniture. It also involves imitating the functional processes and behaviors found in nature. For example, self-healing mechanisms observed in trees can inspire the development of furniture that has the ability to repair minor damages or adapt to changing conditions. The self-cleaning properties of lotus leaves can be applied to furniture surfaces, making them resistant to dirt and stains.

Biomimetic also encourages a shift towards sustainable and resource-efficient practices. Nature has perfected the art of resource management, waste reduction, and recycling. By studying these processes, designers can develop furniture that optimizes material usage, minimizes waste generation, and embraces the principles of a circular economy.

Moreover, biomimetic encourages interdisciplinary collaboration, bringing together designers, scientists, engineers, and biologists. This collaborative approach allows for a cross-pollination of ideas and knowledge, leading to innovative solutions in wood furniture design. By combining the expertise of different fields, biomimicry opens up new avenues for exploration, pushing the boundaries of what is possible in furniture design.

Biomimicry provides an innovative approach in wood furniture design by harnessing the ingenuity of nature. By drawing inspiration from the forms, patterns, properties, and processes found in the natural world, designers can create furniture that is not only visually striking but also functional, sustainable, and resource-efficient. Biomimicry encourages us to look to nature

as a mentor and guide, unlocking a realm of possibilities for innovative and environmentally conscious wood furniture design.

## 1.4 Problem statement

The development of biomimetic wood furniture offers a promising avenue for creating sustainable, functional, and aesthetically appealing pieces inspired by nature. However, this endeavor is accompanied by several complex challenges that require careful consideration and strategic solutions. These challenges include interdisciplinary collaboration, responsible material sourcing, adaptation of natural material properties, manufacturing techniques, and commercial viability. Overcoming these obstacles is crucial to fully realizing the potential of biomimetic wood furniture and its contributions to a more environmentally conscious future. Therefore, the objectives of this project were to design and develop a biomimetic wood furniture prototype embodying sustainability and functional innovation principles, evaluate its performance, and identify best practices for biomimetic wood furniture design. By addressing these challenges and achieving these objectives, this study aimed to pave the way for the widespread adoption of biomimetic design principles in the wood furniture industry, thus fostering sustainability and innovation in furniture production.

## 1.5 Project objectives and scope

Objective of this project aims to develop a prototype of a biomimetic wood furniture piece that showcases three key features: sustainable design principles, material efficiency, and functional innovation.

1) To design and develop a biomimetic wood furniture prototype that embodies the principles of sustainability, and functional innovation, inspired by nature's efficient and adaptive strategies.

2) To evaluate the performance of the biomimetic wood furniture prototype in terms of functionality, and aesthetics, and identify best practices and potential improvements in the field of biomimetic wood furniture design.

## 1.6 Project limitation

The development of a biomimetic wood furniture piece is an exciting endeavor that offers numerous opportunities for innovative and sustainable design. However, it is crucial to recognize and address the limitations that may arise during the project. These limitations include:

First point is research constraints, conducting thorough research on biomimetic design strategies may be limited by the availability of comprehensive resources and access to relevant information. This limitation can impact the depth of exploration into biomimetic principles and the ability to identify and replicate specific natural structures or processes effectively.

Other than that material availability also main reason, finding suitable biomimetic materials that closely resemble those found in nature may be challenging. Limited availability of

such materials can affect the project's ability to fully achieve biomimetic properties and characteristics in the wood furniture piece.

Next is mechanical expertise, the project team's level of expertise in biomimicry, wood furniture design, and construction may vary. This limitation can affect the successful translation of biomimetic design principles into the final product. Collaborating with experts from relevant disciplines and seeking external guidance can help overcome this limitation.

For s cale and complexity, the project may be limited to developing a single prototype or a small-scale piece of furniture. This limitation restricts the ability to explore and implement biomimetic concepts on a larger scale or more complex designs. While the prototype may not fully represent the potential of biomimetic wood furniture, it can still serve as a proof of concept.

Cost and resource constraints, limited financial resources and access to specialized tools or equipment can restrict the project's ability to experiment with different materials, construction techniques, or manufacturing processes. This limitation may affect the overall quality, intricacy, or functionality of the biomimetic wood furniture piece. Creative problem-solving and resourcefulness are essential in finding cost-effective alternatives and maximizing available resources.

Lastly time constraints, the project timeline may impose limitations on the extent of iterations, refinements, and comprehensive testing. Adequate time allocation for research, design, construction, and evaluation is necessary to address potential challenges and ensure the quality of the final product.

While these limitations may pose challenges, they should be considered as opportunities for growth and learning throughout the development process. By acknowledging and addressing these limitations, the project can optimize its outcomes and contribute to the advancement of biomimetic wood furniture design while recognizing the importance of sustainability and functionality.

# CHAPTER 2

# LITERATURE REVIEW

## 2.0 Introduction

In recent years, the combination of nature-inspired design and sustainable innovation has opened up a fascinating world of possibilities in the field of furniture design. Biomimicry, the art and science of replicating nature's time-tested patterns and methods, has emerged as a compelling way to developing sustainable and visually appealing goods (Benyus, 1997). Within this paradigm, biomimetic wood furniture has evolved as a fascinating field of study, combining ecological awareness with cutting-edge design.

While there has been substantial global research into biomimetic design in the furniture business, the purpose of this literature review is to highlight Malaysia's distinctive contributions and advances in the biomimicry product and furniture sector. Malaysia, with its rich biodiversity and dedication to sustainable methods, has become an ideal location for incorporating biomimicry into the production of wooden furniture.

Wood, a classic material in furniture making, has intrinsic attributes that have long been valued for their warmth, durability, and adaptability. However, environmental concerns and the

need for sustainable methods have pushed research into biomimicry as a way to improve wood furniture design in Malaysia's industry. Biomimetic wood furniture in this nation draws inspiration from the area's different ecosystems, aiming to not only emulate the look of natural forms but also include the efficiency and resilience seen in native flora and animals.

This literature review aims to offer a complete overview of current research and advancements in the field of biomimetic wood furniture, with an emphasis on Malaysia. We will explore the intellectual roots of biomimicry, as well as its applications and ramifications in Malaysia. In addition, the analysis will look at particular biomimetic methodologies used by Malaysian designers and manufacturers to create wooden furniture, taking into account both form and function.

This research seeks to identify the important trends, difficulties, and possibilities related with biomimetic wood furniture in Malaysia by examining scholarly papers, design case studies, and technology breakthroughs. By synthesizing the knowledge accumulated in this field, we hope to contribute to a better understanding of how Malaysia's biomimicry product and furniture industry can not only improve the aesthetic qualities of wooden furniture but also promote sustainability and ecological harmony during the design process.

As we progress through this research, it becomes clear that Malaysia's biomimetic wood furniture sector has the potential to not only imitate nature's beauty but also actively participate in the preservation and regeneration of the country's unique natural environment. This literature

study aims to be a starting point for exploring the potential and possibilities that exist at the junction of biomimicry and wood furniture design in Malaysia.

## 2.1 Overview of biomimicry principles in product design

Biologists are key players in the biomimicry design process because it relies heavily on biological knowledge; however, the role of the designer remains central. This orientation is particularly true when it comes to abstracting biological strategies into more broadly applicable design principles and implementing them to solve human challenges. (Benyus, 2013)

Biomimicry is an interdisciplinary approach to study and transfer principles or mechanisms from nature to solve design challenges. It has been applied in various fields, including product design, architecture, and engineering. Here are some literature reviews on biomimicry principles in product design. First is Design and Biomimicry: A Review of Interconnections and Creative Potentials". (Araujo & Dianne Magalhães Viana, 2013) This review analyzed publications related to biomimicry in product design and found that authors tend to adopt a problem-based approach. The study concluded that the study of biomimicry can stimulate the development of multiple skills in design, improving creativity, and enhancing their proposal.

"Biomimicry in Product Design through Materials Selection and Computer Aided Engineering". (al, 2016)This study demonstrated a 7-step methodology that describes how nature can act as a source of inspiration for the design of products. The methodology includes steps such as identifying the problem, researching biological models, selecting materials, and testing the design.

"Bio-inspired Product Design: The Study of Pinicola Shelves": (Zarro, 2014) This study focused on the design of shelves inspired by the structure of Pinicola fungi. The research aimed to demonstrate how biomimicry can be used to create functional and aesthetically pleasing products.

"Natural Genius: Approaches and Challenges to Applying Biomimetic Design Principles in Architecture". (2021) This review discussed the challenges and approaches to applying biomimetic design principles in architecture. It highlighted the importance of understanding biological models and their functions to create sustainable designs. Overall, these literature reviews suggest that biomimicry can be a valuable approach for product design, as it can stimulate creativity, improve functionality, and enhance sustainability.

## 2.2 Biomimetic applications in wood furniture design

Biomimicry is a design concept that involves imitating nature's patterns and strategies to solve human problems. In recent years, biomimicry has gained popularity in furniture design as a sustainable approach to creating functional and aesthetically pleasing products. This literature review aims to synthesize the existing research on biomimicry applications in wood furniture design.

A study by Faidi. (*Feasibility of Bacterial Cellulose in Furniture Design.* (Faidi, 2017). Explored the feasibility of using bacterial cellulose in furniture design. The study found that bacterial cellulose has potential as a sustainable material for furniture design due to its biodegradability, renewability, and versatility. Another study by Tavşan and Sönmez (Tavşan,

2015). investigated the use of biomimicry in furniture design. The study found that biomimicry can be used to create innovative and sustainable furniture designs that are inspired by nature's patterns and structures.

In a literature review by Bumgardner and Nicholls.( (Bumgardner, M., & Nicholls, D, 2020) ). The authors reviewed the sustainable practices in furniture design, including customization, competitiveness, product communication, and biomimicry. The authors found that biomimicry can be used to create sustainable furniture designs that are inspired by nature's patterns and structures. They also found that green manufacturing and supply chains, sustainable materials for furniture design, and drivers of sustainable design in furniture are important factors to consider when designing sustainable furniture.

A thesis by Zarro.( (Zarro K. , 2015) Explored bio-inspired product design through the study of Pinicola shelves. The study applied biomimicry to furniture design and found that it can lead to thoughtful applications of products used daily, which can positively impact consumers.

Figure 2.1: Example chair Spaghetti Bâle PABLO REINOSO

In conclusion, biomimicry is a promising approach to creating sustainable wood furniture designs. By imitating nature's patterns and structures, designers can create functional and aesthetically pleasing products that are environmentally friendly. Future research should focus on exploring new biomimetic materials and designs for wood furniture to further advance this field.

## 2.3 Material efficiency and environmental considerations

Wood is a renewable material and has less of an impact on the environment compared to other materials. The sustainability of wood furniture depends on how sustainably the wood is grown and logged. The most sustainable woods for indoor furniture are black cherry, beech, maple, ash, eastern red cedar, mango, and bamboo.*(* (Roshina Jowaheer, 2018).

High material efficiency can significantly reduce the environmental impact of wood industries and increase carbon storage in forests and wood.*(* (Nguyen, 2023)*).* The manufacturing process of wood furniture uses many chemicals and natural resources and generates considerable amounts of waste materials.

Furniture manufacturers can use materials like bamboo, recycled plastic, or sustainably-harvested wood in order to reduce their environmental impact. Sustainable furniture production can lead to furniture that is more durable and attractive. By using renewable and recycled materials, such as sustainably sourced wood, furniture can be designed to last longer and look better, even after years of use.*(* (Hans, 2023).

Furniture manufacturing has significant environmental impacts, from the depletion of natural resources to the emission of harmful pollutants. However, there are ways to reduce the

environmental impact of furniture production. Here are some best practices for safe and sustainable furniture production.

First one is by Choose sustainable woods: The most sustainable woods for indoor furniture are black cherry, beech, maple, ash, eastern red cedar, mango, and bamboo. In this article,they will guide you through the life-cycle of the seven most sustainable woods for furniture in this post. Then they assess its viability, potential, and shortcomings. Finally, they will teach you how to buy sustainable woods for furniture. (Nguyen, 2023).

Another point is, maximize material efficiency: High material efficiency might significantly reduce the environmental impact of wood industries and increase carbon storage in forests and wood. We also can Increase durability: Sustainable furniture production can lead to furniture that is more durable and attractive. By using renewable and recycled materials, such as sustainably sourced wood, furniture can be designed to last longer and look better, even after years of use. (Hans, 2023)

The last one is use biodegradable wood: Biodegradable wood is a renewable resource and has a lower environmental impact compared to traditional furniture materials (RVJ, 2023). By adhering to these best practices, furniture manufacturers can demonstrate their commitment to sustainability and reduce their environmental impact.

## 2.4 Functional innovation in biomimetic furniture design

Biomimicry is a concept that inspires furniture designers to create designs inspired by micro and macro-sized living beings in nature. It is defined as "the innovation that gets inspired by nature". (Filiz Tavşan & Sonmez, 2015)

By studying the anatomy and function of natural elements, furniture designers can develop sustainable practices in furniture design. Biomimicry design is a process that involves applying nature's principles to solve problems and create innovative products. (on, 2020)

The process involves several strategies that can be applied to furniture design, such as observing and learning from nature, identifying the problem, and developing solutions based on natural principles. The use of biomimicry in furniture design can lead to innovative products that change the way we live.

By taking inspiration from nature, designers can create furniture that is not only aesthetically pleasing but also functional and sustainable. For example, a chair designed to mimic the structure of a bird's nest could be both visually appealing and structurally sound

Overall, the use of biomimicry in furniture design can lead to functional innovation. By studying natural elements and applying their principles to furniture design, designers can create sustainable and innovative products that are both aesthetically pleasing and functional. (al Z. e., 2022)

There are several examples of biomimetic furniture designs that have been created by furniture designers. Some of these designs include, Tree table, this table is designed to mimic the

structure of a tree, with branches serving as the legs and a circular top representing the tree's canopy. (Tavsan & Sönmez, 2015)

Figure 2.2 : Example of biomimetic table

Next one is Butterfly chair,this chair is designed to resemble the wings of a butterfly, with a curved backrest and seat that create a wing-like shape.Coral-inspired chair, this chair is designed to mimic the structure of coral, with a series of interconnected branches that create a lattice-like structure (Sustainable Practices in Furniture Design: Biomimicry, 2023, 2023)

Spider web-inspired chair,chair is designed to resemble a spider web, with a series of interconnected threads that create a web-like structure.Bird's nest-inspired chair: This chair is designed to mimic the structure of a bird's nest, with a woven seat and backrest that resemble the interwoven twigs and branches of a nest and many more ideas.

These biomimetic furniture designs are not only aesthetically pleasing but also functional and sustainable. By taking inspiration from nature, furniture designers can create innovative products that are both beautiful and practical.

# CHAPTER 3

# MATERIAL AND METHOD

## 3.0 Introduction

This chapter will discuss the procedures that have been used to achieved the objectives. Its is organized under the following headings which are research on biomimetic design strategies, development of a design concept for a biomimetic wood furniture piece, Selection for the prototype, Technical drawings and 3D modelling, research design, sampling design, sampling technique, sample of study, research instrument

## 3.1 Research on biomimetic design strategies

From the research that i learn, biomimetic furniture that i will make a wooden bookshelf that mimic a sea shell, A seashell is the hard, protective outer layer created by marine organisms such as mollusks, snails, and clams. These shells are typically made of calcium carbonate and come in various shapes, sizes, and patterns.

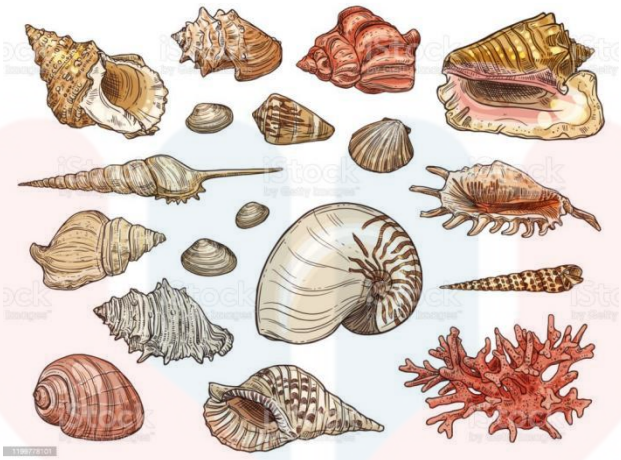

Figure 3.1: Types sea shell

Types of wood that gonna make this furniture is medium dark brown wood color such as Nyatoh, Chengal and Balau wood. Balau is dense hardwood native to Malaysia, the Philippines, and Indonesia. Balau is a lighter colored wood that is primarily used to build boats and is more water-resistant than other woods. It is also used for outdoor furniture and construction.

Nyatoh relatively soft wood with a straight, interlocked grain and a reddish color It is commonly used for boats, cabinets, and utility construction in Southeast Asia and the Philippines.Nyatoh is not particularly attractive or durable and can be difficult to work with due to its high silica content and natural gums, It is rarely exported to the United States as a raw material. Nyatoh is suitable for low-cost outdoor furniture, flooring, and veneer.

Chengal wood is a sturdy and versatile hardwood that is highly valued for its durability and natural resistance to decay and weathering. It is commonly used for outdoor furniture and heavy construction projects. However, due to its density, it can be difficult to work with, and it may require specialized tools and expertise to finish.

Rattan also one of the material will be used in making chair. Rattan wood is a flexible and durable material that is commonly used for making furniture, baskets, and handicrafts. It is lightweight and easy to work with, making it a popular choice for furniture and handicrafts in Malaysia. Rattan furniture is often handmade by local craftsmen using traditional techniques and can be found in a variety of styles.

## 3.2 Development of a design concept for a biomimetic wood furniture piece

Seashells are composed primarily of calcium carbonate (CaCO3) and are formed through a process called biomineralization. Mollusks and other shell-producing organisms extract calcium and carbonate ions from the surrounding environment and deposit them in layers, gradually building the shell's structure. The shape, color, and patterns of seashells vary greatly among different species.

## 3.3 Selection for the prototype

A prototype is a preliminary version or model of a product or design that is created to test and evaluate its functionality, form, and feasibility. It serves as a tangible representation of the concept or idea before moving forward with full-scale production. Prototypes are developed to gather feedback, identify design flaws or improvements, and validate the overall concept.

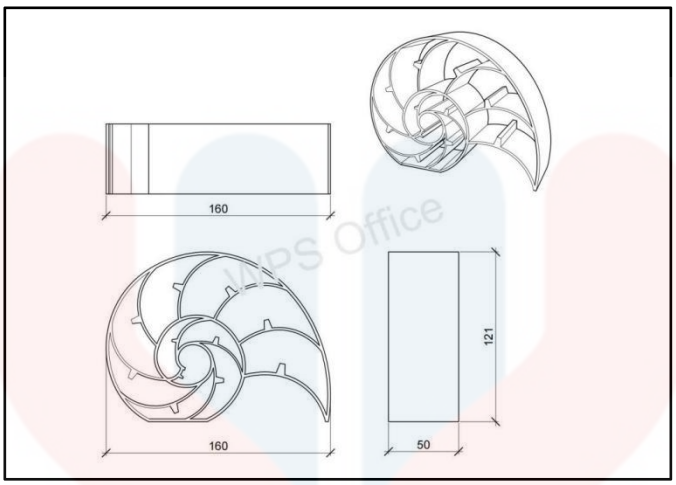


Figure 3.2: A prototype

## 3.4 Technical drawings and 3D modeling

Figure 3.3: 3D model

## 3.4 Research instrument

### 3.4.1 Questionnaire

In this study, data was gathered using a questionnaire survey, which was organized into three sections to assess specific research objectives. The questionnaire was designed to evaluate user perceptions of a biomimetic wood furniture prototype, particularly a bookshelf. Additionally, to accommodate a diverse participant base, the survey was constructed in two languages. This approach aimed to facilitate responses in participants' preferred languages, promoting inclusivity and enhancing the reliability of the collected data. The research utilized the survey's structured sections and bilingual format to comprehensively explore user perspectives on the functionality, aesthetics, and overall impact of the biomimetic bookshelf**.**

### 3.4.2 SketchUp and CAD software

The design of the seashell bookshelf involved the utilization of SketchUp and Computer-Aided Design (CAD) software to create a detailed and accurate digital representation of the furniture prototype. SketchUp, known for its user-friendly interface, was employed for the initial stages of the design process. It enabled the designer to visually conceptualize the seashell-inspired structure in a three-dimensional space, providing a flexible and intuitive platform for creative exploration.

Subsequently, CAD software was integrated into the design process to add a layer of technical precision. This software allowed for the incorporation of specific measurements,

material specifications, and structural details into the digital model. The use of CAD ensured that the seashell bookshelf not only captured the desired aesthetic qualities but also adhered to functional and material efficiency considerations.

The synergy between SketchUp and CAD was instrumental in the design process. SketchUp facilitated the imaginative and artistic aspects of creating a biomimetic design, while CAD provided the necessary tools for a more technical and detailed refinement. The combination of these software applications allowed for a holistic approach to design, ensuring that the final digital model accurately represented the envisioned seashell bookshelf. This digital representation serves as a valuable guide for further development, communication, and realization of the biomimetic wood furniture prototype.

# CHAPTER 4

# RESULT AND DISCUSSION

## Introduction

All survey data have been collected and analyzed using SPSS 25.0, as previously mentioned. The survey was successfully distributed through Google Sheet Form, WhatsApp application, face-to-face interactions, and self-administered methods. Therefore, this chapter will present and discuss the demographic profile of respondents, as well as the results and discussion. The diverse distribution channels ensured comprehensive outreach, enriching the dataset with a variety of perspectives. The subsequent sections aim to illuminate the demographic characteristics of the respondents, providing insights into the composition of the study sample. Following this, the chapter will delve into the results and discussion, unraveling key findings and their implications. This comprehensive approach, merging demographic profiles, statistical outcomes, and insightful discussions, aims to provide a holistic understanding of the surveyed data and its significance within the context of the research objectives.

## 4.0 Demographic profile of respondents

The demographic profile of respondents, encompassing variables such as age, gender, occupation, and campus affiliation, has been delineated through descriptive analysis. The findings of this analysis are succinctly presented in Table 4.1, which reports on the comprehensively examined demographic characteristics of the surveyed participants.

**Table 4.1 Demographic Profile of Respondents**

**Age**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | 13 - 19 years old | 1 | .5 | .5 | .5 |
| | 20 - 25 years old | 123 | 57.5 | 57.5 | 57.9 |
| | 26 - 30 years old | 45 | 21.0 | 21.0 | 79.0 |
| | 31 - 40 years old | 40 | 18.7 | 18.7 | 97.7 |
| | 41 - 50 years old | 1 | .5 | .5 | 98.1 |
| | Above 51 years old | 4 | 1.9 | 1.9 | 100.0 |
| | Total | 214 | 100.0 | 100.0 | |

**Gender**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | Male | 122 | 57.0 | 57.0 | 57.0 |
| | Female | 85 | 39.7 | 39.7 | 96.7 |
| | Prefer not to say | 7 | 3.3 | 3.3 | 100.0 |

| | | | | | |
|---|---|---|---|---|---|
| | Total | 214 | 100.0 | 100.0 | |

**Occupation**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | Working | 82 | 38.3 | 38.3 | 38.3 |
| | Student | 123 | 57.5 | 57.5 | 95.8 |
| | Unemployed | 5 | 2.3 | 2.3 | 98.1 |
| | Retired | 4 | 1.9 | 1.9 | 100.0 |
| | Total | 214 | 100.0 | 100.0 | |

**Which UMK campus are you from**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | Campus Jeli | 97 | 45.3 | 45.3 | 45.3 |
| | Campus Kota | 51 | 23.8 | 23.8 | 69.2 |
| | Campus Bachok | 42 | 19.6 | 19.6 | 88.8 |
| | Other | 24 | 11.2 | 11.2 | 100.0 |
| | Total | 214 | 100.0 | 100.0 | |

## 4.1 Results and Discussion

The Results and Discussion section will be structured into three subsections, each aligned with the main objectives of the survey and bolstered by insights from prior research. The subsections are dedicated to elucidating the identified strengths and weaknesses of existing bookshelves, gauging the level of acceptance of these bookshelves, and assessing the performance of biomimetic wood furniture design. This organized approach ensures a comprehensive exploration of the survey outcomes, offering in-depth discussions that address the primary goals of the study and contribute to the broader understanding of bookshelf design and biomimetic innovations in furniture.

### 4.1.1 Level of strength and weakness of existing bookshelf.

Items B1, B2, B3, and B4 capture the commendable features and strengths of the existing bookshelf, reflecting the positive experiences and satisfaction expressed by respondents. In contrast, items B5, B6, and B7 delve into the identified weaknesses and shortcomings of the current bookshelf design, representing aspects that respondents find less favorable or challenging in their interactions with these structures.

**Table 4.2 Strength and Weakness of Existing Desk.**

| | N | Minimum | Maximum | Mean | Std. Deviation |
|---|---|---|---|---|---|
| Do bookshelf around you can storing a large quantity of books without problem. (B1) | 214 | 1 | 5 | 3.55 | .869 |
| I believe the existing bookshelf around me easy to reach.( e.g. library, home, or hostel). (B2) | 214 | 1 | 5 | 4.06 | 1.026 |
| I feel safe when using the existing bookshelf. (B3) | 214 | 1 | 5 | 4.14 | .991 |
| I believe the existing bookshelf easy to arrange book without any support. ( e.g. stairs ). (B4) | 214 | 1 | 5 | 4.00 | 1.053 |
| **Average Mean** | | | | **3.94** | |
| I believe existing bookshelf are not multifunction. (B5) | 214 | 1 | 5 | 3.39 | .880 |
| I believe all the design of existing bookshelf in library, hostel , or classroom are the same and too common. (B6) | 214 | 1 | 5 | 4.26 | 1.141 |
| I believe the existing bookshelf has less compartment/shelves for books. (B7) | 214 | 1 | 5 | 3.88 | 1.003 |
| **Average Mean** | | | | **3.84** | |

In this survey, participants provided valuable insights on various aspects of the bookshelves in their surroundings. Firstly, the capability of these bookshelves to store a large quantity of books without problems (B1) received an average rating of 3.55 out of 5, representing a key strength of the existing bookshelves. Secondly, opinions were gathered on the ease of reaching existing bookshelves, whether in libraries, homes, or hostels (B2), yielding an average rating of 4.06 out of 5. Additionally, participants expressed their feelings about the safety of using these bookshelves (B3), resulting in an average rating of 4.14 out of 5. Furthermore, respondents evaluated the ease of arranging books on existing bookshelves without any support, such as stairs (B4), providing an average rating of 4.00 out of 5. The overall average mean across these four aspects is 3.94 out of 5, indicating a generally positive perception of the existing bookshelves in terms of storage capacity, accessibility, safety, and the identified strength represented by question B1.

Contras with B1, B2, B3 and B4, these items have represent to the weakness of existing bookshelf. respondents expressed their opinions on specific aspects related to the existing bookshelves. Firstly, respondents conveyed a belief that the existing bookshelves lack multifunctionality (B5), providing an average rating of 3.39 out of 5, indicating a perceived weakness in this aspect. Comparatively, when considering the strengths, the ability of bookshelves to store a large quantity of books without problems (B1) received an average rating of 3.55 out of 5. Secondly, opinions were sought regarding the perception that all designs of existing bookshelves in libraries, hostels, or classrooms are similar and too common (B6), resulting in an average rating of 4.26 out of 5, signifying a perceived weakness in design diversity.

Conversely, the strength represented by the ease of reaching existing bookshelves (B2) received a higher average rating of 4.06 out of 5. Additionally, respondents shared their views on the belief that the existing bookshelves have insufficient compartments/shelves for books (B7), with an average rating of 3.88 out of 5, suggesting a perceived weakness in the availability of storage space. In contrast, the strength represented by the feeling of safety when using existing bookshelves (B3) received a higher average rating of 4.14 out of 5. The overall average mean across these three weakness aspects is 3.84 out of 5, indicating a mixed perception regarding multifunctionality, design diversity, and compartment availability in the existing bookshelves, with an overall tendency towards identifying weaknesses.

### 4.1.2 Bookshelf Design Selection

Within the scope of the survey, participants were presented with a distinctive choice between two bookshelf models: Model A, embodying a biomimicry-inspired design, and Model B, representing a more basic bookshelf concept. Model B is common bookshelf around us like in library, home or public space and the design is simple horizontal design. Figure 4.1 show that the model B.

**Figure 4.1 Modal B basic wooden bookshelf**

Respondents were explicitly instructed to express a singular preference by selecting either Model A or Model B. The resulting dataset sheds light on the distribution of preferences among the participants. The models can be viewed in Chapter 3. An overwhelming majority, totaling 84.1% of respondents, demonstrated a clear preference for Model A, the biomimicry bookshelf. In contrast, 15.9% of survey participants opted for Model B, the basic bookshelf design. This discernible pattern in preference distribution offers valuable insights, underscoring the notable inclination towards the biomimicry-inspired bookshelf model as opposed to the more conventional basic alternative.

**Table 4.3 Chosen Design**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| **Valid** | Model 1 | 180 | 84.1 | 84.1 | 84.1 |
| | Model 2 | 34 | 15.9 | 15.9 | 100.0 |
| | Total | 214 | 100.0 | 100.0 | |

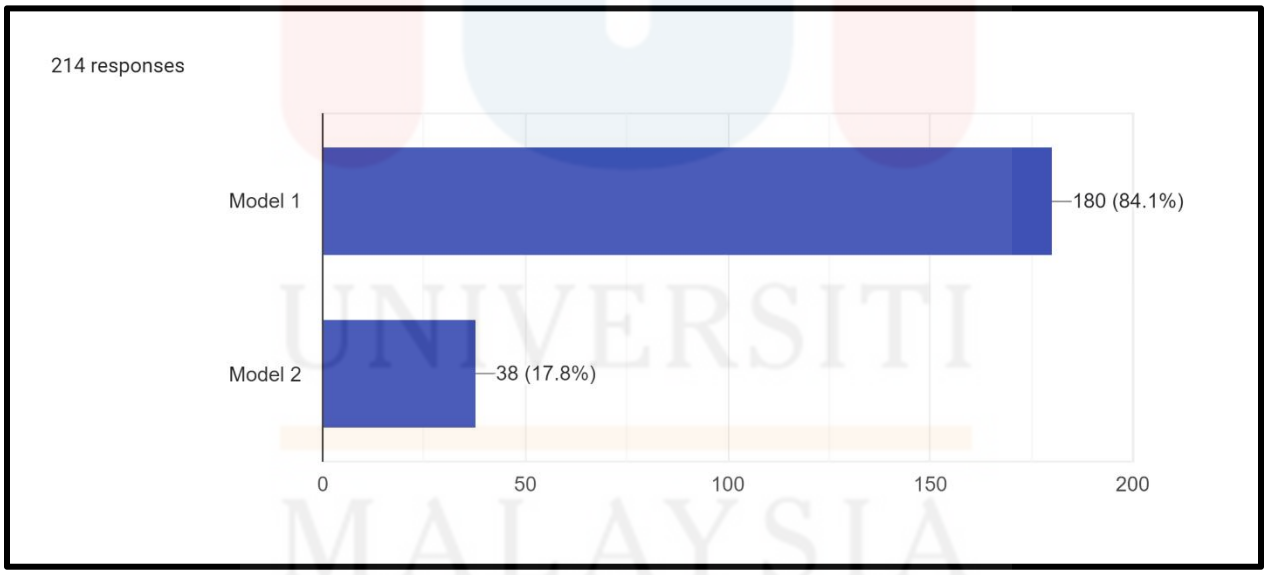


**Figure 4.2 Bar chart of bookshelf design do respondents prefer**

In the conducted survey, participants were presented with a choice between two distinctive bookshelf models: Model 2, representing a more basic bookshelf concept, and Model 1, characterized by a biomimicry-inspired design. The data reveals that 15.9% of survey participants opted for Model 2, while a significant majority, constituting 84.1%, expressed a preference for Model 1, the biomimicry bookshelf. The cumulative percentages provide a clear overview of the preference distribution among the 214 respondents, showcasing the predominant inclination towards the biomimicry-inspired model.

Additionally, the descriptive statistics for the preference question further illuminate the respondents' inclinations. The mean preference score of 1.16 suggests an overall tendency towards favoring Model 1. The median and mode, both at 1.00, reinforce this central tendency, indicating a concentration of preferences around the biomimicry bookshelf. The standard deviation of 0.366 implies a relatively low level of variability in respondents' preferences. The overall variance is 0.134, reflecting the dispersion of preference scores. The sum of 248 underscores the cumulative strength of preferences for Model 1 among the surveyed participants.

### 4.1.3 Acceptance by respondents about the value added of biomimicry in new bookshelf design.

**Table 4.4 Mean of acceptance of biomimicry furniture**

**Statistics**

| | | I haved see or found biomimicry bookshelf in Malaysia before. (D1) | I am impressive with the new biomimicry design of bookshelf. (D2) | I understand the objective of this biomimicry bookshelf to build for. (D3) | I would like to recommend the biomimicry bookshelf to my friends. (D4) |
|---|---|---|---|---|---|
| N | Valid | 214 | 214 | 214 | 214 |
| | Missing | 0 | 0 | 0 | 0 |
| Mean | | 3.52 | 4.13 | 4.01 | 4.06 |
| Median | | 4.00 | 5.00 | 4.00 | 5.00 |
| Mode | | 4 | 5 | 5 | 5 |
| Std. Deviation | | 1.042 | 1.053 | 1.113 | 1.079 |
| Variance | | 1.087 | 1.110 | 1.239 | 1.165 |
| Sum | | 753 | 884 | 858 | 869 |
| Average Mean | | | | | |

In this section, we gauge respondents' views on biomimicry's impact on new bookshelf design in Malaysia. On visibility, respondents scored an average of 3.52, indicating a moderate level of awareness, with many expressing higher visibility. Impressions of the biomimicry design are notably positive, with an average score of 4.13 and a concentrated highly positive impression.

Understanding the biomimicry objectives received an average score of 4.01, indicating solid comprehension, and a concentrated understanding is evident with median and mode values of 4.00 and 5.00. Respondents are inclined to recommend biomimicry bookshelves, as shown by an average score of 4.06, with a concentrated preference for a high likelihood of recommendation (median and mode values of 5.00). Overall, respondents exhibit positive acceptance and understanding of biomimicry's value in new bookshelf designs, reflecting a favorable impression and a likelihood to recommend.

**Table 4.5 Performance of the biomimetic wood furniture design**

| | N | Minimum | Maximum | Mean | Std. Deviation |
|---|---|---|---|---|---|
| Do you want to use this bookshelf to organize and store your books? (D5) | 214 | 1 | 5 | 3.89 | 1.086 |
| Do you believe that the presence of this biomimetic bookshelf can provide additional motivation for you to read and dig for knowledge? (D6) | 214 | 1 | 5 | 3.94 | 1.001 |
| Do you think this bookshelf able to accommodate your book collection? (D7) | 214 | 1 | 5 | 4.20 | .839 |
| Do you think this shell bookshelf can help users find books quickly? (D8) | 214 | 1 | 5 | 3.84 | .809 |
| **Average mean for Functionality** | | | | **3.97** | |
| Do you think this biomimetic bookshelf provides aesthetic utility to your living room or reading room? (D9) | 214 | 1 | 5 | 3.98 | .784 |
| Do you feel that a well-organized bookshelf has a positive effect on the overall atmosphere of the room? (D10) | 214 | 1 | 5 | 4.55 | .901 |
| Do you feel that this | 214 | 1 | 5 | 4.45 | 1.000 |

| | | | | | |
|---|---|---|---|---|---|
| bookshelf based on the design of the shell will coordinate with the decoration or design of library? (D11) | | | | | |
| Do you think this shell bookshelf design fits the theme of the reading room or the general decor style of your home? (D12) | 214 | 1 | 5 | 4.07 | 1.102 |
| Do you think this shell bookshelf creation is creative or innovative in arranging bookshelves to attract visual attention? (D13) | 214 | 1 | 5 | 3.90 | 1.020 |
| Will this bookshelf be well received by aesthetic furniture enthusiasts if it is marketed? (D14) | 214 | 1 | 5 | 4.02 | .712 |
| Does this bookshelf provide balance and symmetry in the arrangement of books? (D15) | 214 | 1 | 5 | 4.30 | .957 |
| **Average mean for Aesthetic** | | | | **4.21** | |
| Do you think this bookshelf makes it easier for you to organize your books? (D16) | 214 | 1 | 5 | 4.11 | 1.129 |
| Is this bookshelf able to protect books from weather conditions or moisture? (D17) | 214 | 1 | 5 | 3.90 | .798 |
| Does this bookshelf make it | 214 | 1 | 5 | 4.20 | 1.043 |

| | | | | | |
|---|---|---|---|---|---|
| easier for you to identify books you haven't read yet? (D18) | | | | | |
| **Average mean for best Practice and Improvement** | | | | **4.07** | |
| Do you think this bookshelf is safe for users of all ages? (D19) | 214 | 1 | 5 | 4.27 | .935 |
| **Average mean for safety** | | | | **4.27** | |
| Valid N (listwise) | 214 | | | | |

In the functionality category, respondents expressed positive views, yielding an average mean of approximately 3.97. This suggests that individuals find the biomimetic bookshelf not only practical for organizing and storing books but also believe it can serve as a motivating factor for reading and digging for knowledge. Furthermore, the perception that the bookshelf can effectively accommodate a diverse book collection and aid users in quickly finding books adds to its functional appeal. The average mean of 3.97 reflects an overall satisfaction with the bookshelf's functional aspects, indicating a well-rounded appreciation for its practical utility.

Moving on to the aesthetic category, the average mean of about 4.21 signifies a strong positive sentiment towards the bookshelf's visual appeal. Respondents perceive it as not only providing aesthetic utility to living spaces but also as a design element that seamlessly coordinates with the overall décor, particularly in libraries or reading rooms. Additionally, participants view the biomimetic bookshelf as a creative and innovative piece, suggesting that its unique design attracts visual attention and aligns well with the preferences of aesthetic furniture

enthusiasts. The elevated average mean in the aesthetic category underscores the bookshelf's success in combining functionality with an aesthetically pleasing design.

In the best practice and improvement category, the average mean of around 4.07 indicates positive perceptions of the bookshelf's ability to enhance organizational practices and contribute to an improved reading experience. Respondents believe the bookshelf makes it easier to organize books and identify unread ones, emphasizing its practical value in facilitating efficient book management. The high average mean in this category underscores the bookshelf's alignment with users' expectations for best practices in book organization and improvement in the reading experience.

As for safety, the biomimetic bookshelf received a notably high average mean of 4.27. This implies that respondents overwhelmingly consider the bookshelf safe for users of all ages. The positive perception of safety reflects a crucial aspect of user satisfaction, contributing to the overall positive evaluation of the bookshelf. In conclusion, the survey results highlight a favorable reception of the biomimetic bookshelf across functionality, aesthetic, best practices, and safety, providing a comprehensive understanding of respondents' positive sentiments towards various aspects of this innovative piece of furniture.

# CHAPTER 5

# CONCLUSION DAN RECOMMENDATION

## 5.0 Introduction

This concluding chapter aims to thoroughly examine the findings of the study and offer insightful conclusions. Additionally, it will provide comprehensive recommendations for future research endeavors, suggesting potential areas for further exploration and enhancement of the current research framework.

## 5.1 Conclusion

The objective of this study was to evaluate the performance of the biomimetic wood furniture prototype, specifically a bookshelf, across key dimensions such as functionality, material efficiency, and aesthetics. Through the analysis of survey responses using the Statistical Package for the Social Sciences (SPSS), this study aimed to provide quantitative insights into user perceptions. The data, comprising mean ratings across various aspects of the biomimetic bookshelf, aligns closely with the study's objectives. The average mean ratings revealed positive

assessments, indicating user satisfaction with the functionality, aesthetic appeal, and safety aspects of the biomimetic bookshelf.

The utilization of SPSS facilitated a rigorous statistical analysis, allowing for a comprehensive examination of the survey data. The results showcased the bookshelf's commendable performance in terms of functionality, as evidenced by high mean ratings for features like organization, motivation, and accommodation. The aesthetic category also received favorable ratings, suggesting that the biomimetic design not only adds visual appeal to living spaces but also aligns well with diverse décor styles.

Furthermore, this study sought to identify best practices and potential areas for improvement in the field of biomimetic wood furniture design. The findings, particularly in the best practice and improvement category, indicate positive perceptions regarding the bookshelf's contribution to enhanced organizational practices and improved reading experiences.

The strong rationale behind the use of biomimicry in designing the bookshelf lies in the emulation of nature's efficiency, adaptability, and sustainability. Biomimetic wood furniture prototypes leverage design principles inspired by natural forms, resulting in innovative solutions that are not only aesthetically pleasing but also functionally efficient. The biomimetic approach allows for the creation of furniture that aligns with sustainable practices, utilizing materials efficiently and offering a unique and appealing design that resonates with users.

In summary, this study, conducted with the aid of SPSS, successfully met its objectives by evaluating the performance of the biomimetic wood furniture prototype, identifying user perceptions across dimensions, and shedding light on best practices and potential improvements. The positive survey data underscores the reasonability of adopting biomimicry in furniture design, emphasizing its ability to deliver functional, aesthetically pleasing, and environmentally conscious solutions.

## 5.2 Recommendation for future studies.

Future research into biomimetic wood furniture design can go into a variety of dimensions to help us better understand and use this novel technique. First, looking at cultural impacts on user perceptions might help us understand how biomimetic designs resonate in different communities. Longitudinal studies that follow user experiences over time can provide a better knowledge of biomimetic furniture's durability and utility. Assessing the environmental effect and sustainability of biomimetic materials is critical to assuring eco-friendly furniture solutions. Exploring human behavior and interaction patterns in real-world situations, along with market research on customer preferences, can help designers create biomimetic wood furniture that meets market expectations.

Additionally, exploring more advanced biomimetic design principles, performing comparison studies with traditional designs, and adapting research to specific user demographics might help progress the area. Finally, researching the integration of future technology with biomimetic wood furniture might lead to new opportunities for smart and sustainable living

spaces. These research approaches have the potential to bring vital insights and breakthroughs to the ever-changing world of biomimetic wood furniture design.

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**APPENDIX A**

**Questionnaires**

**SECTION 1 – Personal Detail / Maklumat Peribadi**

1. Age / Umur :

   Below 13 Years old
   13 - 19 years old
   26 - 30 years old
   31 - 40 years old
   41 - 50 years old
   Above 51 years old

2. Gender / Jantina :

   Male
   Female

3. Occupation / Pekerjaan :

   Working
   Student
   Unemployed
   Retired

4. If You a student which UMK campus are you from / Jika Anda pelajar UMK anda kampus mana ?

   Jeli campus
   Kota campus
   Bachok campus

**SECTION 2 – Strengh and Weekness of Existing Desk. / Kekuatan dan Kelemahan Rak Buku Sedia Ada.**

Indicates your level of agreement regarding the listed statement by using the following scale:

Nyatakan tahap persetujuan anda mengenai pernyataan yang disenaraikan dengan menggunakan skala berikut:

1 – Strongly Disagree , 2 – Disagree , 3 – Modrate , 4 – Agree , 5 – Strongly Agree

1 – Sangat Tidak Setuju , 2 – Tidak Setuju , 3 – Sederhana , 4 – Setuju , 5 – Sangat Setuju

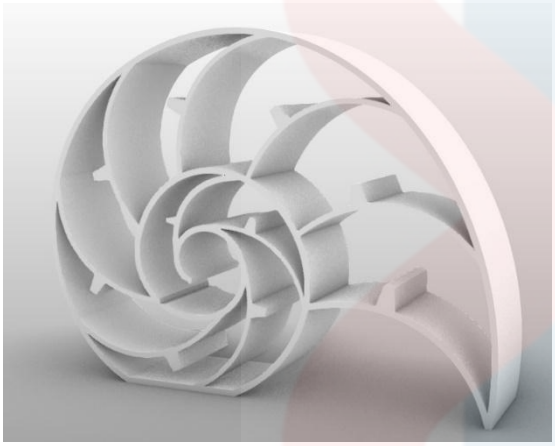
| ***STATMENT / PENRNYATAAN*** | **1** | **2** | **3** | **4** | **5** |
|---|---|---|---|---|---|
| ***STRENGTHS / KEKUATAN*** | | | | | |
| Do bookshelf around you can storing a large quantity of books without problem.<br><br>*Adakah rak buku di sekeliling anda boleh menyimpan sejumlah besar buku tanpa masalah*. | | | | | |
| I believe the existing bookshelf around me easy to reach.( e.g. library, home, or hostel).<br><br>*Saya percaya rak buku yang sedia ada di sekeliling saya mudah dicapai.( cth. perpustakaan, rumah atau asrama).* | | | | | |
| I feel safe when using the existing bookshelf.<br><br>*Saya berasa selamat apabila menggunakan rak buku sedia ada.* | | | | | |
| ***WEAKNESS / KELEMAHAN*** | | | | | |
| I believe the existing bookshelf easy to arrange book without any support. ( e.g. stairs ).<br><br>*Saya percaya rak buku sedia ada mudah untuk disusun buku tanpa sebarang alat sokongan. (cth. tangga)* | | | | | |

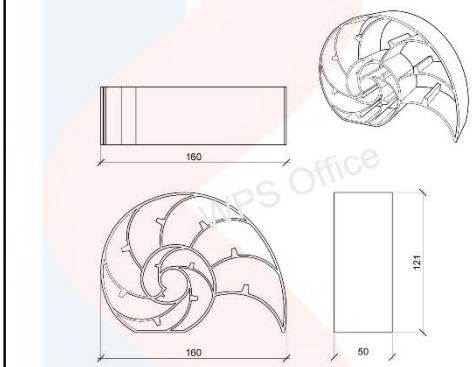
| | | | | | |
|---|---|---|---|---|---|
| I believe existing bookshelf are not multifunction.<br><br>*Saya percaya rak buku sedia ada tidak pelbagai fungsi.* | | | | | |
| I believe all the design of existing bookshelf in library, hostel , or classroom are the same and too common.<br><br>*Saya percaya semua reka bentuk rak buku sedia ada di perpustakaan, asrama atau bilik darjah adalah sama dan terlalu biasa.* | | | | | |
| I believe the existing bookshelf has less compartment/shelves for books.<br><br>*Saya percaya rak buku sedia ada mempunyai kurang petak/rak untuk buku.* | | | | | |

**SECTION 3 – Evaluation of Biomimicry Bookshelf and Old Bookshelf Design. / Penilaian Reka Bentuk Rak Buku Baru dan Rak Buku Lama**.

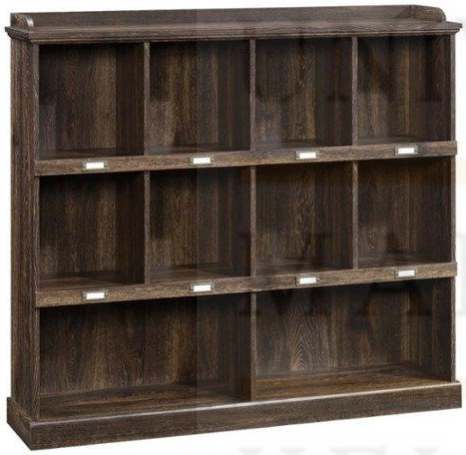
Which design of bookshelf do you prefer? / Reka bentuk rak buku yang anda suka?

☐ New Biomimicry Design






☐ Old Design



**Standard Bookcase Dimensions**

| | H | W | D |
|---|---|---|---|
| Two-shelf | 32" | 41" | 12"-13" |
| Three-shelf | 41"-48" | 30"-36" | 12"-13" |
| Four-shelf | 54" | 24" | 12"-14⅝" |
| Five-shelf | 72"-77" | 31"-37" | 12"-13" |

Indicates your lavel of agreement regarding the listed statment by using the following scale:

*Tunjukkan tahap persetujuan anda mengenai penyata yang disenaraikan dengan menggunakan skala berikut:*

1 – Strongly Disagree , 2 – Disagree , 3 – Modrate , 4 – Agree , 5 – Strongly Agree

*1 – Sangat Tidak Setuju , 2 – Tidak Setuju , 3 – Sederhana , 4 – Setuju , 5 – Sangat Setuju*

| **STATMENT / PERNYATAAN** | **1** | **2** | **3** | **4** | **5** |
|---|---|---|---|---|---|
| I haved see or found biomimicry bookshelf in Malaysia before.<br><br>*Saya pernah melihat atau menjumpai rak buku biomimikri di Malaysia sebelum ini.* | | | | | |
| I am impressive with the new biomimicry design of bookshelf.<br><br>*Saya kagum dengan reka bentuk biomimikri baharu rak buku.* | | | | | |
| I understand the objective of this biomimicry bookshelf to build for.<br><br>*Saya faham objektif rak buku biomimikri ini dibina.* | | | | | |
| I would like to recommend the biomimicry bookshelf to my friends.<br><br>*Saya ingin mengesyorkan rak buku biomimikri kepada rakan-rakan saya.* | | | | | |

**SECTION 3 – Performance of the biomimetic wood furniture design / Prestasi reka bentuk perabot kayu biomimetik** .

Indicates your lavel of agreement regarding the listed statment by using the following scale:

*Tunjukkan tahap persetujuan anda mengenai penyata yang disenaraikan dengan menggunakan skala berikut:*

1 – Strongly Disagree , 2 – Disagree , 3 – Modrate , 4 – Agree , 5 – Strongly Agree

*1 – Sangat Tidak Setuju , 2 – Tidak Setuju , 3 – Sederhana , 4 – Setuju , 5 – Sangat Setuju*

| **STATMENT / PERNYATAAN** | **1** | **2** | **3** | **4** | **5** |
|---|---|---|---|---|---|
| **A. FUNCTIONALITY / FUNGSI** | | | | | |
| Do you want to use this bookshelf to organize and store your books?<br><br>*Adakah anda mahu menggunakan rak buku ini untuk menyusun dan menyimpan buku anda?* | | | | | |
| Do you believe that the presence of this biomimetic bookshelf can provide additional motivation for you to read and dig for knowledge?<br><br>*Adakah anda percaya dengan kehadiran rak buku biomimetik ini dapat memberikan motivasi tambahan untuk anda membaca dan menggali ilmu?* | | | | | |
| Do you think this bookshelf able to accommodate your book collection?<br><br>*Adakah anda merasa rak buku ini mampu untuk menampung koleksi buku anda?* | | | | | |
| Do you think this shell bookshelf can help users find books quickly?<br><br>*Adakah anda merasa rak buku cengkerang ini dapat membantu pengguna dalam mencari buku-buku dengan cepat?* | | | | | |

| B. AESTHETIC / ESTETIK | | | | | |
|---|---|---|---|---|---|
| Do you think this biomimetic bookshelf provides aesthetic utility to your living room or reading room?<br><br>*Adakah anda fikir rak buku biomimetik ini menyediakan utiliti estetik ke ruang tamu atau ruang bacaan anda?* | | | | | |
| Do you feel that a well-organized bookshelf has a positive effect on the overall atmosphere of the room?<br><br>*Adakah anda merasa rak buku yang diatur dengan baik memberikan kesan positif terhadap atmosfera ruangan secara keseluruhan?* | | | | | |
| Do you feel that this bookshelf based on the design of the shell will coordinate with the decoration or design of library?<br><br>*Adakah anda merasa rak buku berdasarkan reka bentuk cengkerang ini akan menyelaras dengan hiasan atau rekabentuk ruangan pusat sumber?* | | | | | |
| Do you think this shell bookshelf design fits the theme of the reading room or the general decor style of your home?<br><br>*Adakah anda merasa reka bentuk rak buku cengkerang ini sesuai dengan tema ruang membaca atau gaya dekorasi umum di rumah anda?* | | | | | |
| Do you think this shell bookshelf creation is creative or innovative in arranging bookshelves to attract visual attention?<br><br>*Adakah anda merasa ciptaan rak buku cengkerang ini kreatif atau inovatif dalam menata rak buku untuk menarik perhatian visual?* | | | | | |
| Will this bookshelf be well received by aesthetic furniture enthusiasts if it is marketed?<br><br>*Adakah rak buku ini mendapat sambutan ramai oleh penggemar perabot estetik sekiranya dipasarkan?* | | | | | |
| Does this bookshelf provide balance and symmetry in the | | | | | |

| | | | | | |
|---|---|---|---|---|---|
| arrangement of books?<br><br>*Adakah rak buku ini memberikan keseimbangan dan simetri dalam penyusunan buku?* | | | | | |
| **C. BEST PRACTICE AND IMPROVEMENT** | | | | | |
| Do you think this bookshelf makes it easier for you to organize your books?<br><br>*Adakah anda merasa rak buku ini memudahkan anda untuk menyusun buku-buku anda?* | | | | | |
| Is this bookshelf able to protect books from weather conditions or moisture?<br><br>*Adakah rak buku ini mampu melindungi buku daripada keadaan cuaca atau kelembapan?* | | | | | |
| Does this bookshelf make it easier for you to identify books you haven't read yet?<br><br>*Adakah rak buku ini memudahkan anda mengenal pasti buku yang anda belum baca?* | | | | | |
| **D. SAFETY / KESELAMATAN** | | | | | |
| Do you think this bookshelf is safe for users of all ages?<br><br>*Adakah anda merasa rak buku ini selamat digunakan oleh pengguna pelbagai usia?* | | | | | |