

# **Biomimicry as a Catalyst for Innovation and Sustainable Development in Lagelu Local Government, Oyo State, Nigeria.**

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## **Abstract**

This study examined biomimicry as a catalyst for innovation and sustainable development in Lagelu Local Government Area of Oyo State, Nigeria. The objectives focused on assessing awareness, application, perceived contributions, barriers, and strategies for enhancing biomimicry adoption among construction professionals. A descriptive survey design was adopted, and data were collected using a structured questionnaire. Descriptive statistics (mean and standard deviation) and inferential statistics (one-sample t-test, correlation, and regression) were employed for data analysis. The results revealed that awareness and application of biomimicry are significantly low ( $p < 0.05$ ), while perceived benefits, barriers, and integration strategies are significantly high ( $p < 0.05$ ). Furthermore, awareness significantly correlates with application ( $r = 0.62$ ), and application significantly predicts sustainable development outcomes ( $\beta = 0.73$ ;  $R^2 = 0.53$ ). The study concludes that biomimicry has strong sustainability potential but remains underutilized. It recommends capacity building, policy support, and increased research to enhance adoption in the construction industry.

**Keywords:** Biomimicry, Innovation, Sustainable Development

## **Introduction**

The construction industry is currently experiencing a global shift toward innovative and sustainable design approaches, among which biomimicry has emerged as a promising strategy.

Biomimicry refers to the practice of learning from and emulating nature's time-tested patterns and strategies to solve human problems. As conceptualized by Benyus (2020), biomimicry involves viewing nature as a model, mentor, and measure, recognizing that natural systems have evolved over billions of years to become efficient, adaptive, and sustainable. The concept encompasses three key dimensions: emulating nature's forms (such as structures inspired by plants or animals), processes (such as energy-efficient production mechanisms), and systems (such as ecosystem-based resource cycling) (Badarnah & Kadri, 2021; Benyus, 2020). These

principles provide a framework for rethinking conventional construction methods toward more innovative and sustainable alternatives (United Nations Environment Programme (UNEP), 2024),

Innovation and Sustainable development, as defined by the United Nations through the World Commission on Environment and Development, is “development that meets the modernization and the needs of the present without compromising the ability of future generations to meet their own needs.” This concept emphasizes the integration of environmental protection, economic growth, and social equity. Within the built environment, achieving sustainable development requires a fundamental transformation in how buildings are designed, constructed, and operated. However, in Nigeria, persistent reliance on traditional construction techniques, inadequate awareness of sustainable practices, and limited adoption of innovative materials continue to hinder progress toward sustainability goals (Hussein & Abbood, 2025).

The link between biomimicry, innovation and sustainable development lies in the inherent efficiency and resilience of natural systems. Nature operates on renewable energy sources, primarily solar energy, and maintains closed-loop systems where waste from one process becomes input for another, resulting in zero waste (Pawlyn, 2020). These characteristics align closely with the principles of sustainability and innovation, making biomimicry a viable pathway for transforming the built environment. Mimicking these natural processes, construction industries can significantly reduce its environmental footprints while enhancing building performance and resilience (Zari, 2020; UNEP, 2024).

Biomimicry promotes innovation and sustainable development in several critical ways. Foremost, it enhances energy efficiency by inspiring building designs that optimize natural

ventilation, daylighting, and thermal regulation, similar to how organisms adapt to their environments (termite mounds) that reduce reliance on mechanical air conditioning. It improves resource efficiency by encouraging the use of locally available and renewable materials, thereby minimizing resource depletion. It supports waste reduction through the adoption of circular systems, where materials are reused and recycled in a manner similar to natural ecosystems. It contributes to water conservation by mimicking natural water harvesting and storage mechanisms observed in plants and animals.

In addition, biomimicry enables climate-responsive design by creating structures that adapt to local environmental conditions, thereby improving resilience to climate change (Badarnah, 2021; Goyes-Balladares, 2025). It also drives innovation in materials by promoting the development of environmentally friendly, high-performance construction materials inspired by natural substances. Despite these potentials, the application of biomimicry in Nigeria's construction industry remains relatively limited. Therefore, this study seeks to examine how biomimicry can serve as a catalyst for innovation and sustainable development in Lagelu Local Government Area (LGA).

### **Statement of the Problem**

The construction industry remains one of the largest contributors to environmental degradation globally, accounting for significant levels of energy consumption, greenhouse gas emissions, and resource depletion. Building sector is responsible for a substantial proportion of global energy demand and carbon emissions, thereby posing serious threats to sustainable development in modern building industries (Oguntona & Aigbavboa, 2023; Metwally, 2025). Despite increasing global advocacy for innovation and sustainable construction practices, conventional building practices in many areas continue to rely on resource-intensive processes that undermine

ecological balance. In response to these challenges, biomimicry has emerged as an innovative design approach that draws inspiration from nature to enhance efficiency, reduce waste, and improve environmental performance in the built environment (Ahmed & Hussein, 2024; Oguntona & Aigbavboa, 2025). However, although biomimicry has demonstrated significant potential in promoting sustainability, its practical integration into construction remains limited, particularly in developing countries.

In the Nigerian context, the adoption of biomimicry in construction practices is still at an early stage, its environmental and economic benefits is empirically limited to innovation and sustainable development (Adekunye & Oke, 2024; Hussein & Abbood, 2024). This gap creates a disconnect between theoretical advancements and practical implementation in the construction industry. Therefore, there is a need for a systematic investigation into biomimicry awareness, adoption, perceived benefits, barriers, and integration strategies to provide evidence-based insights that can enhance innovation and sustainable development in the built environment of Lagelu LGA.

### **Objectives of the Study**

The study is designed to achieve the following objectives:

1. determine the level of awareness of biomimicry among construction professionals.
2. examine the extent of application of biomimicry in the built environment of Lagelu LGA.
3. assess the perceived contributions of biomimicry to innovation and sustainable development.
4. identify the barriers to the adoption of biomimicry in construction practices.
5. evaluate the strategies for enhancing the integration of biomimicry for innovation and sustainable development.

## **Research Questions**

The following research questions guide the study.

1. What is the level of awareness of biomimicry among construction professionals?
2. To what extent is biomimicry applied in the built environment of Lagelu LGA?
3. What are the perceived contributions of biomimicry to innovation and sustainable development?
4. What are the barriers to the adoption of biomimicry in construction practices?
5. What strategies can enhance the integration of biomimicry for innovation and sustainable development?

## **Research Hypotheses**

The following null hypotheses were formulated to guide the study:

**H0<sub>1</sub>:** There is no significant level of awareness of biomimicry among construction professionals.

**H0<sub>2</sub>:** There is no significant extent of application of biomimicry in the built environment of Lagelu LGA.

**H0<sub>3</sub>:** Biomimicry has no significant perceived contribution to innovation and sustainable development in the built environment.

**H0<sub>4</sub>:** There are no significant barriers to the adoption of biomimicry in construction practices.

**H0<sub>5</sub>:** There are no significant strategies for enhancing the integration of biomimicry for innovation and sustainable development.

**H0<sub>6</sub>:** There is no significant relationship between awareness of biomimicry and its adoption.

**H0<sub>7</sub>:** Biomimicry adoption does not significantly predict innovation and sustainable development outcomes.

## **Methodology**

The study adopted a descriptive survey research design to examine awareness, application, perceived contributions, barriers, and strategies related to biomimicry in Lagelu Local Government Area (LGA), a location refers to ancient city characterized by growing construction activities and a mix of urban and semi-urban development. The population comprised construction professionals, including architects, builders, engineers, and quantity surveyors within the area, totaling 68 respondents. Given the relatively small and accessible population, a census sampling technique was employed, allowing all identified professionals to participate in the study and thereby eliminating sampling bias while ensuring comprehensive data coverage.

Data were collected using a structured questionnaire developed by the researchers, consisting of 35 items measured on a 4-point Likert scale (Highly Aware/Highly Applied/Strongly Agree (4 points) = 3.50 – 4.00, Aware/Applied/Agree (3 points) = 2.50 – 3.49, Low Awareness/ Low Application/Disagree (2 points) = 1.50 – 2.49, Not Aware/ Not Applied /Strongly Disagree (1 point) = 1.00 – 1.49). The instrument covered five key variables: awareness, application, perceived contributions, barriers, and strategies related to biomimicry. The instrument was validated through face and content validation by experts in building technology to ensure clarity and relevance. Reliability was established using the Cronbach Alpha method, yielding a coefficient of 0.81, indicating good internal consistency. Ethical considerations were strictly observed: respondents were informed about the purpose of the study, participation was voluntary, confidentiality and anonymity were guaranteed, and data were used strictly for Research purposes. The administration of the questionnaire was carried out directly by the researcher to ensure a high response rate and proper guidance which yielded hundred percent.

Data analysis involved both descriptive and inferential statistics. Mean and standard deviation were used to answer the research questions, with a decision rule of 2.50 as the acceptance benchmark. Inferential statistics included one-sample t-test for testing the hypotheses and multiple regression analysis to examine the predictive influence of awareness and application on innovation and sustainable development outcomes. The regression model for the study was specified as:  $Y = \beta_0 + \beta_1X_1 + \beta_2X_2 + \varepsilon$

## Results

**Research Question 1:** What is the level of awareness of biomimicry among construction professionals?

**Table 1: Mean and Standard Deviation of Awareness of Biomimicry among construction professionals**

N = 68				
S/N	Items	Mean ( $\bar{x}$ )	SD	Remark
1	I am familiar with the concept of biomimicry.	1.36	0.62	Not Aware
2	Biomimicry involves learning from nature to solve human problems.	3.12	0.78	Aware
3	I have heard about biomimicry in construction practices.	2.18	0.90	Low Awareness
4	Biomimicry is relevant to sustainable building design.	1.41	0.66	Not Aware
5	I understand the principles of biomimicry	1.44	0.69	Not Aware
6	I am aware of examples of biomimicry in architecture or construction.	2.33	0.85	Low Awareness
7	Biomimicry is gaining attention in the modern construction industry.	2.88	0.81	Aware
<b>Grand Mean</b>		<b>2.10</b>	<b>0.76</b>	<b>Low Awareness</b>

The results in table 1 show that the mean scores range from 1.36 to 3.12. Three items recorded mean values less than 1.49 ( $\bar{x} < 1.49$ ), indicating lack of awareness, while five items fall within the interval  $1.50 \leq \bar{x} \leq 2.49$ , reflecting low awareness. Only two items exceeded the threshold of 2.50, indicating awareness. The computed grand mean of 2.10 satisfies the condition  $1.50 \leq \bar{x} \leq 2.49$ , which implies that respondents generally exhibit a low level of awareness of

biomimicry. The grand standard deviation of 0.76 ( $SD < 1.00$ ) indicates low dispersion, suggesting that responses are relatively consistent.

**Research Question 2:** To what extent is biomimicry applied in the built environment of Lagelu LG?

**Table 2: Mean and Standard Deviation of Application of Biomimicry in the Built Environment**  
N = 68

S/N	Items	Mean ( $\bar{x}$ )	SD	Remark
1	Biomimicry principles are applied in building design projects.	1.38	0.64	Not Applied
2	Nature-inspired solutions are used in construction practices.	2.21	0.88	Low Application
3	Biomimicry influences structural design decisions	1.44	0.69	Not Applied
4	Biomimicry is considered during material selection.	2.30	0.83	Low Application
5	Biomimicry is used in energy-efficient building design.	2.62	0.79	Applied
6	Biomimicry is applied in ventilation and cooling systems.	1.41	0.66	Not Applied
7	Biomimicry is integrated into construction projects in my area.	2.18	0.91	Low Application
<b>Grand Mean</b>		<b>1.93</b>	<b>0.77</b>	<b>Low Application</b>

The results in Table 2 indicate that the mean scores range from 1.38 to 2.62. Three items recorded mean values below 1.49 ( $\bar{x} < 1.49$ ), indicating that biomimicry is not applied in those aspects of construction practices. Four items fall within the interval  $1.50 \leq \bar{x} \leq 2.49$ , reflecting a low level of application, while only one item exceeded the threshold of 2.50, indicating moderate application. The computed grand mean of 1.93 satisfies the condition  $1.50 \leq \bar{x} \leq 2.49$ , which implies that the overall level of application of biomimicry in the built environment is low. The grand standard deviation of 0.77 ( $SD < 1.00$ ) indicates low variability among responses, suggesting that respondents share similar views regarding the limited application of biomimicry.

**Research Question 3:** What are the perceived contributions of biomimicry to sustainable development?

**Table 3: Mean and Standard Deviation of Perceived Contributions of Biomimicry to Innovation and Sustainable Development.**

N = 68				
S/N	Items	Mean ( $\bar{x}$ )	SD	Remark
1	Biomimicry enhances energy efficiency in buildings.	3.42	0.68	Agree
2	Biomimicry reduces material waste in construction.	3.36	0.72	Agree

3	Biomimicry promotes environmentally friendly construction practices.	3.48	0.65	Agree
4	Biomimicry improves resource efficiency.	3.31	0.70	Agree
5	Biomimicry supports climate-responsive building design.	3.44	0.66	Agree
6	Biomimicry reduces environmental pollution.	3.29	0.73	Agree
7	Biomimicry contributes to long-term sustainability in the built environment.	3.47	0.67	Agree
<b>Grand Mean</b>		<b>3.40</b>	<b>0.69</b>	<b>Agree</b>

The results in Table 3 show that the mean scores range from 3.29 to 3.48, all of which fall within the interval  $2.50 \leq \bar{x} \leq 3.49$ . This indicates that respondents agree that biomimicry contributes positively to innovation and sustainable development. The grand mean of 3.40 satisfies the condition  $\bar{x} > 2.50$ , confirming overall agreement. The grand standard deviation of 0.69 ( $SD < 1.00$ ) indicates low variability, suggesting a high level of consistency in responses.

**Research Question 4:** What are the barriers to the adoption of biomimicry in construction practices?

**Table 4: Mean and Standard Deviation of Barriers to Adoption of Biomimicry**

		N = 68		
S/N	Items	Mean ( $\bar{x}$ )	SD	Remark
1	Lack of awareness limits the adoption of biomimicry.	3.45	0.66	Agree
2	Lack of technical knowledge hinders its implementation.	3.39	0.71	Agree
3	High cost of biomimicry discourages its use.	3.33	0.75	Agree
4	Lack of skilled professionals affects its adoption.	3.28	0.73	Agree
5	Absence of supportive government policies limits its application.	3.41	0.69	Agree
6	Limited research and information restrict its use.	3.36	0.72	Agree
7	Resistance to change in the construction industry affects adoption.	3.22	0.78	Agree
<b>Grand Mean</b>		<b>3.35</b>	<b>0.72</b>	<b>Agree</b>

The results in Table 4 indicate that the mean values range from 3.22 to 3.45, all within the range  $2.50 \leq \bar{x} \leq 3.49$ . This implies that respondents agree that the listed factors constitute barriers to the adoption of biomimicry. The grand mean of 3.35 satisfies the condition  $\bar{x} > 2.50$ , indicating overall agreement. The grand standard deviation of 0.72 ( $SD < 1.00$ ) shows low dispersion, suggesting consistency in respondents' opinions.

**Research Question 5:** What strategies can enhance the integration of biomimicry for innovation and sustainable development?

**Table 5: Mean and Standard Deviation of Strategies for Enhancing Biomimicry Integration**

N = 68				
S/N	Items	Mean ( $\bar{x}$ )	SD	Remark
1	Training programs can improve biomimicry adoption.	3.51	0.64	Strongly Agree
2	Inclusion of biomimicry in academic curricula will enhance awareness	3.47	0.68	Agree
3	Government policies can promote biomimicry in construction.	3.52	0.63	Strongly Agree
4	Research and development can improve its application.	3.49	0.67	Agree
5	Collaboration among professionals can enhance adoption.	3.44	0.70	Agree
6	Public awareness campaigns can increase its usage.	3.46	0.69	Agree
7	Financial incentives can encourage biomimicry implementation.	3.50	0.65	Strongly Agree
<b>Grand Mean</b>		<b>3.48</b>	<b>0.67</b>	<b>Agree</b>

The results in Table 5 show that the mean scores range from 3.44 to 3.52. Three items recorded mean values greater than or equal to 3.50 ( $\bar{x} \geq 3.50$ ), indicating strong agreement, while the remaining items fall within  $2.50 \leq \bar{x} \leq 3.49$  indicating agreement. The grand mean of 3.48 satisfies the condition  $\bar{x} > 2.50$ , indicating that respondents generally agree on the effectiveness of the proposed strategies. The grand standard deviation of 0.67 ( $SD < 1.00$ ) indicates low variability, suggesting consistent responses.

### Hypothesis 1

**H<sub>01</sub>:** There is a statistically significant low level of awareness of biomimicry among construction professionals.

**Table 6: One-Sample t-test Analysis of Awareness of Biomimicry**

Variable	N	Mean ( $\bar{x}$ )	SD	t-value	df	Sig. (2-tailed)	Mean Difference	Decision
Awareness of Biomimicry	68	2.10	0.76	-4.35	67	0.000	-0.40	Reject (H <sub>0</sub> )

The results presented in Table 6 indicate that the mean score for awareness of biomimicry is 2.10, which is lower than the test value of 2.50. The computed t-value of -4.35 with 67 degrees of freedom is statistically significant at  $p = 0.000$  ( $p < 0.05$ ), indicating a significant difference between the observed mean and the benchmark mean. Mathematically, since  $\bar{x} = 2.10 < 2.50$

and  $p < 0.05$ , the null hypothesis is rejected. This implies that the level of awareness of biomimicry among construction professionals is significantly low. Furthermore, the negative mean difference (-0.40) confirms that the observed awareness level falls below the expected average level; thus, there is a statistically significant low level of awareness of biomimicry among construction professionals.

### Hypothesis 2

**H<sub>02</sub>:** There is no significant extent of application of biomimicry in the built environment of Lagelu LG.

**Table 7: One-Sample t-test Analysis of Application of Biomimicry**

Variable	N	Mean ( $\bar{x}$ )	SD	t-value	df	Sig. (2-tailed)	Mean Difference	Decision
Application of Biomimicry	68	1.93	0.77	-5.62	67	0.000	-0.57	Reject (H <sub>0</sub> )

The results in Table 7 show that the mean score for application of biomimicry is 1.93, which is lower than the test value of 2.50. The computed t-value of -5.62 with 67 degrees of freedom is statistically significant at  $p = 0.000$  ( $p < 0.05$ ), indicating a significant difference between the observed mean and the benchmark mean. Mathematically, since  $\bar{x} = 1.93 < 2.50$  and  $p < 0.05$ , the null hypothesis is rejected. This implies that the level of application of biomimicry in the built environment in Lagelu LG is significantly low, and the negative mean difference (-0.57) further confirms that the observed application-level falls below the expected average.

### Hypothesis 3

**H<sub>03</sub>:** Biomimicry has no significant perceived contribution to innovation and sustainable development in the built environment.

**Table 8: One-Sample t-test Analysis of Perceived Contributions**

Variable	N	Mean ( $\bar{x}$ )	SD	t-value	df	Sig. (2-tailed)	Mean Difference	Decision
Perceived Contributions	68	3.40	0.69	10.73	67	0.000	0.90	Reject (H <sub>0</sub> )

The results in Table 8 indicate that the mean score for perceived contributions of biomimicry is 3.40, which is higher than the test value of 2.50. The computed t-value of 10.73 with 67 degrees of freedom is statistically significant at  $p = 0.000$  ( $p < 0.05$ ), indicating a significant difference between the observed mean and the benchmark mean. Mathematically, since  $\bar{x} = 3.40 > 2.50$  and  $p < 0.05$ , the null hypothesis is rejected. This implies that biomimicry has significant positive contributions to sustainable development, and the positive mean difference (0.90) confirms that respondents strongly perceive its benefits.

#### Hypothesis 4

**H04:** There are no significant barriers to the adoption of biomimicry in construction practices.

**Table 9: One-Sample t-test Analysis of Barriers to Adoption**

Variable	N	Mean ( $\bar{x}$ )	SD	t-value	df	Sig. (2-tailed)	Mean Difference	Decision
Barriers to Adoption	68	3.35	0.72	9.82	67	0.000	0.85	Reject (H <sub>0</sub> )

The results in Table 9 show that the mean score for barriers to adoption is 3.35, which is higher than the test value of 2.50. The computed t-value of 9.82 with 67 degrees of freedom is statistically significant at  $p = 0.000$  ( $p < 0.05$ ), indicating a significant difference between the observed mean and the benchmark mean. Mathematically, since  $\bar{x} = 3.35 > 2.50$  and  $p < 0.05$ , the null hypothesis is rejected. This implies that there are significant barriers to the adoption of biomimicry in construction practices, and the positive mean difference (0.85) confirms that these barriers are strongly perceived by respondents.

#### Hypothesis 5

**H05:** There are no significant strategies for enhancing the integration of biomimicry for innovation and sustainable development.

**Table 10: One-Sample t-test Analysis of Strategies for Integration**

Variable	N	Mean ( $\bar{x}$ )	SD	t-value	df	Sig. (2-tailed)	Mean Difference	Decision
Strategies for Integration	68	3.48	0.67	11.45	67	0.000	0.98	Reject (H <sub>0</sub> )

The results in Table 10 indicate that the mean score for strategies for enhancing biomimicry integration is 3.48, which is higher than the test value of 2.50. The computed t-value of 11.45 with 67 degrees of freedom is statistically significant at  $p = 0.000$  ( $p < 0.05$ ), indicating a significant difference between the observed mean and the benchmark mean. Mathematically, since  $\bar{x} = 3.48 > 2.50$  and  $p < 0.05$ , the null hypothesis is rejected. This implies that there are significant strategies for enhancing biomimicry integration, and the positive mean difference (0.98) confirms strong agreement among respondents regarding these strategies.

### Hypothesis 6

**H06:** There is no significant relationship between awareness of biomimicry and its adoption.

**Table 11: Correlation Analysis between Awareness and Application of Biomimicry**

Variable	N	Mean ( $\bar{x}$ )	SD	r	Sig. (2-tailed)	Decision
Awareness	68	2.10	0.76	0.62	0.000	Reject (H <sub>0</sub> )
Application	68	1.93	0.77			

The results in Table 11 reveal a Pearson correlation coefficient of  $r = 0.62$  between awareness and application of biomimicry, indicating a strong positive relationship. The p-value of 0.000 ( $p < 0.05$ ) shows that the relationship is statistically significant. Mathematically, since  $r = 0.62$  and  $p < 0.05$ , the null hypothesis is rejected. This implies that an increase in awareness of biomimicry is associated with a corresponding increase in its application in the built environment. The strength of the correlation suggests that awareness plays a critical role in influencing adoption among construction professionals.

### Hypothesis 7

**H07:** Biomimicry adoption does not significantly predict innovation and sustainable development outcomes.

**Table 12: Regression Analysis of Application on innovation and Sustainable Development**

Variable	Beta ( $\beta$ )	Std. Error	t-value	Sig.	R	R <sup>2</sup>	F	Decision
Awareness	0.92	0.20	4.60	0.000	0.73	0.53	75.21	Reject
Application	0.73	0.08	8.67					

The results in Table 12 indicate that biomimicry application significantly predicts sustainable development outcomes. The regression coefficient for application ( $\beta = 0.73$ ) is positive and statistically significant at  $p = 0.000$  ( $p < 0.05$ ), indicating a strong predictive effect. The model shows a correlation coefficient of  $R = 0.73$  and a coefficient of determination of  $R^2 = 0.53$ , implying that 53% of the variation in sustainable development is explained by biomimicry application. The F-value of 75.21 further confirms that the model is statistically significant. Mathematically, since  $\beta > 0$  and  $p < 0.05$ , the null hypothesis is rejected. This implies that biomimicry adoption significantly predicts innovation and sustainable development outcomes in the built environment.

### **Findings of the Study**

- The level of awareness of biomimicry among construction professionals is significantly low ( $\bar{x} < 2.50$ ;  $p < 0.05$ ), indicating limited awareness with biomimicry concept familiarity, principles, relevance in architecture or construction. Mathematically, since  $\bar{x} = 2.10 < 2.50$  and  $p < 0.05$ , the null hypothesis is rejected.
- The extent of application of biomimicry in the built environment is significantly low ( $\bar{x} < 2.50$ ;  $p < 0.05$ ), suggesting minimal practical implementation in structural design decisions, energy-efficient building design, integrated into construction projects. Mathematically, since  $\bar{x} = 1.93 < 2.50$  and  $p < 0.05$ , the null hypothesis is rejected.
- The perceived contributions of biomimicry to sustainable development are significantly high ( $\bar{x} > 2.50$ ;  $p < 0.05$ ), showing strong recognition of its benefits in enhancing energy efficiency, reduces material waste and contributes to long-term sustainability in the built environment. Mathematically, since  $\bar{x} = 3.40 > 2.50$  and  $p < 0.05$ , the null hypothesis is rejected.

- There are significant barriers to the adoption of biomimicry ( $\bar{x} > 2.50$ ;  $p < 0.05$ ), including lack of awareness, inadequate expertise, high cost, and weak policy support. Mathematically, since  $\bar{x} = 3.35 > 2.50$  and  $p < 0.05$ , the null hypothesis is rejected.
- There are significant and effective strategies for enhancing biomimicry integration ( $\bar{x} > 2.50$ ;  $p < 0.05$ ), such as training, curriculum inclusion, policy frameworks, and financial incentives. Mathematically, since  $\bar{x} = 3.48 > 2.50$  and  $p < 0.05$ , the null hypothesis is rejected.
- A strong positive relationship exists between awareness and application of biomimicry ( $r = 0.62$ ;  $p < 0.05$ ), indicating that increased awareness leads to higher adoption.
- Biomimicry application significantly predicts innovation and sustainable development outcomes ( $\beta = 0.73$ ;  $p < 0.05$ ;  $R^2 = 0.53$ ), confirming its critical role in improving sustainability performance.

### **Discussion of Findings**

The findings of RQ1 revealed that the level of awareness of biomimicry among construction professionals is significantly low ( $\bar{x} < 2.50$ ) and the one-sample t-test ( $p < 0.05$ ), leading to the rejection of  $H_{01}$ . This finding aligns with previous studies which reported limited awareness of biomimicry concepts among professionals in developing construction sectors (Oguntona & Aigbavboa, 2025; Adekunye & Oke, 2024). The low level of awareness suggests that biomimicry has not been sufficiently integrated into professional training and practice. This supports the proposition of the Diffusion of Innovation Theory by Everett Rogers, which posits that awareness is the first stage in the adoption process; without adequate awareness, subsequent adoption is unlikely.

Similarly, the findings for RQ2 indicated that the extent of application of biomimicry in the built environment is significantly low ( $\bar{x} < 2.50$ ;  $p < 0.05$ ), resulting in the rejection of  $H_{02}$ . This result

corroborates earlier studies that identified a gap between knowledge and practical implementation of sustainable innovations in construction (Hussein & Abbood, 2024; Ahmed & Hussein, 2024). Despite the growing global interest in biomimicry, its actual use in construction projects remains limited, particularly in developing contexts like that of Lagelu LGA. This suggests that awareness alone is insufficient to drive adoption, as practical, institutional, and technical factors also play critical roles.

In contrast, the findings for RQ3 showed that the perceived contributions of biomimicry to sustainable development are significantly high ( $\bar{x} > 2.50$ ;  $p < 0.05$ ), leading to the rejection of  $H_{03}$ . Respondents acknowledged that biomimicry enhances energy efficiency, reduces environmental impact, and promotes resource sustainability. This is consistent with studies that highlight biomimicry as a transformative approach for achieving sustainability in the built environment (Aguilar-Planet & Peralta, 2024; Metwally, 2025). The high perception of benefits, despite low awareness and application, indicates a latent acceptance of biomimicry's value among professionals.

The findings for RQ4 further revealed that there are significant barriers to the adoption of biomimicry ( $\bar{x} > 2.50$ ;  $p < 0.05$ ), resulting in the rejection of  $H_{04}$ . Key barriers identified include lack of awareness, insufficient technical expertise, high implementation costs, and weak policy support. This finding is in agreement with Adekunye and Oke (2024); Rahubadda & Kulatunga (2024), who emphasized that structural and institutional challenges limit the adoption of innovative construction practices in Nigeria. These barriers reflect systemic issues that hinder the diffusion of sustainable innovations.

Conversely, the findings for RQ5 indicated that there are significant strategies for enhancing the integration of biomimicry into building constructions ( $\bar{x} > 2.50$ ;  $p < 0.05$ ), leading to the rejection of  $H_{05}$ . Strategies such as professional training, curriculum development, policy frameworks, and financial incentives were strongly supported by respondents. This aligns with global recommendations that emphasize capacity building and policy intervention as critical drivers for sustainable innovation adoption (Oguntona & Aigbavboa, 2025; Al-Masri *et al.*, 2025). The presence of clear strategies suggests that the barriers identified can be effectively addressed through coordinated efforts.

Furthermore, the study established a significant positive relationship between awareness and application of biomimicry ( $r = 0.62$ ;  $p < 0.05$ ), leading to the rejection of  $H_{06}$ . This finding confirms that increased awareness directly influences the level of adoption, supporting the argument that knowledge dissemination is essential for innovation uptake. This is consistent with the Diffusion of Innovation Theory, which highlights awareness as a precursor to adoption.

Finally, the regression analysis revealed that biomimicry application significantly predicts sustainable development outcomes ( $\beta = 0.73$ ;  $p < 0.05$ ;  $R^2 = 0.53$ ), resulting in the rejection of  $H_{07}$ . This indicates that application is a strong determinant of sustainability performance in the built environment of Lagelu LGA. The finding supports the principles of Ecological Modernization Theory, which emphasizes the role of technological and design innovations in achieving environmental sustainability (Ahmed & Hussein, 2024; Karimi, *et al.*, 2025). It also reinforces the argument that practical implementation, rather than mere awareness, is the key driver of sustainable development.

## **Conclusion**

The study examined the biomimicry as a catalyst for innovations and sustainable development in Lagelu Local Government Area. The study established and revealed that both awareness and application of biomimicry among construction professionals are significantly low, despite strong acknowledgment of its contributions to sustainable development. The study also, identified significant barriers hindering adoption, recognized viable strategies for enhancing integration and confirmed a significant positive relationship between awareness and application, as well as a strong predictive effect of application on sustainable development outcomes. Lastly, the findings establish a clear pathway in which awareness influences application, and application in turn drives sustainable development outcomes. However, the persistence of significant barriers alongside low awareness and application highlights the need for targeted interventions to bridge the gap between knowledge and practice in the construction industry.

## **Recommendations**

Based on the findings of the study, the following recommendations are proposed:

- **Capacity Building:** Professional bodies and construction firms should organize regular training, workshops, and seminars to improve awareness and technical understanding of biomimicry among practitioners.
- **Curriculum Integration:** Educational institutions should incorporate biomimicry principles into architecture, engineering, building technology and building technology education curricula to foster early exposure and skill development.
- **Policy and Regulatory Support:** Government agencies should develop and implement policies that promote the adoption of biomimicry and other sustainable construction practices through standards, guidelines, and enforcement mechanisms.

- **Industry Collaboration:** Collaboration among professionals, researchers, and policymakers should be strengthened to facilitate knowledge exchange and accelerate the adoption of biomimicry through research and development.
- **Awareness Campaigns:** Public and industry-wide awareness campaigns should be conducted to highlight the benefits and practical applications of biomimicry in sustainable development.

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