

EXTRACTION, DIGITIZATION, AND TEXTILE APPLICATION OF *KÒKÒRÒ* (INSECTS)-INSPIRED MOTIFS FROM YORÙBÁLAND FOR SURFACE PATTERN DESIGN AND DIGITAL FABRIC PRINTING

CHRISTIANAH Y. KOLAWOLE¹, OLAYINKA O. BAKARE², SAMINU S. YAKUBU³

¹Department of Industrial Design, Modibbo Adama University, Yola

²Department of Industrial Design, Modibbo Adama University, Yola

³Department of Industrial Design, Modibbo Adama University, Yola

Christianah Y. Kolawole: kolawolechristianahyetunde@gmail.com

Corresponding Author: CHRISTIANAH Y. KOLAWOLE

ABSTRACT

This study explores the extraction, digitization, and application of *Kòkòrò* (Insects)-inspired motifs from Yorùbáland for contemporary textile surface design using digital printing techniques.

Kòkòrò (Yorùbá term for insects) are culturally embedded within Yorùbá worldview, appearing in proverbs, folklore, and symbolic expressions associated to diligence, transformation, and resilience. The research adopts a practice-based design methodology integrating photographic documentation, motif abstraction, computer-aided design (CAD), and textile prototyping. Digital printing technologies enable precise color application and motif reproduction, enhancing design accuracy and scalability in textile production. Motifs derived from selected *Kòkòrò* (Insects) forms were digitized and developed into repeat patterns, which were applied to fabric substrates using digital textile printing. The resulting textile samples were evaluated based on aesthetic quality, motif clarity, and color performance. Findings indicate that indigenous insect forms can be effectively transformed into contemporary textile designs, contributing to innovative surface pattern development. The study demonstrates the potential of integrating indigenous visual resources with modern textile technologies, thereby promoting cultural sustainability through the preservation, reinterpretation, and contemporary application of Yorùbá insect motifs, while enhancing innovation in textile surface design.

KEYWORDS: Computer-aided design (CAD); Cultural sustainability; Digital textile printing; Insect-inspired motifs; Motif digitization; Textile surface design; Yorùbáland

1. INTRODUCTION

Textile surface design involves the creation and application of motifs, patterns, and color schemes in fabric production (Braddock & O'Mahony, 1998; Udale, 2014; Woodhead Publishing, 2011). Textile design in Yorùbá culture is deeply rooted in symbolic representation, where visual forms are derived from environmental observation, oral traditions, and philosophical meaning systems. Among these visual sources, natural organisms such as insects (*Kòkòrò*) hold significant interpretive value in Yorùbá cosmology. In Yorùbá thought, insects are often associated with metaphorical meanings expressed through proverbs and oral narratives. For instance, butterflies are commonly linked with transformation and beauty due to their metamorphic life cycle, while dragonflies are associated with agility, movement, and transitional states between environments. As reflected Yorùbá proverbs, small creatures (*Kòkòrò*) are often used to illustrate wisdom, resilience, and subtle strength, reinforcing their role as metaphorical carriers of cultural knowledge (Drewal, Pemberton, & Abiodun, 1989; Abiodun, 2014).

These symbolic interpretations extend into visual culture, where natural forms are abstracted into motifs that communicate social values and philosophical ideas. In traditional textile practices such as *Adire*, motifs derived from environmental elements serve not only decorative purposes but also function as carriers of cultural identity and collective memory (Picton & Mack, 1979; Rovine, 2015). Despite this rich symbolic system, contemporary textile design research has largely focused on geometric and abstract motifs, with limited exploration of insect morphology as a structured and culturally grounded design source within Yorùbá visual practice.

2. MATERIALS AND METHODS

2.1 RESEARCH DESIGN

This study adopts a practice-based research methodology, which emphasizes iterative design experimentation and reflective production processes in textile development (Gray & Malins, 2004). The approach is suitable for design-led inquiry where knowledge is generated through making.

Stage 1: Practice-Based Design Framework and Motif Development

Insect selection was guided by visual distinctiveness, morphological clarity, and cultural relevance within Yorùbá ecological understanding. This aligns with biomimetic design principles, which prioritize structural and functional inspiration from natural systems (Benyus, 1997). Selected insect forms (Kòkòrò) were photographed and digitally analyzed for motif extraction.

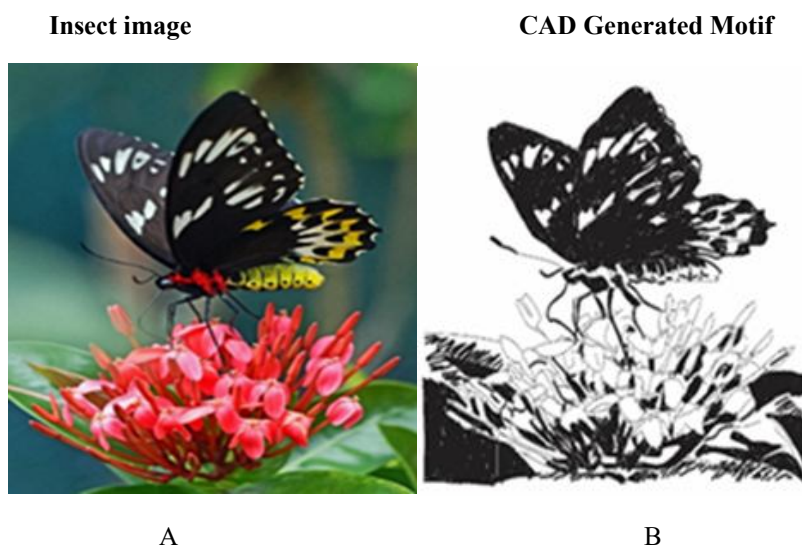


Figure 1: this is as ample of figure (A), and this is sample of figure (B) Butterfly (Labalaba)

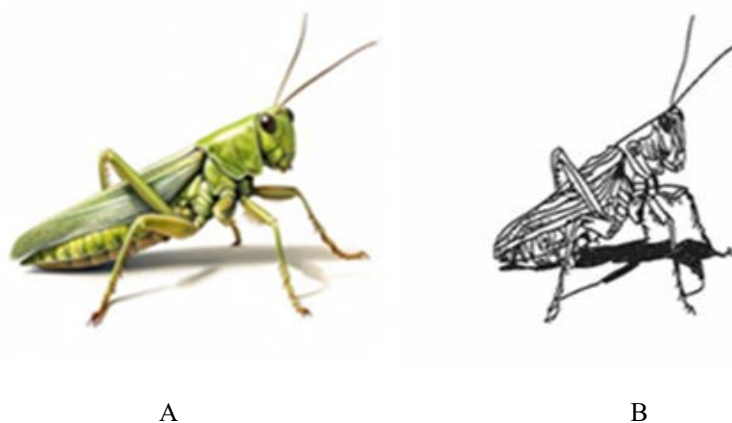


Figure 2: this is as ample of figure (A), and this is sample of figure (B) Grasshopper (Tata)

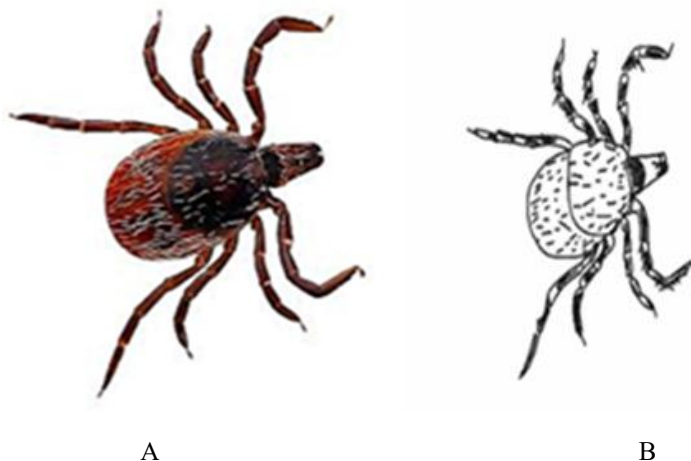


Figure 3: this is as ample of figure (A), and this is sample of figure (B) Goliath Beetle (Alikan)

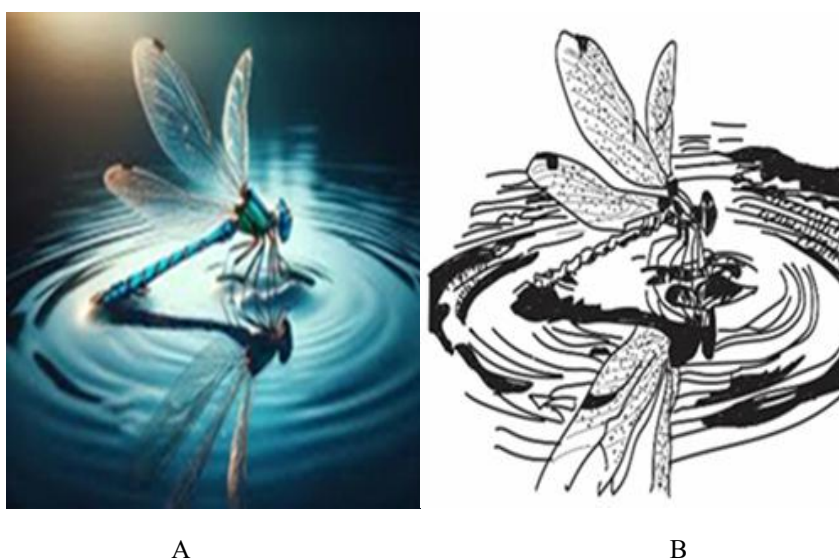


Figure 4: this is as ample of figure (A), and this is sample of figure (B) Dragonfly (Lamilami)

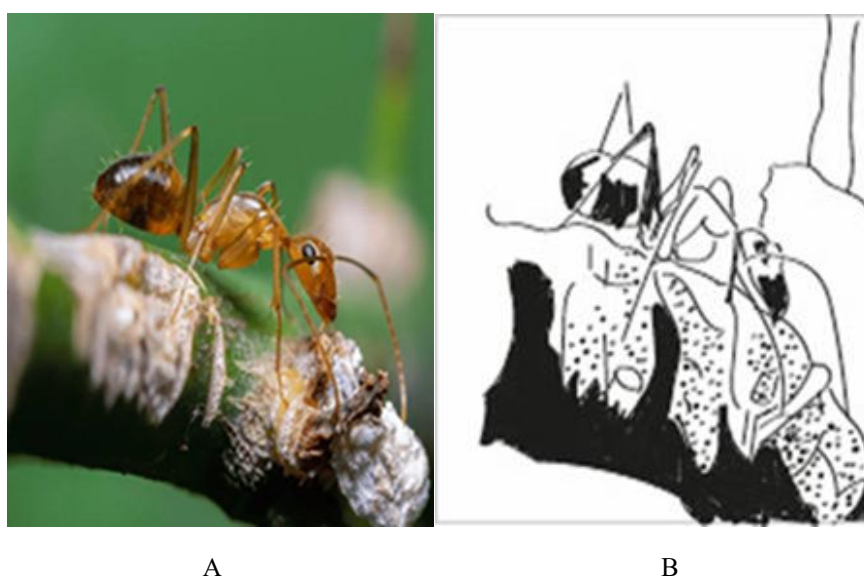


Figure 5: this is as ample of figure (A), and this is sample of figure (B) Ant (Eera)



A

B

Figure 6: this is as ample of figure (A), and this is sample of figure (B) Bee (Oyin)



A

B

Figure 7: this is as ample of figure (A), and this is sample of figure (B) Moth (Afopin ina)

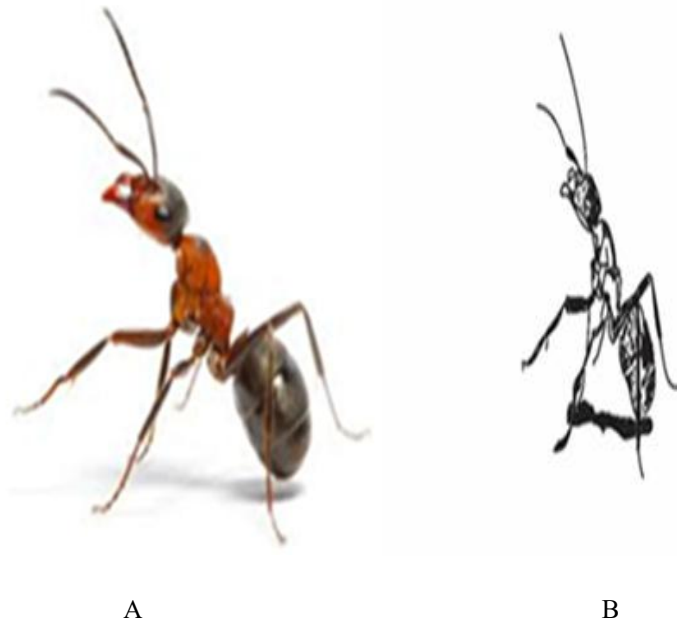


Figure 8: this is as ample of figure (A), and this is sample of figure (B) Termite (Ikan)

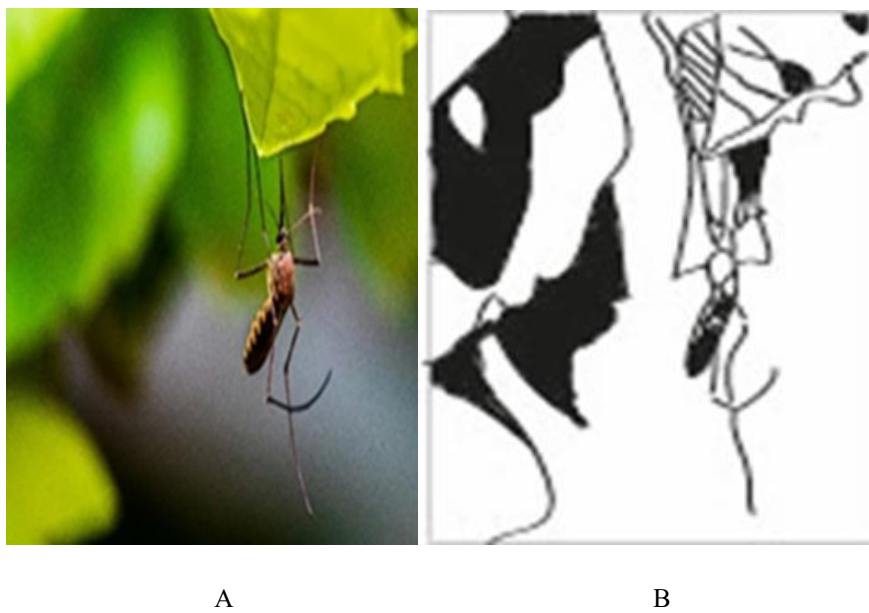


Figure 9: this is as ample of figure (A), and this is sample of figure (B) Mosquito (Efon)

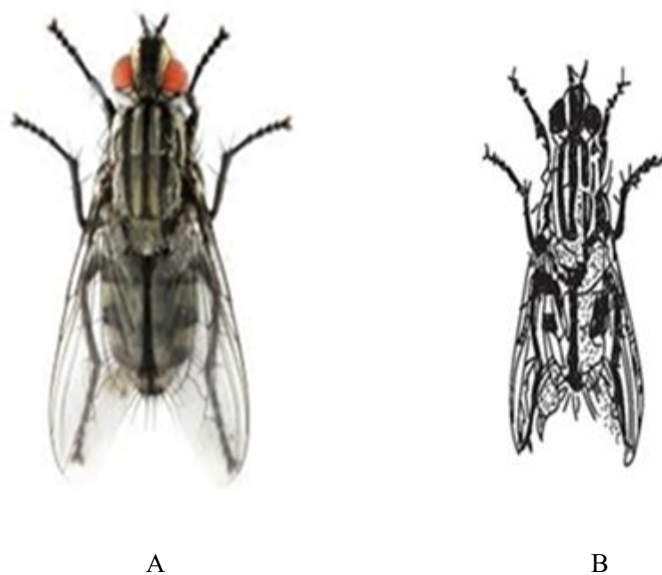


Figure 10: this is as ample of figure (A), and this is sample of figure (B) Housefly (Eshinshin)

Figure 1-10: Photographed and Digitally Analyzed Motif Extraction, Source: Kolawole C.Y (2025)

Stage 2: Digital Motif Construction Using CAD

The transformation of insect imagery into textile motifs was conducted using Computer-Aided Design (CAD) software (Adobe Illustrator). The process involved image tracing, vector simplification, abstraction of key morphological features, and repeat pattern construction as shown in figure 11(A)-20(C). CAD systems enable precision-based manipulation of motifs for scalable textile production (Jackson, 2011; Radhakrishna & Khanna, 2014).

Pattern extraction in this study as shown in figure 11(C)-20(C) refers to the systematic reduction of insect forms into simplified visual units suitable for repeat composition. This aligns with established digital textile workflows that emphasize abstraction, symmetry, and modularity in pattern design (Kipphan, 2001).

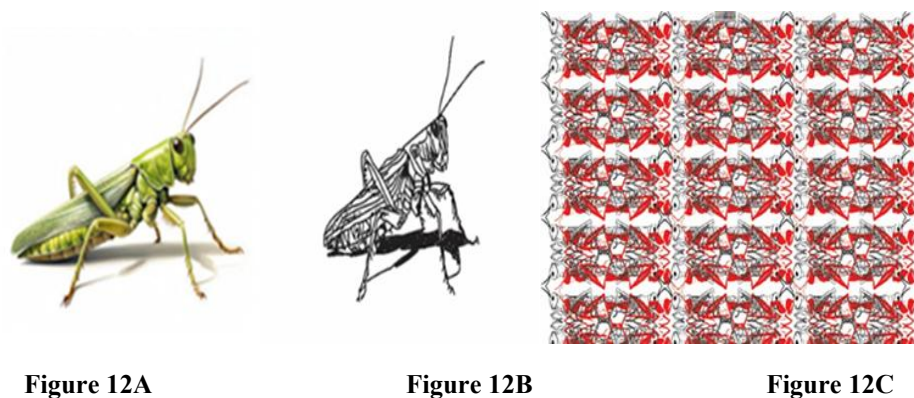
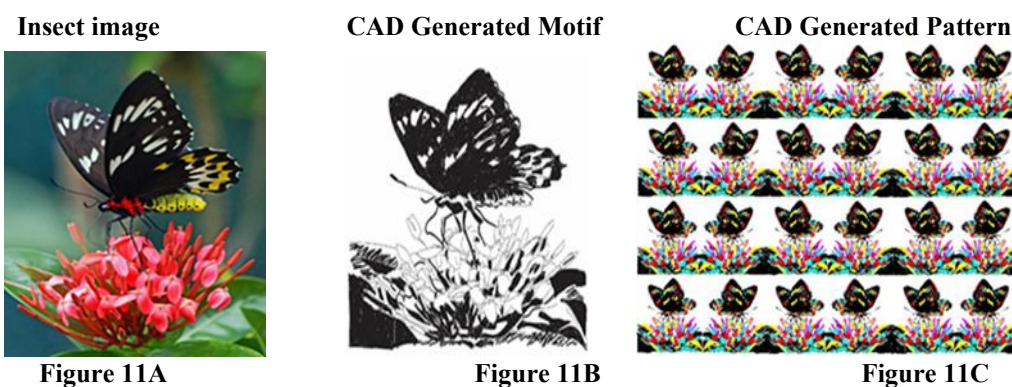




Figure 13A



Figure 13B

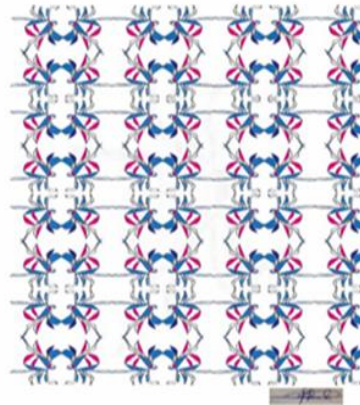


Figure 13C



Figure 14A



Figure 14B

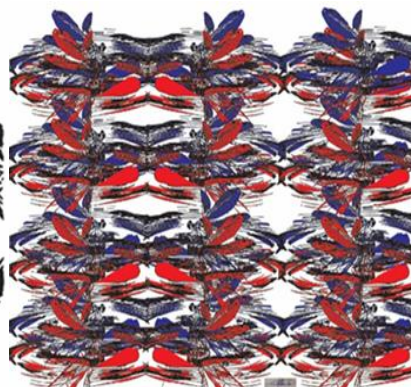


Figure 14C



Figure 15A



Figure 15B



Figure 15C



Figure 16A



Figure 16B



Figure 16C

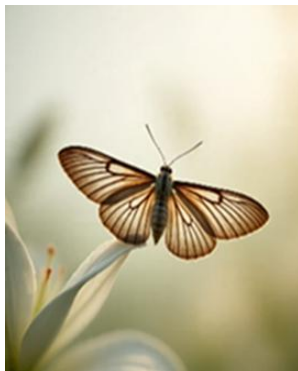


Figure 17A



Figure 17B

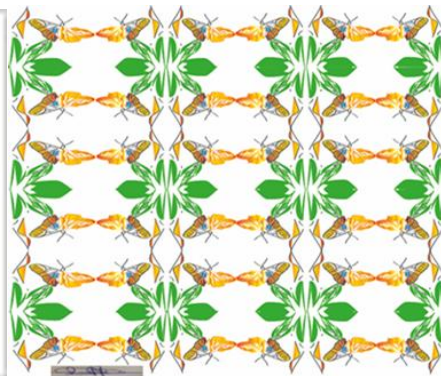


Figure 17C



Figure 18A



Figure 18B

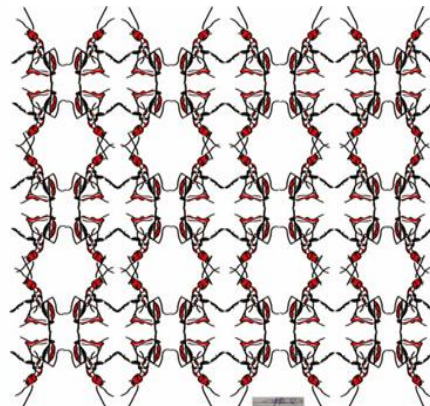


Figure 18C

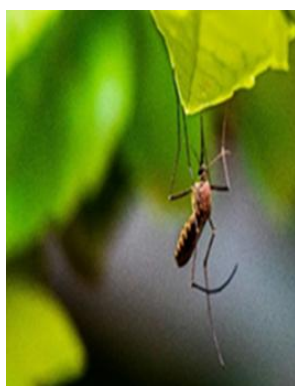


Figure 19A



Figure 19B



Figure 19C



Figure 20A



Figure 20B

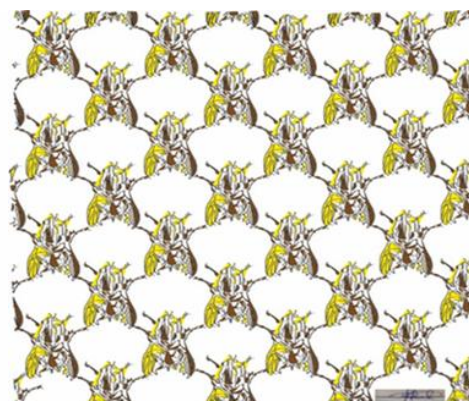


Figure 20C

Figure 11(A)-20(C): *Kòkòrò*, CAD Generated Motif, and CAD Generated Pattern,
 (Source: Kolawole C.Y, 2025).

Stage 3: Digital Printing Process (DTF)

The finalized patterns were printed using Direct-to-Film (DTF) technology, a method known for high-resolution textile surface reproduction as shown in figure 21-30. DTF involves digital design preparation (Adobe Illustrator or CorelDraw), printing onto PET Film, application of adhesive powder, curing processes (110°-130°C) for a few minutes, controlled temperature (heat transfer onto fabric), peeling the film, final press to ensure adhesion quality and color stability (Hussain & Nawaz, 2022). Standard heat press parameters were maintained within industrial ranges such as transfer temperature (130–160°C) and the pressing duration (10–20 seconds), depending on fabric type (Cotton, Silk, Linen, Polyester, Denim) (Ganesan, 2021).

The materials and equipment required for Direct-to-Film (DTF) production typically include: Pet DTF film, DTF pigment inks, Hot-melt adhesive powder, Heat press equipment.



Figure 21: Design of Butterfly on a T-shirt



Figure 22: Design of Grasshopper on a polo T-shirt



Figure 23: Design of Goliath Beetle on a T-shirt **Figure 24:** Design of Dragonfly on a 5yardage fabric



Figure 25: Design of Ant on a gown

Figure 26: Design of Bee on a T-shirt



Figure 27: Design of Moth on a T-shirt

Figure 28: Design of Termite on a Polo-shirt



Figure 29: Design of Mosquito on a T-shirt



Figure 30: Design of Housefly on a T-shirt

Figure 21-30: Textile application using digital printing (DTF), Source: Kolawole C.Y (2026)

2.2 DATA COLLECTION

Primary data included photographic images, motif designs, textile samples, and evaluation responses.

Secondary data were obtained from literature on textile design and digital printing.

2.3 EVALUATION PROCEDURE

The evaluation of the developed textile patterns was conducted using a structured survey method. The textile samples were presented to respondents for assessment based on defined criteria, including motif clarity, pattern quality, color accuracy, print quality, and aesthetic appeal. A 5-point Likert scale was employed, where 5 represented “Excellent” and 1 represented “Poor.”

Respondents were instructed to independently rate each sample according to the specified criteria. The data collected from the evaluation were analyzed using descriptive statistics, including mean and standard deviation, to determine the overall performance and ranking of the textile patterns.

2.4 DATA ANALYSIS

The data obtained from the evaluation were analyzed using descriptive statistics, including mean and standard deviation. The mean was used to determine the average rating of each textile sample across the evaluation criteria, while standard deviation measured the variability of responses among respondents. These statistical tools provided a basis for ranking the textile samples and assessing the level of agreement among evaluators.

Evaluation of textile outputs.

The mean score was calculated using the formula: $\bar{X} = \frac{\sum(f \times x)}{\sum f}$

Where: f = frequency (number of people choosing each rating)

x = rating value (e.g., 1,2,3,4,5)

$\sum f$ = Total respondents (e.g., 20)

$$s = \sqrt{\frac{\sum(x_i - \bar{x})^2}{n-1}}$$

The standard deviation was computed using the sample standard deviation formula to determine the dispersion of respondents’ ratings ground the mean.

Where x_i represents individual responses, \bar{x} is the mean score, n is the number of respondents, and denotes \sum summation.

2.5 RESPONDENT PROFILE

A total of twenty (20) respondents participated in the study. The participants comprised individuals with relevant backgrounds in textile design, art, and general consumer aesthetics, providing a range of perspective on visual appeal and cultural relevance. The demographic characteristics of the respondents, including age range, educational background, and design experience, are presented in Table 2.

The selection of respondents reflects a combination of expert and semi-expert judgement, which is considered appropriate for exploratory design studies. This diversity enhances the reliability and validity of evaluation outcomes.

3. RESULTS AND DISCUSSION

3.1 PRESENTATION OF RESULTS

The findings of this study demonstrate that insect morphology (kòkòrò) can be successfully translated into structured textile motifs through digital design processes. This supports the principles of biomimicry, where natural forms serve as generative frameworks for creative design innovation (Benyus, 1997).

The integration of Yorùbá insect symbolism into textile patterns extends traditional *Adire* aesthetics into a contemporary digital context, reinforcing the idea that indigenous visual systems can be adapted without losing cultural meaning (Abiodun, 2014). This aligns with cultural sustainability theory, which emphasizes the continuity and evolution of cultural identity within modern design systems (Soini & Birkeland, 2014; Throsby, 2008).

However, while the study demonstrates visual and conceptual success, sustainability claims must be interpreted cautiously. True sustainable textile production requires consideration of material lifecycle, ink composition, and production waste, which were not fully assessed in this study (Fletcher, 2014). Therefore, the sustainability contribution of this work is primarily cultural and design-led rather than environmental in full industrial terms.

The evaluation results indicate positive aesthetic reception of the generated motifs, supporting previous findings that structured evaluation using Likert-scale methods can capture user perception in textile design studies (Likert, 1932; Field, 2018). However, the absence of advanced statistical testing limits inferential strength, suggesting that future studies should incorporate reliability and variance analysis for stronger validation.

Table 1 presents the coding system used to identify the developed textile samples based on their corresponding insect motif sources.

Table 1: Coding of Developed Textile Samples

Sample Code	Insect Motif Source
T1	Butterfly
T2	Grasshopper
T3	Beetle
T4	Dragonfly
T5	Ant
T6	Bee
T7	Moth
T8	Termite
T9	Mosquito
T10	Housefly

Table 2: Demographic Characteristics of Respondents (N = 20)

Variable	Category	Frequency (f)	Percentage (%)
Gender	Male	8	40%
	Female	12	60%
Age Range	18-25	6	30%
	26-35	9	45%
	36-45	5	25%
Educational Level	Undergraduate	7	35%
	Graduate	13	65%
Professional Background	Textile Designers	8	40%
	Art/Design Students	7	35%
	General Consumers	5	25%

The respondents were selected based on their familiarity with textile design and visual aesthetics to ensure informed evaluation of the developed patterns.

Table 3: Mean Scores of Textile Samples Across Evaluation Criteria

Table 3 Presents the Evaluation of Insect-Based Textile Samples Based on Design Quality Attributes (N = 20).

Sample	Motif Clarity (Mean ± SD)	Pattern Quality (Mean ± SD)	Color Accuracy (Mean ± SD)	Print Quality (Mean ± SD)	Aesthetic Appeal (Mean ± SD)	Grand Mean
T1	4.60 ± 0.52	4.50 ± 0.51	4.70 ± 0.48	4.60 ± 0.50	4.80 ± 0.41	4.64
T2	4.30 ± 0.46	4.20 ± 0.52	4.40 ± 0.50	4.30 ± 0.48	4.50 ± 0.51	4.34
T3	4.40 ± 0.50	4.30 ± 0.47	4.50 ± 0.51	4.40 ± 0.49	4.60 ± 0.50	4.44
T4	4.70 ± 0.45	4.60 ± 0.50	4.80 ± 0.41	4.70 ± 0.46	4.90 ± 0.31	4.74
T5	4.10 ± 0.55	4.00 ± 0.60	4.20 ± 0.54	4.10 ± 0.53	4.30 ± 0.48	4.14
T6	4.50 ± 0.50	4.40 ± 0.51	4.60 ± 0.49	4.50 ± 0.50	4.70 ± 0.45	4.54
T7	4.20 ± 0.52	4.10 ± 0.55	4.30 ± 0.50	4.20 ± 0.52	4.40 ± 0.49	4.24
T8	4.00 ± 0.58	3.90 ± 0.60	4.10 ± 0.55	4.00 ± 0.57	4.20 ± 0.54	4.04
T9	3.90 ± 0.60	3.80 ± 0.62	4.00 ± 0.58	3.90 ± 0.60	4.10 ± 0.55	3.94
T10	4.10 ± 0.55	4.00 ± 0.60	4.20 ± 0.54	4.10 ± 0.53	4.30 ± 0.48	4.14

The results indicate that all samples performed within the “Good” to “Excellent range, with the dragonfly motif (T4) achieving the highest overall mean score as shown in table 3, which may be attributed to its visually dynamic wing structure and strong cultural association with movement and transformation, making it more appealing compared to other motifs. The standard deviation values indicate low to moderate variability among respondents’ ratings, suggesting a relatively consistent perception of the evaluated textile samples. Due to the aggregation of responses into mean criterion scores, standard deviation reflects the extent of variability in respondents’ evaluations across each design attribute, indicating the level of agreement among assessors.

Interpretation Scale (Adapted from Likert Framework) presents the interpretation scale used to categorize the mean scores obtained from the evaluation of textile samples.

Mean Range	Interpretation
4.50 – 5.00	Excellent
3.50 – 4.49	Good
2.50 – 3.49	Fair
1.50 – 2.49	Poor
1.00 – 1.49	Very Poor

The grading scale was adapted from standard Likert scale interpretation frameworks commonly used in design evaluation and textile studies.

3.2 LIMITATIONS OF THE STUDY

This study is limited by its focus on design and visual evaluation without incorporating standard physical textile performance tests such as colorfastness, wash durability, and abrasion resistance. This constraint reflects the exploratory and design-led nature of the research and limits the assessment of the durability and industrial applicability of the developed textile patterns.

Additionally, the relatively small sample size of twenty (20) respondents, may affect the generalizability of the findings. The use of purposive sampling, while appropriate for exploratory design studies, may introduce selection bias. Furthermore, the evaluation was based on subjective visual assessment, which may vary across individuals despite the use of structured criteria. Future studies should incorporate a larger and more diverse samples alongside laboratory-based performance testing to enhance the robustness of the findings.

4. CONCLUSION

This study demonstrates that *Kòkòrò* (insect)-inspired motifs can be successfully transformed into textile designs using CAD and digital printing technologies. The approach enhances innovation, supports cultural sustainability, and improves design precision. The study contributes to cultural sustainability through design innovation; however, environmental sustainability was not empirically evaluated within the scope of this research. The findings provide a framework for integrating indigenous biological resources with modern textile production methods.

Overall, the study contributes to the growing field of digitally mediated indigenous textile design by bridging Yorùbá visual culture, biomimetic inspiration, and CAD-based production systems

REFERENCES

- [1] Abiodun, R. (2014). Yoruba art and language: Seeking the African in African art. Cambridge University Press.
- [2] Benyus, J. M. (1997). Biomimicry: Innovation inspired by nature. William Morrow.
- [3] Drewal, H. J., Pemberton, J., & Abiodun, R. (1989). Yoruba: Nine centuries of African art and thought. Center for African Art.
- [4] Field, A. (2018). Discovering statistics using IBM SPSS statistics (5th ed.). Sage Publications.
- [5] Fletcher, K. (2014). Sustainable fashion and textiles: Design journeys. Routledge.
- [6] Ganesan, P. (2021). Digital textile printing technologies and applications. *Journal of Textile Engineering*, 12(3), 45–52.
- [7] Gray, C., & Malins, J. (2004). Visualizing research: A guide to the research process in art and design. Ashgate.
- [8] Hussain, T., & Nawaz, M. (2022). Advances in direct-to-film printing for textile applications. *Textile Research Journal*, 92(15–16), 2890–2902.
- [9] Jackson, P. (2011). Digital textile design. Thames & Hudson.
- [10] Kipphan, H. (2001). Handbook of print media. Springer.
- [11] Likert, R. (1932). A technique for the measurement of attitudes. *Archives of Psychology*, 22(140), 1–55.
- [12] Picton, J., & Mack, J. (1979). African textiles. British Museum Publications.
- [13] Radhakrishna, S., & Khanna, P. (2014). Computer-aided textile design systems. *International Journal of Fashion Technology*, 6(2), 89–97.
- [14] Rovine, V. L. (2015). African fashion, global style: Histories, innovations, and ideas you can wear. Indiana University Press.
- [15] Soini, K., & Birkeland, I. (2014). Exploring the scientific discourse on cultural sustainability. *Geoforum*, 51, 213–223.
- [16] Throsby, D. (2008). Modelling the cultural industries. *International Journal of Cultural Policy*, 14(3), 217–232.
- [17] Woodhead Publishing. (2011). *Advances in textile design*. Woodhead Publishing.