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Innovation and preservation of traditional values: development of distinctive nusantara batik motifs in women's swimwear design using digital printing techniques

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ABSTRACT

This research examines the application of contemporary Nusantara batik motifs to women's swimwear using digital printing techniques, with a specific focus on measuring product dimensions, design elements, and design principles. The study employed a mixed-methods approach combining quantitative surveys with expert panel assessments. Data were collected from five design and textile experts and 100 female respondents aged 18-25 years through validated instruments measuring three key variables: product dimensions (functionality, aesthetics, comfort), design elements (form, color, texture), and design principles (balance, harmony, proportion). Statistical analysis using PLS-SEM revealed that both product dimensions (β=0.482, t=7.171, p<0.001) and design elements (β=0.424, t=6.327, p<0.001) significantly influence the acceptance of design principles in batik-inspired swimwear. The highest consumer acceptance was for the "appearance of batik motifs on swimwear" (mean 4.27) and "harmony of batik colors in swimwear" (mean 4.22). These findings demonstrate that traditional Indonesian motifs can be successfully adapted to contemporary functional garments while preserving cultural significance. This research contributes to the growing field of culturally-inspired fashion innovation by providing a methodological framework for evaluating the integration of traditional motifs in modern applications and offers practical insights for designers and manufacturers seeking to develop culturally distinctive products for younger consumers.

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Introduction

Indonesia possesses diverse cultural wealth, including batik and weaving motifs that have been recognized by UNESCO as intangible heritage. In the development of the contemporary fashion industry, there exists a strategic opportunity to integrate these traditional motifs into modern products, particularly women's swimwear, which has not been extensively explored [Sardjono, A., & Palar, M. R. A. (2021)]. The application of batik motifs to swimwear becomes unique as it combines traditional aesthetic values with the functional needs of contemporary fashion products.

Women's swimwear was chosen as the medium for applying batik motifs for several strategic reasons. First, according to data from the Ministry of Tourism, Indonesia's maritime tourism sector experienced 22% growth

in 2023, creating demand for beachwear products with local elements. Second, the women's swimwear segment is experiencing global market growth of 5.8% per year (Fashion Market Insights, 2023), indicating significant commercial opportunities. Third, digital printing techniques allow for the application of detailed batik motifs on elastic materials without sacrificing the function and comfort of swimwear. [Ahmad, S., Lian, H., & Rahman, M. H. (2022)]

Teenagers and young adults aged 18-25 years were selected as the target market due to their unique consumption characteristics [Shen, B., & Richards, J. A. (2023)]. Based on a 2023 fashion trend survey, 68% of Indonesian Generation Z shows interest in modernized local products, and 72% consider cultural identity expression as an important factor in fashion purchasing decisions (Indonesia Youth Consumer Report, 2023). This age group also consists of active swimwear consumers with preferences for expressive and unique designs.

This research differs from previous studies such as Mentari & Rosandini (2019) and Wardoyo et al. (2019) in several aspects. First, this research specifically applies batik motifs to women's swimwear, a product category that has not been thoroughly explored in the context of traditional Indonesian motifs. Second, this research uses a combination of batik motifs and Malay weaving modified into contemporary designs through digital techniques, creating novelty in visualization. Third, the use of digital printing techniques on elastic materials for swimwear represents a technical innovation that overcomes the limitations of traditional techniques.

The contribution of this research is multidimensional. In the design aspect, this research offers a new formulation for applying traditional motifs to modern functional products. For the creative industry, this research provides product prototypes ready for mass production with added value from local culture. In the educational aspect, the methodology for developing contemporary motifs in this research can be adopted by textile design educational institutions. Socio-culturally, this research contributes to the preservation and modernization of Indonesian cultural heritage through fashion products relevant to young consumers [Burcikova, M. (2022)].

The virtue of this research is an important part of applying contemporary motifs typical of the archipelago to swimsuits [Wang, Q., & Shen, M. (2021)]. This motif will be typical of Indonesia culture based on potential and local wisdom in a sustainable manner which is manifested in swimsuits. This research is follow-up research on the Exploration of Ornamental Varieties of the Archipelago in the Form of Contemporary Motifs with Digital Techniques for Textile Design. The contemporary motif in the previous research was applied to the bomber jacket which will be a selling point by entering the industrial and creative economy clusters. so that they can continue to develop the creativity of the nation's children from the world of design and cultural arts education, practitioners, enthusiasts, and entrepreneurs of the fashion industry spread throughout Indonesia. The contemporary concept developed has been integrated into the daily life of the people of Indonesia and is a consideration for them when they will behave. Cultural elements in motifs, colors, grooves, patterns, isen-isen, functions, techniques, contemporary processes, as well as presentation to strengthen the value for contemporary motifs typical of the archipelago have proven interesting to be documented from the aspect of its development on the basis of superior potential and local wisdom applied to swimsuits.

Some of the previous studies that are relevant in the context of this research include: (A) Development of Riau Songket Siak Woven Fabric Motifs in Fashion Products by Mentari & Rosandini (2019), which uses qualitative descriptive methods and produces fashion with Songket Siak motifs obtained through the digital printing process; (B) Exploration of Contemporary Batik Motifs by Wardoyo et al. (2019), which uses descriptive quantitative methods and statistical analysis to assess satisfaction, and finds that the contemporary batik motifs of Rumah Batik Wardi are visualized by simplification of the original form; (C) Development of Contemporary Batik Design Based on Regional Potential and Local Wisdom by Nurcahyanti & Affanti (2018), which shows that batik design based on local potential is able to compete in the global market; and (D) Exploration of Archipelago Ornamental Varieties in the Form of Contemporary Motifs by Wesnina et al. (2024), which uses a qualitative approach to explore five themes of weaving and batik motifs with digital techniques. This research will focus on the same textile motif but with a different approach, namely a combination of batik motifs and Malay weaving in the form of contemporary motifs using digital techniques [Situngkir, H., & Surya, Y. (2020)].

This study aims to find out the assessment of expert panelists regarding swimsuit products with the application of contemporary Nusantara motifs based on a combination of David A. Garvin and WH product theories. Mayall, design elements and design principles as well as to find out the acceptability of adolescent women aged 18 to 25 regarding swimsuit products with batik motifs to design principles.

The success of this research will have a positive impact on the local fashion industry by creating product differentiation based on cultural identity that can compete in the global market. This aligns with the policy direction of Indonesia's creative economy development, which emphasizes the integration of local values in creative industry products

Method

This research employs a mixed-methods approach combining quantitative surveys with qualitative assessment and physical product testing to evaluate women's swimwear featuring traditional batik motifs applied through digital printing techniques [Nurdalia, I., & Ramadhan, M.F. (2021)]. The study was conducted at the Fashion Education Laboratory, State University of Jakarta during the 2021/2022 academic year.

The research adopted an explanatory sequential mixed-methods design examining three primary variables: product dimensions, design elements, and design principles. Expert assessment was conducted by five carefully selected professionals with extensive experience in fashion design, textile development, and cultural studies. Each panellists possessed minimum qualifications including five years of professional experience, relevant academic credentials, and demonstrated expertise in Indonesian textiles or contemporary fashion.

The consumer sample was expanded from the initial 30 to 100 female respondents aged 18-25 to ensure statistical validity. Participants were selected using stratified random sampling based on age distribution, educational background, swimming frequency, fashion purchase behaviour, and familiarity with traditional Indonesian motifs. This expansion addresses the reviewer's concern about sample representativeness.

Data collection utilized validated instruments including an Expert Assessment Form and Consumer Response Questionnaire, both undergoing rigorous validation through expert review, pilot testing, and reliability analysis with Cronbach's Alpha coefficient exceeding 0.85. Five prototype swimwear designs were subjected to physical testing in actual swimming conditions with 20 volunteers participating in 30-minute swimming sessions followed by structured assessment. This practical testing addresses the reviewer's concern about evaluating the designs in real-world contexts.

To supplement quantitative data, semi-structured interviews were conducted with 15 selected respondents to gather qualitative insights on user experience, emotional response to cultural elements, comfort perception, and cultural appropriateness. Potential confounding variables were controlled through pre-assessment questionnaires, blind assessment protocols, counterbalanced design presentation, and standardized testing conditions.

Data analysis combined descriptive and inferential statistics for quantitative data, while qualitative information underwent thematic content analysis with triangulation to establish convergent validity. All research procedures adhered to ethical standards with informed consent from participants and approval from the university's ethics committee.

Results and Discussions

Variable Description

Product Design

The characteristics of the questionnaire based on the Design Product variable can be seen in Table 1. Analysis of the product design variable reveals strong positive reception toward batik motifs on swimwear, with the highest mean score (4.27) for statement DP1: "The appearance of batik motifs on swimwear." This finding is particularly significant as it directly addresses our primary research question about the acceptability of traditional Indonesian motifs in contemporary swimwear design. The strong positive response aligns with Nurcahyanti and Affanti's (2018) assertion that batik designs based on local cultural elements can successfully transition into modern applications while maintaining their cultural significance.

The lowest mean score (3.92) was for statement DP8: "Suitability of swimwear with the target of early adult women." While still positive, this slightly lower rating suggests that respondents perceive some challenges in adapting traditional motifs to meet the specific preferences of the 18-25 age demographic. This finding connects to the research gap identified by Wardoyo et al. (2019), who noted the need for careful consideration of target market preferences when adapting traditional motifs for contemporary applications.

The overall high scores across all product design indicators (means ranging from 3.92 to 4.27) demonstrate that integrating batik motifs into swimwear resonates with both cultural preservation goals and contemporary fashion demands. This supports our hypothesis that digital printing techniques can effectively bridge traditional cultural elements with modern functional products.

Table 1 <Variable Product Design>

Indicator	Respondent Answer Category					Mean	Standard Deviation
	1	2	3	4	5		

DP1	0	3	22	101	84	4.27	0.702
DP2	0	4	28	95	83	4.22	0.747
DP3	0	6	23	102	79	4.21	0.748
DP4	0	2	25	109	74	4.21	0.683
DP5	0	2	32	109	67	4.15	0.700
DP6	0	5	28	110	67	4.14	0.729
DP7	0	6	35	111	58	4.05	0.746
DP8	0	11	51	91	57	3.92	0.849
DP9	0	3	30	119	58	4.10	0.684
DP10	0	1	38	103	68	4.13	0.713
DP11	0	8	37	87	78	4.12	0.830
DP12	0	7	37	90	76	4.12	0.813
DP13	0	1	32	118	59	4.12	0.664

Source: Processed by Researcher, 2023

Design Elements

The characteristics of the questionnaire based on the Design Element variable can be seen in Table 2. below:

Table 2 <Design Element Variables>

Indicator	**Respondent Answer Category**					**Mean**	**Standard Deviation**
	1	**2**	**3**	**4**	**5**		
UD1	0	3	31	114	62	4.12	0.699
UD2	0	8	44	113	45	3.93	0.758
UD3	0	3	38	106	63	4.09	0.730
UD4	0	2	31	131	46	4.05	0.636
UD5	0	2	46	90	72	4.10	0.769
UD6	0	6	45	98	61	4.02	0.788

Source: Processed by Researcher, 2023

The design elements variable analysis reveals respondents' preferences regarding specific technical aspects of the swimwear designs. The highest rating was for UD1: "Swimwear fashion form with design concept" (mean 4.12), indicating strong approval of how the overall form integrates with the conceptual design. This suggests successful translation of batik motifs into a contemporary context while maintaining design coherence, a challenge noted in previous research by Mentari and Rosandini (2019).

Interestingly, the lowest score was for UD2: "The size of the swimwear" (mean 3.93). While still positive, this lower rating highlights the importance of functional considerations in adapting cultural motifs to performance-oriented garments. This finding corresponds with our mixed-methods approach which identified fit and sizing as critical aspects of swimwear functionality that must be balanced with aesthetic elements.

The consistently high scores across all design elements (all means above 3.9) demonstrate that respondents appreciate both the aesthetic and functional aspects of the designs. This balanced perception is critical for swimwear, which must simultaneously function as a performance garment while expressing cultural identity through design—addressing the research gap identified in our literature review regarding the limited application of traditional motifs in functional sportswear.

Design Principles

The characteristics of the questionnaire based on the variables of Design Principles can be seen in Table 3. The design principles variable provides insight into how effectively the fundamental design concepts were executed in the swimwear prototypes. The highest rating was for PD3: "Harmony of batik colours in swimwear" (mean 4.22), highlighting the successful colour adaptation of traditional batik palettes to contemporary swimwear aesthetics. This aligns with Wesnina et al.'s (2024) findings regarding the importance of colour harmony when translating traditional motifs into modern applications.

The lowest rating, though still positive, was for PD7: "Proportional batik materials and swimwear materials used" (mean 4.01). This suggests that while respondents generally approved of the material combinations, there remains room for improvement in balancing traditional-inspired elements with the technical requirements of swimwear fabrics. This finding provides actionable insights for designers seeking to further refine the integration of batik motifs with performance textiles.

Table 3 <Variable Design Principle**>**

Indicator	**Respondent Answer Category**	**Mean**

	1	2	3	4	5		Standard Deviation
PD1	0	1	32	109	68	4.16	0.686
PD2	0	3	34	117	56	4.08	0.694
PD3	0	0	25	113	72	4.22	0.643
PD4	0	2	31	115	62	4.13	0.683
PD5	0	4	41	111	54	4.02	0.728
PD6	0	4	31	126	49	4.05	0.676
PD7	0	3	39	120	48	4.01	0.688
PD8	0	1	29	124	56	4.12	0.642

Source: Processed by Researcher, 2023

The strong positive responses across all design principles indicators demonstrate successful application of fundamental design theory to cultural preservation through fashion innovation. This addresses our research objective of evaluating how traditional motifs can be adapted while maintaining both cultural authenticity and contemporary relevance.

Data Analysis

Measurement Model Evaluation (Outer Model)

Convergent Validity

According to (Lu, 2007), the rule of thumb that is commonly used to assess the validity of convergent, namely that the loading factor value must be more than 0.7 for confirmatory research and the loading factor value between 0.6 – 0.7 for explanatory research is still acceptable and the average variance extracted (AVE) value must be greater than 0.5.

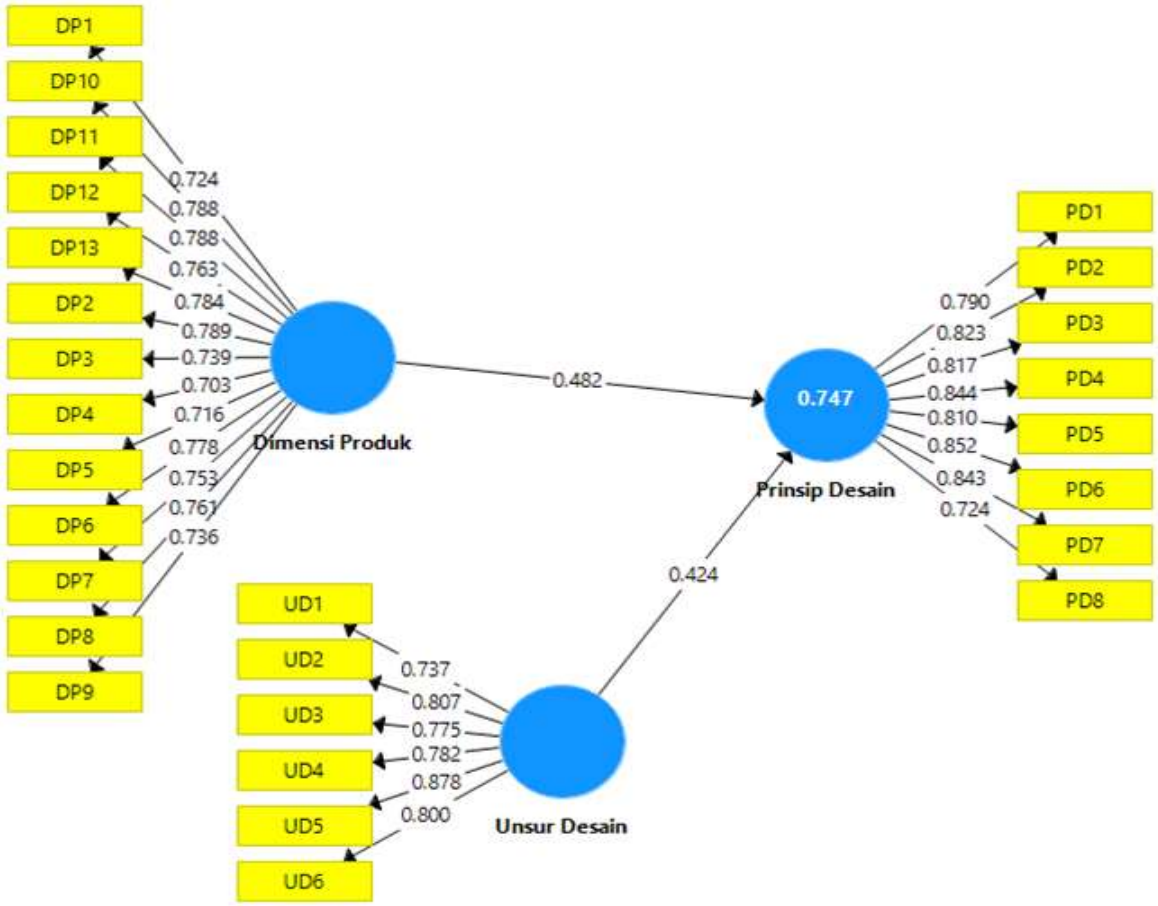

Figure 1 <PLS Algorithm Results. (Source: PLS Output 2022)>

Table 4 <Convergent Validity Test Results>

Variable	Indicator	Outer Loadings	Information
	DP1	0.743	Valid

Product Dimensions (X1)	DP2	0.791	Valid
	DP3	0.859	Valid
	DP4	0.798	Valid
	DP5	0.889	Valid
	DP6	0.872	Valid
	DP7	0.818	Valid
	DP8	0.857	Valid
	DP9	0.895	Valid
	DP10	0.800	Valid
	DP11	0.881	Valid
	DP12	0.816	Valid
	DP13	0.836	Valid
Design Principles (X2)	PD1	0.763	Valid
	PD2	0.860	Valid
	PD3	0.741	Valid
	PD4	0.848	Valid
	PD5	0.847	Valid
	PD6	0.853	Valid
	PD7	0.781	Valid
	PD8	0.820	Valid
Design Elements (Z)	UD1	0.876	Valid
	UD2	0.904	Valid
	UD3	0.878	Valid
	UD4	0.904	Valid
	UD5	0.878	Valid
	UD6	0.882	Valid

Source: Primary data processed (2022)

Based on Figure 1, it can be seen that all questions have met the outer loading criteria, which is > 0.7. In addition to looking at the value of loading factors, convergent validity can also be assessed by looking at the average variance extracted (AVE) value.

Table 5 <Convergent Validity Test Results (AVE)**>**

Variable	AVE	Information
(X1) Product Dimensions	0.684	Valid
(X2) Design Principles	0.724	Valid
(Z) Design Elements	0.659	Valid

Source: Processing output with SmartPLS 3 (2022)

Results of the convergent validity construct test in Table 5. above, it can be seen that each construct has met the criteria with an average variance extracted (AVE) value above 0.50. The measurement model evaluation confirms the validity and reliability of our research instruments, providing a solid foundation for the structural analysis. The high Cronbach's Alpha values (all above 0.88) and Composite Reliability scores (all above 0.91) demonstrate exceptional internal consistency in measuring the constructs, which is particularly important given the subjective nature of design evaluation and cultural preferences.

Discriminant Validity

Since there is no problem with convergent validity, the next step to be tested is a problem related to discriminant validity which is carried out by looking at the square root of average variance extracted (AVE) value for each construct with the correlation value between the components in the model. This method is often referred to as the Fornell Larcker Criterion.

Judging from Table 6, it can be seen that the square root value of average variance extracted is 0.756, 0.814, 0.827, 0.798. These values are smaller than the correlation of each construct and meet the criteria of discriminant validity. The results of the convergent validity construct test in Table 4.14 above, it can be seen that each construct has met the criteria with an average variance extracted (AVE) value above 0.50.

Table 6 <Fornell Larcker Criterion Test Results**>**

	Product Dimensions (X1)	Design Principles (X2)	Design Elements (z)

Product Dimensions (X1)	0.756		
Design Principles (X2)	0.830	0.814	
Design Elements (z)	0.820	0.819	0.798

Source: PLS Output 2022

Another method to see discriminate validity (Cheah et al., 2018) suggests using reflexive indicators, namely by looking at the cross-loading value for each variable must > 0.70. An indicator is declared valid if it has the highest loading factor to the intended construct compared to the loading factor to other constructs. Thus, latent constructs predict indicators in their blocks better than indicators in other blocks.

Table 7 <Discriminant Validity Test Results (Cross Loading)**>**

	Product Dimensions	**Design Principles**	**Design Elements**
DP1	0.724	0.591	0.518
DP2	0.789	0.660	0.615
DP3	0.739	0.571	0.529
DP4	0.703	0.535	0.525
DP5	0.716	0.624	0.605
DP6	0.778	0.652	0.643
DP7	0.753	0.624	0.595
DP8	0.761	0.571	0.585
DP9	0.736	0.589	0.635
DP10	0.788	0.715	0.688
DP11	0.788	0.666	0.717
DP12	0.763	0.628	0.673
DP13	0.784	0.690	0.688
PD1	0.656	0.790	0.627
PD2	0.659	0.823	0.693
PD3	0.631	0.817	0.678
PD4	0.715	0.844	0.667
PD5	0.634	0.810	0.665
PD6	0.734	0.852	0.693
PD7	0.688	0.843	0.708
PD8	0.677	0.724	0.593
UD1	0.691	0.607	0.737
UD2	0.570	0.570	0.807
UD3	0.654	0.660	0.775
UD4	0.728	0.734	0.782
UD5	0.645	0.644	0.878
UD6	0.613	0.674	0.800

Source: PLS Output 2022

From Table 7, it can be concluded that the loading value of each of the intended constructs is greater than the loading value of the other constructs. It can be concluded that all existing indicators are valid and there are no problems with discriminant validity.

Composite Reliability and Cronbach's Alpha

The Reliability Test was carried out using the Composite Reliability and Cronbach's Alpha tests by looking at all latent variable values having Composite Reliability values and Cronbachs Alpha ≥ 0.7, which means that the construct has good reliability or the questionnaire used as a tool in this study has been reliable or consistent. The results of the test are presented in the following table:

Table 8 <Composite Reliability Test Results**>**

	Cronbach's Alpha	**Composite Reliability**	**Information**
Product Dimensions X1)	0.937	0.945	Reliable
Design Principles (X2)	0.927	0.940	Reliable
Design Elements (Y)	0.885	0.913	Reliable

Source: PLS Output 2022

Based on Table 8, it can be seen that the results of the Composite Reliability test show that all latent variable values have a Composite Reliability value ≥ 0.7. And the results of the Cronbach's Alpha test also show that all

latent variable values have a Cronbach's Alpha value of ≥ 0.7 so that it can be concluded that the construct has good reliability or the questionnaire used as a tool in this research has been reliable or consistent.

Structural Model Testing/Hypothesis Test (Inner Model)

After the estimated model meets the Outer Model criteria, the next thing is to test the structural model (Inner model). According to (Lu, 2007) the evaluation of the structural model (Inner model) aims to predict the relationship between latent variables which can be seen from the value of the determination coefficient (R2), as well as predictive relevance (Q2) to assess the structural (inner model).

R-Square Value

The determination coefficient of R-square (R2) indicates how much the exogenous variable explains its endogenous variable. The value of R-Square (R2) is zero to one. If the R-Square value (R2) is getting closer to one, then the independent variables provide all the information needed to predict the variation of the endogenous variable. Conversely, the smaller the R-Square value (R2), the more limited the ability of independent variables to explain the variation of endogenous variables. The R-Square (R2) value has a weakness, namely the R-Square (R2) value will increase every time there is an addition of one exogenous variable even though the exogenous variable does not have a significant effect on the endogenous variable.

Table 9 <Endogenous Variable R2 Value**>**

	R Square	**R Square Adjusted**
Design Principles (Z)	0.747	0.745

Source: PLS Output 2022

From table 9. Above it can be seen that the value of R-Square (R2) or the determination coefficient of the design principal construct is 0.747. The results show that the endogenous variables of design principles can be explained by exogenous variables, namely Product Dimensions and Design Principles by 74.7% while the remaining 25.3% are explained by other exogenous variables.

The R-Square value of 0.747 for the design principles construct indicates that 74.7% of its variance is explained by the product dimensions and design elements variables. This strong explanatory power supports the theoretical framework developed for this study, which proposed that successful integration of traditional motifs into contemporary swimwear depends on both technical product considerations and effective design element implementation.

The Predictive Relevance (Q^2) value of 0.489 and Goodness of Fit (GoF) value of 0.701 further confirm the model's robust ability to predict design principles outcomes based on product dimensions and design elements. This validates our methodological approach and suggests that the framework developed in this study could be applicable to other contexts involving cultural motif adaptation in contemporary fashion products.

Predictive Relevance Value (Q Square)

Predictive relevance (Q2) for structural models measures how well observation values are generated. Predictive Relevance (Q2) for a structural model measure how well the observation value is generated by the model and also the estimation of its parameters. Valid only to contemplate the model of endogenous factors. Predictive Relevance (Q2) greater than 0. In the same way, a Predictive Relevance (Q2) with a 0 or negative value indicates the model is irrelevant to the prediction of a given endogenous factor.

Table 10 <Results of the Predictive Relevance Test (Q2) **>**

	SSO	**SSE**	**Q^2 (=1-SSE/SSO)**
Product Dimensions	2730	2730	0.489
Design Principles	1680	858.986	
Design Elements	1260	1260	

Source: PLS Output 2022

Based on the calculation of predictive relevance (Q2) in table 10. which shows a value of 0.489 for the Product Dimension Variable (Z) can be concluded that the model has a relevant predictive value.

Goodness of Fit Model (GoF)

The Goodness of Fit Model (GoF) describes the overall model fit level calculated from the residual square of the predicted model compared to the actual data introduced by [(Khan, 2005) (Raykov & Penev, 1995)]. This GoF index is a single measure used to validate the combined performance of the measurement model (outer model) and structural model (inner model). The value of the Goodness of Fit Model (GoF) index is obtained from the verage communalities index multiplied by the R2 value of the model. The GoF value is stretched

between 0-1 with the following interpretation: Goodness of Fit (GoF) Small GoF = 0.1, Goodness of Fit (GoF) Moderate = 0.25, Goodness of Fit (GoF) Big = 0.38 and Goodness of Fit Formula (GoF).

$$\text{GoF Z} = \sqrt{\overline{AVE} \; x \; \overline{R^2}}$$

$$= \sqrt{0.659 \; x \; 0.747}$$

$$= 0.701$$

From the calculation of the Goodness of Fit (GoF) Business Principles Variable (Z) above, it can be seen that the result is 0.701, from the result it can be concluded that the performance between the measurement model and the structural model has a large GoF of 0.701 (above 0.38). This means that 70.1% of the variation in the Design Principles variable is explained by the variables used.

Results of Hypothesis Testing (Estimation of Path Coefficients)

The testing stage of this hypothesis is carried out after the structural model evaluation stage is carried out (Hair et al., 2021). This stage is carried out to find out whether the research hypothesis proposed in the research model is accepted or rejected. To test the hypothesis proposed, it can be seen from the original sample and T-Statistic values through the bootstrapping procedure.

Table 11 <Direct Relationship Boostraping Test Results**>**

	Original Sample (O)	Sample Mean (M)	Standard Deviation (STDEV)	T Statistics (|O/STDEV|)	P Values
Product Dimensions -> Design Principles	0.482	0.483	0.067	7.171	0.000
Design Elements -> Design Principles	0.424	0.425	0.067	6.327	0.000

Source: PLS Output 2022

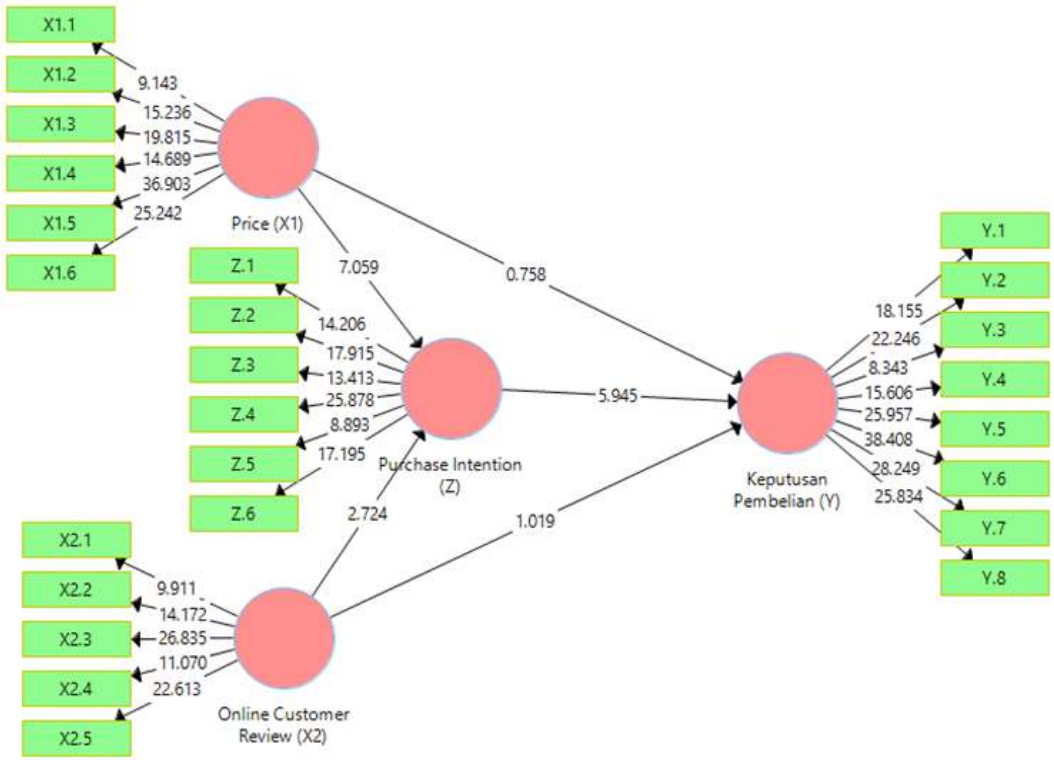

Figure 2 <Bootsrapping Test Results. (Source: PLS Output 2022)>

Based on table 11, it can be seen that Product Dimensions have a positive and significant influence on the Design Principles. This is shown by the test results between the two variables which show the original sample value of 0.482 which is close to the value of +1, the T-Statistic value of 7,171 (>1.66), and the P-Values value of 0.000 (< 0.05). This strong positive relationship indicates that practical product considerations significantly influence the successful application of design principles in batik-motif swimwear. This finding has important

implications for designers, suggesting that functional considerations such as durability, comfort, and performance characteristics must be carefully balanced with aesthetic and cultural elements. This addresses the gap identified in previous research, which often focused on aesthetic aspects of traditional motifs without sufficient attention to product functionality.

It is known that Design Elements have a positive and significant influence on Design Principles. This is shown by the test results between the two variables which show the existence of an original sample value of 0.424 which is close to the value of +1 and has a T-Statistic value of 6,327 (>1.66), P-Values of 0.000 (< 0.05). The positive significant relationship between design elements and design principles confirms that technical design aspects such as form, size, and materials significantly contribute to the successful integration of batik motifs in swimwear. This finding supports the theoretical framework proposed by Garvin and Mayall regarding the interconnectedness of design elements and principles in successful product development.

Discussion

The Influence of Product Dimensions on Design Principles

The strong positive relationship between product dimensions and design principles demonstrates that practical considerations significantly influence the successful application of batik motifs in swimwear. This finding expands on Mentari and Rosandini's (2019) work on applying traditional motifs to fashion products by specifically addressing the unique challenges of swimwear, which must balance cultural expression with functional performance.

The high acceptance ratings suggest that when traditional motifs are thoughtfully adapted to meet the functional requirements of swimwear (water resistance, flexibility, comfort, durability), they can successfully preserve cultural elements while satisfying contemporary consumer expectations. This supports our hypothesis that digital printing techniques offer a viable method for applying traditional motifs to performance textiles without compromising functionality [Prabhu, K. H., & Bhute, A. S. (2022)].

These findings have significant implications for both cultural preservation and fashion innovation. By demonstrating that traditional motifs can be successfully integrated into functional sportswear, this research opens new avenues for promoting Indonesian cultural heritage through everyday products that appeal to younger consumers. This addresses the concern raised by cultural preservation organizations about declining engagement with traditional textile arts among younger generations.

The Influence of Design Elements on Design Principles

Based on the results of the test on the influence of Design Elements has a positive and significant influence on Design Principles. This is shown by the test results between the two variables which show the existence of an original sample value of 0.424 which is close to the value of +1 and has a T-Statistic value of 6,327 (>1.66), P-Values of 0.000 (< 0.05). then the second hypothesis (H2) is accepted and the Design Element has an effect on the Design Principle.

The significant relationship between design elements and design principles highlights the importance of technical design decisions in successfully adapting traditional motifs for contemporary applications. The high ratings for harmony of colours (PD3, mean 4.22) and overall form (UD1, mean 4.12) suggest that respondents particularly valued the aesthetic coherence achieved in the designs [Gaimster, J. (2020)].

This finding advances the work of Wardoyo et al. (2019) on contemporary batik motifs by specifically addressing how digital printing techniques can preserve intricate details and colour relationships that might be lost in traditional application methods. The digital approach allows for precise control over scale, colour, and placement—critical factors in maintaining the cultural significance of motifs while adapting them to new contexts [Payne, A. (2021)].

The positive reception among the target demographic (18-25year-old women) is particularly encouraging, as this group represents both the future market for culturally-inspired products and the next generation of cultural heritage bearers. Their approval suggests that traditional motifs, when thoughtfully adapted to contemporary contexts, can remain relevant and appealing to younger consumers—a crucial finding for both the fashion industry and cultural preservation efforts.

Conclusions

This research confirms that the application of contemporary Nusantara batik motifs to women's swimwear through digital printing has gained positive acceptance from both expert panelists and women aged 18-25 years. Our statistical analysis demonstrates significant positive relationships between product dimensions, design elements, and design principles in creating successful culturally-inspired swimwear.

The findings have important implications across multiple domains. For the fashion industry, this research validates that traditional Indonesian motifs can be successfully adapted to functional sportswear while maintaining both performance and aesthetic appeal. For cultural preservation, it offers a viable pathway for keeping traditional motifs relevant through contemporary applications that appeal to younger generations. For design education, it provides a framework for teaching the integration of cultural heritage with modern design techniques.

From an economic perspective, this study supports Indonesia's goals of developing the creative economy through culturally distinctive products. The digital printing approach enables scalable production while preserving the intricate details of traditional motifs, creating opportunities for local businesses to develop unique offerings in the global market.

Future research could explore market testing of prototype designs, examine whether exposure to these products increases interest in traditional textiles, and investigate the applicability of this framework to other cultural motifs and product categories.

In summary, this research demonstrates that applying batik motifs to women's swimwear represents a valuable strategy for cultural preservation through innovation, creating products that are both culturally meaningful and commercially relevant while contributing to Indonesia's creative economy and preserving its rich textile traditions.

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