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Human–AI Co-Creation in Traditional Craft: Generative Artificial Intelligence for Batik Design Innovation in Indonesian Creative Communities

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Abstract

Background: The declining generational renewal of *batik* designers poses challenges to sustaining innovation in Indonesia's traditional craft industry.
Objective: This study investigates how generative artificial intelligence can support human–AI co-creation in *batik*design innovation.
Methods: Using a mixed-methods case study of a *Batik* AI training program organized by the Indonesian Batik Artisans and Entrepreneurs Association, this research examines the integration of AI-assisted design exploration within *batik*creative communities. Data were collected through observations, documentation of AI-generated designs, and a perception survey involving 300 respondents from the *batik* ecosystem.
Results: The results indicate that generative AI substantially expands the exploration of motif variations, enabling participants to generate 300 *batik* design simulations—200 in Cirebon and 100 in Bandung—featuring traditional motifs, including *parang*, *kawung*, and *megamendung*. Descriptive statistical analysis involving 300 respondents revealed positive perceptions across all dimensions. Motif composition received the highest score (mean = 4.24, SD = 0.68), followed by color sharpness (mean = 4.21), motif authenticity (mean = 4.18), color brightness (mean = 4.15), originality of motif ideas (mean = 4.11), and the quality of supplementary motifs (mean = 4.07). The philosophical meaning of the motifs received the lowest score (mean = 3.96), indicating the limitations of AI in encoding cultural symbolism. The instrument demonstrated satisfactory reliability (Cronbach's alpha = 0.87).
Conclusion: The findings suggest that generative AI functions as a collaborative tool that enhances the capacity for creative design exploration. However, respondents' perceptions of the philosophical meaning of the motifs (mean = 3.96) indicate that human cultural curation remains indispensable for preserving the profound symbolic authenticity of traditional *batik* designs. These findings reflect respondents' perceptions within the specific training contexts of Cirebon and Bandung.

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INTRODUCTION

Batik is an intangible cultural heritage of Indonesia that was inscribed in 2009 on UNESCO's Representative List of the Intangible Cultural Heritage of Humanity. It is recognized not only as a textile craft but also as a representation of the Indonesian people's cultural identity, traditional knowledge, and artistic expression. In the context of the global creative industry, batik

faces significant challenges related to the sustainability of design innovation, particularly because of the declining regeneration of batik tulis (hand-drawn batik) designers who possess the expertise required to create new motifs while preserving traditional aesthetic and philosophical values. This phenomenon highlights the urgent need to explore innovative approaches that can support the batik design process without eliminating the essence of local wisdom or the craft skills that have been passed down through generations.

The development of generative artificial intelligence (AI) technology in recent years has created new opportunities across various creative domains, including textile design and traditional crafts. Recent studies have shown that generative AI, particularly generative adversarial networks (GANs) and text-to-image models, has been successfully applied to fashion design Abdullah (2024), architecture Adeleye (2024), and traditional crafts such as textiles Bagnato (2023) and Malaysian batik (Chandrasekera et al., 2025). This technology enables broader and faster design exploration by producing diverse motif variations while preserving selected aesthetic characteristics. In the context of cultural heritage preservation, the integration of AI into traditional craft practices has the potential to bridge the gap between technological innovation and cultural authenticity.

However, the application of AI technology to batik design presents several fundamental challenges. First, few individuals possess competencies in both traditional batik design and digital technology literacy (Hughes et al., 2021). Second, concerns remain regarding the potential loss of the human touch and the philosophical values embedded in batik motifs generated through automated processes (Hutson et al., 2023). Third, there is still limited understanding of how AI technology can be integrated into the batik industry ecosystem, which continues to rely heavily on manual processes and artisans' tacit knowledge (Ibarrola et al., 2023). Fourth, no clearly defined model of human–AI collaboration has been established for batik design creation that can maximize the complementary strengths of both humans and AI systems.

Various approaches have been developed to address the challenges associated with integrating technology into traditional crafts. In general, the literature indicates that AI can function as a collaborative tool that enhances human creativity rather than replacing it entirely. Within the design context, research has shown that human–AI collaboration can improve the efficiency of creative processes, expand the exploration of design spaces, and produce more diverse outputs. This approach emphasizes the importance of preserving the human role in creative decision-making, aesthetic judgment, and cultural contextualization, while AI assists by generating design alternatives, processing large volumes of visual data, and accelerating design iterations.

In the specific context of batik and Southeast Asian traditional crafts, several studies have explored the application of AI to motif innovation. Research conducted in Malaysia has shown that GANs can be used to generate new batik designs that combine traditional elements with contemporary aesthetics (Chandrasekera et al., 2025). An Indonesian–Malaysian collaborative study demonstrated that AI platforms can help overcome limitations in the generation of batik motif ideas and create new business opportunities (Hughes et al., 2021). In Thailand, the integration of AI into local textile design has shown that technology can enhance creative efficiency and support sustainable practices while maintaining cultural resonance (Bagnato, 2023). However, most of these studies have focused primarily on the technical aspects of motif generation and have not examined in sufficient depth the dynamics of collaboration between batik artisans and AI technologies within training programs and community capacity-building initiatives.

Previous approaches to integrating digital technology into batik design have tended to be top-down and oriented toward process automation, with limited attention given to human-centered design and the empowerment of artisan communities (Rianto et al., 2024). Several studies have shown that text-based interfaces, or text prompts, alone are insufficient to support optimal creative exploration, particularly among users without technical backgrounds (Song, 2024). Research has also indicated that the success of human–AI collaboration depends heavily on system designs that provide flexibility in the level of AI involvement according to users' preferences and needs (Tang et al., 2023). In the context of design education, studies have shown that generative AI can reduce cognitive load and improve creative outcomes when it is integrated

with reflective practice (Davis et al., 2024).

Despite significant advances in research on human–AI co-creation in creative design, the literature review reveals several important research gaps. First, empirical research examining the application of generative AI to batik design training that directly involves artisans and other batik industry practitioners remains limited (Zhang et al., 2023). Second, no comprehensive framework currently explains how AI technology can be integrated into the Indonesian batik ecosystem while involving various stakeholders, including artisans, designers, entrepreneurs, and consumers (Abdullah et al., 2024). Third, previous studies have not systematically examined public perceptions and acceptance of batik designs produced through human–AI co-creation, particularly in relation to cultural authenticity and aesthetic quality (Adeleye, 2024). Fourth, limited understanding exists regarding how human–AI collaboration can support the emergence of new professional roles in the batik ecosystem, such as the AI Batik Prompter and Visual Batik Stylist.

This research seeks to address these gaps by examining the application of generative AI in a batik design training program organized by the Indonesian Batik Artisans and Entrepreneurs Association (APPBI) through the Kampung Batik AI initiative in Cirebon and Bandung. The novelty of this research lies in its mixed-methods embedded case study approach, which integrates participant observation of the training process, analysis of the resulting batik design documentation, and a perception survey involving 300 respondents from various segments of the batik ecosystem, including artisans, designers, entrepreneurs, academics, and consumers. This research contributes to the intersection of science, technology, creative industry studies, and interdisciplinary innovation by advancing understanding of how AI-based design tools can be integrated into traditional craft training programs. The study is framed as a descriptive, mixed-methods embedded case study and is therefore distinct from purely algorithmic or laboratory-based studies of AI-assisted design. The primary research questions are as follows: (1) How does generative AI technology affect the capacity for batik design exploration in a community training context. (2) How do respondents perceive the aesthetic quality dimensions of AI-assisted batik designs. (3) What professional roles emerge from the human–AI co-creation process within the batik ecosystem.

The primary objective of this research is to investigate how generative artificial intelligence can support human–AI co-creation in batik design innovation within Indonesian creative communities. Specifically, this research aims to understand the dynamics of collaboration between batik artisans and AI technology in the context of capacity-building programs by examining how such integration can expand design exploration while preserving the cultural authenticity and aesthetic values inherent in traditional batik craftsmanship. By focusing on the Batik AI training program organized by the Indonesian Batik Artisans and Entrepreneurs Association, this research seeks to provide empirical evidence regarding the potential benefits and challenges of implementing generative AI as a collaborative tool in the traditional craft industry.

In the development of the contemporary batik industry, motif design is a crucial element in determining the sustainability of innovation in batik production. Effective batik design considers not only visual beauty but also motif structure and composition, balance of forms, visual rhythm, and suitability for the intended fabric layout (Fraser-Lu, 1989). Accordingly, the traditional batik design process usually involves several methodological stages, including the study of existing batik motifs, form exploration, preliminary sketching, motif composition development, and, finally, the batik production process itself. These stages demonstrate that batik motif creation is a systematic design process requiring substantial artistic expertise (Sennett, 2008).

However, the contemporary Indonesian batik industry faces a serious structural problem related to the regeneration of batik designers. Based on data collected from various batik production centers, the number of batik artisans in Indonesia was estimated to reach approximately 95,000 by the end of 2025, distributed across various batik-producing regions. Of this estimated total, approximately 57,000 artisans were located in the Pekalongan region, 12,000 in Solo, 7,000 in Madura, 6,000 in Yogyakarta, and 1,500 active batik artisans in Cirebon. Although the total number of batik artisans is substantial, fewer than 5% reportedly possess the specialized

ability to design new batik motifs professionally. This condition indicates a significant gap between the number of individuals involved in batik production and the number of motif designers capable of sustaining design innovation.

One of the principal causes of the limited number of batik designers is the educational background of batik artisans, most of whom have not received formal education in graphic or textile design. Most artisan-level batik designers acquire motif-design skills through self-directed learning based on observing, imitating, and modifying existing motifs. Although this method supports the continuity of motif traditions, it often limits opportunities for more innovative and original design exploration (Adamson, 2013; Dormer, 1997). The production of genuinely new batik designs generally requires a more systematic understanding of design theory, visual composition, and form-exploration processes. Such knowledge is typically acquired through formal education in textile design or visual communication design at the diploma or bachelor's degree level (Cross, 2011; Norman, 2013).

In the context of current digital technological developments, the emergence of generative artificial intelligence has created new opportunities for visual design creation, including in textile design and traditional crafts. This technology enables humans to collaborate with artificial intelligence systems to generate various design alternatives through prompt-based processes that can produce visual variations within a very short period (Goodfellow et al., 2016; Elgammal et al., 2017). In the design field, this approach is often referred to as human–AI co-creation, which describes a collaborative process in which humans and artificial intelligence systems jointly contribute to the creation of new designs (Davis et al., 2016; Rezwana & Maher, 2022).

Several recent studies have shown that the use of generative AI in art and design can enhance creative exploration and accelerate the design iteration process (McCormack et al., 2019; Hertzmann, 2018). In the creative industries, generative AI can also help designers identify combinations of forms, patterns, and visual compositions that may be difficult to achieve through manual processes alone (Colton et al., 2015; Boden, 2016). Nevertheless, the use of AI in traditional crafts remains contested because of concerns that the technology could replace human artisans or diminish the cultural authenticity of craft products (Miller, 2019).

Conversely, several studies have shown that human–AI co-creation can strengthen human creative capacity when AI is used as a design exploration tool rather than as a replacement for human creativity (Kantosalo & Toivonen, 2016). Under this approach, humans remain the primary directors of the design process, while AI functions as a tool that expands the range of possibilities for visual exploration (Candy & Edmonds, 2018). Thus, integrating AI technology into traditional craft design processes can be understood as a form of innovation that supports cultural sustainability while enabling adaptation to developments in digital technology (Giaccardi & Karana, 2015).

Although research on the use of AI in visual design has grown rapidly in recent years, studies examining the application of AI technology to traditional batik design remain relatively limited. Most batik research continues to focus on its history, motif symbolism, production techniques, and cultural heritage preservation (Fraser-Lu, 1989; Veldhuisen, 2007). Meanwhile, academic studies examining the relationship between generative AI technology and batik design innovation within artisan communities remain scarce.

This situation indicates an important research gap in the study of batik design innovation in the digital era. On the one hand, there is an urgent need to strengthen the design capacity of batik artisans so that they can produce new motif innovations. On the other hand, advances in AI technology offer considerable potential to support this design exploration process. However, little empirical research has systematically examined how AI technology can be used in batik design training for traditional artisan communities.

In response to this gap, the present research examines the application of generative AI technology in a batik design training program organized by the Indonesian Batik Artisans and Entrepreneurs Association through the Kampung Batik AI initiative in Cirebon and Bandung. This training program seeks to introduce AI-based batik design methods to artisans, students, teachers, and members of batik enthusiast communities. Its broader objective is to foster a new generation of batik design professionals referred to as Visual Batik Stylist AI or Prompt Batik Designer AI.

The state of the art of this research lies in its integration of traditional design training approaches with generative AI technology within the context of batik craftsmanship. Unlike previous research, which has primarily discussed AI in relation to digital art or modern graphic design, this study examines how AI can function as a collaborative tool in the creation of traditional craft designs characterized by strong cultural values.

The novelty of this research encompasses four dimensions. First, its contextual novelty lies in being an empirical study that applies generative AI to Indonesian community-based batik design training and incorporates a multistakeholder perception assessment. Second, its methodological novelty lies in the integration of observational, documentary, and survey data from six stakeholder groups within a single embedded case study. Third, its conceptual novelty lies in introducing and operationally defining the roles of the AI Batik Prompter and Visual Batik Stylist. Fourth, its practical novelty lies in producing evidence-based recommendations for integrating AI into artisan capacity-building programs.

Operationally, the AI Batik Prompter is defined as a professional responsible for translating traditional batik design concepts into effective text prompts for AI systems. This role requires competencies in batik motif knowledge, AI platform operation, and iterative prompt refinement. The Visual Batik Stylist evaluates, curates, and adapts AI-generated outputs to ensure their alignment with batik aesthetic standards, cultural authenticity, and production feasibility. Both roles mediate between the generative capabilities of AI systems and traditional batik production and were derived from observational documentation of participant behavior during the Kampung Batik AI training program.

Based on this background, the purpose of this research is to examine the role of generative AI technology in supporting human–AI co-creation in batik design innovation within Indonesian batik artisan communities. Specifically, the study aims to evaluate the effectiveness of the Batik AI training program in improving participants' design exploration capabilities and to assess the extent to which AI-assisted designs can be accepted and realized as batik tulis (hand-drawn batik) and batik cap (stamped batik).

The urgency of this research lies in the importance of identifying innovative solutions to address the limited number of batik designers in Indonesia while strengthening the creative capacity of artisan communities to respond to the challenges of the global creative industry. By using AI technology as a collaborative design tool, the Indonesian batik community may increase the productivity and diversity of motif innovation without eliminating the cultural values that form the foundation of the batik tradition.

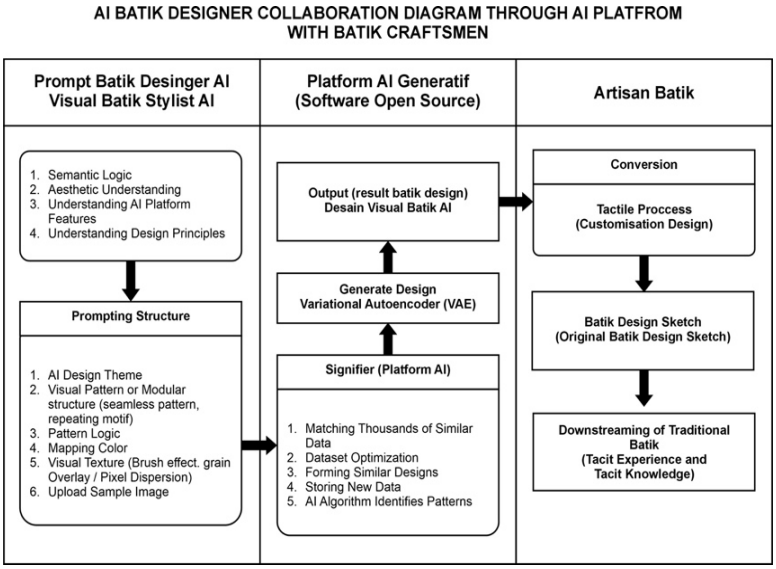

Figure 1. AI Batik Designer Collaboration Diagram

METHOD

This research employed a mixed-methods approach that combined quantitative and qualitative analyses to develop a comprehensive understanding of the creative collaboration

between humans and artificial intelligence in batik design. This approach was selected because the phenomenon of human–AI co-creation in the creative industries required not only the quantitative measurement of public visual perceptions but also a contextual understanding of the batik design process, beginning with generative AI design simulations and culminating in their realization as original batik tulis. Methodologically, the research was developed within the framework of an empirical case study of the Batik AI training activities organized by the Indonesian Batik Artisans and Entrepreneurs Association (APPBI) at Kampung Batik AI in Cirebon and Bandung in 2025.

The mixed-methods approach enabled the researchers to combine observational data from the AI-assisted batik design training process with quantitative data obtained through visual perception surveys of batik tulis works developed from generative AI design simulations. In design and visual culture research, this approach has often been used to examine the relationships among creative processes, the visual quality of creative works, and public acceptance of technology-based design innovations (Creswell, 2014). Through this approach, the research provided a more comprehensive account of the effectiveness of AI technology in supporting innovation in traditional batik design.

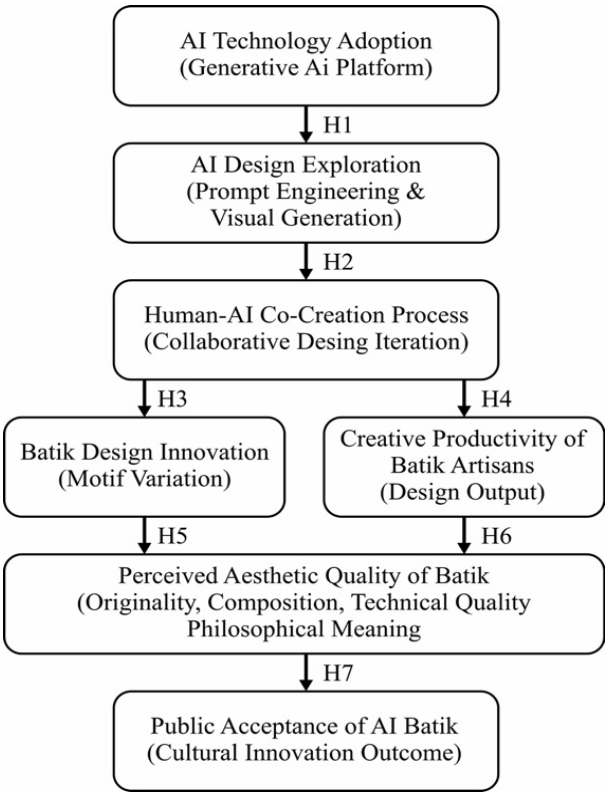

Figure 2. Human AI Co Creation

Research Variables (SEM Model)

Table 1. Research Variables

Latent Variable	Indicators
AI Technology Adoption	Use of Generative AI Platforms, Prompting Ability
AI Design Exploration	Motif Exploration, Visual Simulation
Human–AI Co-Creation	Human and AI Collaboration in Design
Batik Design Innovation	New Motif Variations, Motif Combinations
Creative Productivity	Number of Designs Generated
Perceived Aesthetic Quality	Originality, Composition, Technical Quality, Philosophy
Public Acceptance	Public Acceptance of AI-based Batik

Research Hypotheses

H1: Adoption of generative AI technology has a positive effect on batik design exploration.
H2: AI-based design exploration has a positive effect on the Human–AI Co-Creation process in batik design.
H3: The Human–AI Co-Creation process has a positive effect on batik motif design innovation.
H4: The Human–AI Co-Creation process has a positive effect on the creative productivity of batik artisans.
H5: Batik design innovation has a positive effect on the perception of batik aesthetic quality.
H6: Artisan creative productivity has a positive effect on the perception of batik quality.
H7: Perception of batik aesthetic quality has a positive effect on public acceptance of AI-based batik.

H1 is proposed to test whether better adoption of generative AI technology will improve batik design exploration capability. H2 tests whether AI-based design exploration strengthens the creative collaboration process between humans and AI. H3 and H4 test the effect of the Human–AI Co-Creation process on batik design innovation and creative productivity. H5 and H6 test whether design innovation and creative productivity contribute to the perception of batik aesthetic quality. H7 tests whether the perception of aesthetic quality drives public acceptance of batik resulting from human-AI collaboration.

Suitable Statistical Research Model for SmartPLS / AMOS

For SmartPLS

This model is highly suitable for SmartPLS if the research objectives are: 1) New Model Development. 2) Relatively Limited Number of Indicators. 3) Focus on Prediction and Relationships Between Constructs. 4) Data may not be fully normal

Recommended SmartPLS Specifications:

- Model approach: reflective measurement model
- Bootstrapping: 5,000 resamples
- Significance level: 0.05
- Cut-off outer loading: ideal > 0.70, minimum exploratory > 0.60
- AVE: > 0.50
- Composite Reliability: > 0.70
- Cronbach's Alpha: > 0.70
- HTMT: < 0.85 or < 0.90
- R^2 for endogenous constructs: weak 0.25, moderate 0.50, strong 0.75
- f^2 effect size: 0.02 small, 0.15 medium, 0.35 large
- Q^2 predictive relevance: > 0

Conceptual structural equations for SmartPLS:

- AIDE = β1 AITA + e1
- HAIC = β2 AIDE + e2
- BDI = β3 HAIC + e3
- CP = β4 HAIC + e4
- PAQ = β5 BDI + β6 CP + e5
- PAAIB = β7 PAQ + e6

For AMOS

This model can also be used in AMOS if the emphasis is on covariance-based SEM with conditions: 1) data approximates normal distribution. 2) sample size is sufficiently stable. 3) model is more confirmatory than exploratory

Commonly used goodness-of-fit indices:

- Chi-square/df < 3.00
- GFI > 0.90
- AGFI > 0.90
- CFI > 0.90
- TLI > 0.90

- RMSEA < 0.08
- SRMR < 0.08

For AMOS, a slightly leaner structure is suggested:
AI Technology Adoption → AI Design Exploration
AI Design Exploration → Human–AI Co-Creation
Human–AI Co-Creation → Batik Design Innovation
Human–AI Co-Creation → Creative Productivity
Batik Design Innovation → Perceived Aesthetic Quality
Creative Productivity → Perceived Aesthetic Quality
Perceived Aesthetic Quality → Public Acceptance

Relationship Between Model and Questionnaire Data

The Perceived Aesthetic Quality variable is measured through the questionnaire indicators that have been compiled.

Table 2. Relationship Between Model and Questionnaire Data

Dimension	Indicator
Design Originality	Authenticity of Motifs and Motif Ideas
Motif Composition	Main Motif and Supplementary Motif
Technical Quality	Color Brightness and Color Sharpness
Philosophical Meaning	Cultural Meaning of Motifs

These four dimensions form the latent variable Perceived Aesthetic Quality in the SEM model. This model is usually placed after the Literature Review section with the format: Figure X. Conceptual Framework of Human–AI Co-Creation in Batik Design Innovation. This framework is important because: 1) It explains the relationships between research variables theoretically. 2) It becomes the basis for statistical SEM testing. 3) It shows the theoretical contribution of the research to the study of AI creativity and craft innovation

Research Location and Context

This research was conducted in the context of the Batik AI Training program organized by APPBI in two main locations: Kampung Batik AI Cirebon in Trusmi Village and surrounding areas, and Kampung Batik AI in Cigadung Village, Bandung City. This training program was designed as a creative experiment space for the batik community to learn to use generative AI technology in the batik design process. The training activities lasted for three days and were facilitated by five instructors experienced in using generative AI platforms for visual design.

During the training, participants were introduced to AI prompt-based batik design methods, a technique of giving textual instructions to AI systems to generate various batik motif design variations. The resulting designs were then evaluated, selected, and printed in folio and A0 sizes as basic designs that could be realized in the form of *batik tulis* or *batik cap*. Through this process, the training not only functioned as an educational activity but also as a creative laboratory that produced various new batik design prototypes based on AI technology.

Kampung Batik AI Training Activities in Cirebon

Several documentation photos of the Kampung Batik AI training in Cirebon.

Figure 1. Documentation Photos of Kampung Batik AI Training in Cirebon

Figure 2. Results of Generative AI Design Simulation

Subjects and Respondent Characteristics

The respondents of this research totaled 300 people from various community groups connected to the batik and textile field. Respondents were recruited using purposive sampling. Inclusion criteria required: (1) direct experience in batik production, education, or consumption; (2) ability to evaluate visual quality of textile works; and (3) voluntary informed consent. All 300 respondents evaluated the same 10 selected batik works (chosen based on motif diversity, design quality, and variety of prompting approaches) realized from the AI-assisted design simulations. Respondents were informed that the evaluated works were produced through human-AI collaboration; there was no blinding to the AI-assisted origin of designs, as this study assessed informed public acceptance.

The respondent groups consisted of six main categories: textile vocational high school (SMK) students, textile vocational high school teachers, textile craft university students, textile craft and handicraft lecturers, textile artists, and the general public who are batik enthusiasts. The diversity of respondent backgrounds was intended to obtain a broader perspective on public acceptance of batik designs generated through human-AI technology collaboration.

Table 3. Research Respondent Characteristics

Respondent Group	Role in the Batik Ecosystem	Number of Respondents
Textile SMK Students	Future batik industry workforce	80
Textile SMK Teachers	Textile field educators	20
Textile Craft Students	Textile design university students	80
Textile Craft Lecturers	Textile field academics	10
Textile Artists	Textile art practitioners	10
Batik Enthusiasts	Consumers and cultural community members	100
Total		**300**

Research Instrument

The main instrument in this research was a visual perception questionnaire designed to measure respondents' assessments of the aesthetic quality and cultural value of *batik tulis* produced from generative AI design simulations. This questionnaire used a five-point Likert scale ranging from Strongly Disagree (1) to Strongly Agree (5). The Likert scale approach was chosen because it allows systematic measurement of attitudes and visual perceptions in social

and visual design research.

The research instrument was designed based on four main dimensions of batik aesthetic assessment: motif originality, motif design composition, visual technical quality, and philosophical meaning of batik motifs. These dimensions were chosen because they are important elements in evaluating batik design quality from both textile design and visual culture perspectives.

Table 4. Research Variables and Indicators

Assessment Variable	Indicator	Measurement Scale
Originality	Authenticity of the resulting batik motif	Likert 1–5
Originality	Authenticity of the batik motif idea	Likert 1–5
Motif Composition	Quality of the main motif	Likert 1–5
Motif Composition	Quality of the supplementary motif	Likert 1–5
Technical Quality	Brightness of batik colors	Likert 1–5
Technical Quality	Sharpness of batik colors	Likert 1–5
Motif Philosophy	Philosophical and cultural meaning of the motif	Likert 1–5

These variables were formulated based on an aesthetic evaluation approach to textile design that emphasizes the balance between visual, technical, and cultural value aspects of a traditional textile work.

Data Collection Procedure

Data collection in this research was carried out through several integrated stages. The first stage was direct observation of the Batik AI training process, which lasted for three days. At this stage, the researcher documented the interaction process between training participants and generative AI technology, including the design prompt exploration process, selection of generated designs, and the process of translating digital designs into *batik tulis* designs.

The second stage was visual documentation of batik design results generated through AI simulation. More than two hundred batik designs were produced during the training activities, and some of them were then realized into original *batik tulis* works that became the objects of visual perception testing in this research.

The third stage was the implementation of a visual perception survey to respondents. In this stage, respondents were asked to assess the visual quality of *batik tulis* produced from AI designs using the previously prepared questionnaire instrument. The questionnaire filling process was carried out directly by displaying the batik works that had been realized from generative AI design simulations.

Data Analysis Method

Data obtained from the questionnaire were analyzed using descriptive statistical approaches to determine the tendency of respondents' perceptions of the aesthetic quality of batik produced through the Human-AI co-creation process. Descriptive analysis was used to calculate mean values, frequency distributions, and the level of respondent agreement with each assessment indicator.

In addition to descriptive analysis, this research also used instrument reliability analysis to ensure that the indicators in the questionnaire had adequate internal consistency. Reliability testing was conducted using the Cronbach Alpha coefficient, which is generally used in social research to measure the consistency of perception measurement instruments.

Data analysis in this research aimed to answer the main research question regarding the extent to which batik designs generated through generative AI technology are aesthetically acceptable to the batik community and batik enthusiasts. Through this approach, the research can provide an empirical picture of the potential of AI technology as a collaborative tool in traditional batik design innovation.

Research Validity and Reliability

To ensure the methodological quality of the research, several research instrument

validation steps were taken. The content validity of the questionnaire was tested through consultation with textile design experts and batik practitioners experienced in evaluating batik design quality. This process aimed to ensure that the indicators used in the questionnaire truly represented important aspects of batik aesthetic assessment.

In addition, instrument reliability was tested using statistical analysis to ensure that each indicator had adequate measurement consistency. This approach is important to ensure that research results can be trusted and have strong scientific validity according to research standards in reputable international journals. With this methodological approach, the research is expected to make a significant scientific contribution to the study of artificial intelligence technology integration in traditional craft design innovation, particularly in the context of the Indonesian batik industry.

RESULTS AND DISCUSSION

Results

This research involved 300 respondents from six community groups with connections to the textile field and batik culture, namely textile vocational high school (SMK) students, textile vocational high school teachers, textile craft university students, textile craft lecturers, textile artists, and batik enthusiasts. This respondent composition was chosen to obtain a representative perception of the aesthetic quality of *batik tulis* originating from Generative Artificial Intelligence design simulations and then realized into original *batik tulis* works.

Respondents were asked to provide assessments on four main dimensions of batik design quality: motif originality, motif composition, visual technical quality, and philosophical meaning of batik motifs. The assessment was conducted using a five-point Likert scale ranging from strongly disagree to strongly agree. Statistical analysis was performed to calculate the mean values of respondent perceptions for each indicator tested.

Distribution of Respondent Perceptions

The following table presents the descriptive statistical results for all batik quality assessment indicators tested in this research.

Table 5. Results of Respondent Perception Statistics on AI Batik

Variable	Indicator	Mean	Std Dev	Category
Originality	Authenticity of batik motif	4.18	0.71	High
Originality	Authenticity of motif idea	4.11	0.74	High
Motif composition	Quality of main motif	4.24	0.68	Very Good
Motif composition	Quality of supplementary motif	4.07	0.72	High
Technical quality	Color brightness	4.15	0.70	High
Technical quality	Color sharpness	4.21	0.69	Very Good
Philosophy	Philosophical meaning of motif	3.96	0.77	Good

Based on the results of the descriptive statistical analysis, it can be seen that all indicators obtained mean values above 3.9, indicating that respondents generally gave positive assessments of the quality of *batik tulis* originating from generative AI designs.

The dimension with the highest score was the quality of the main motif composition, with a mean value of 4.24. This result indicates that respondents assessed that the compositional structure of batik designs resulting from the human-AI collaboration process has good visual quality and is able to follow textile design principles commonly used in traditional batik.

Meanwhile, the lowest mean value was found in the indicator of philosophical meaning of the motif, with a score of 3.96. Although this value is still in the good category, this finding indicates that the philosophical aspect of batik designs generated through AI still requires strengthening through deeper cultural interpretation.

Comparative Analysis of Perceptions Between Respondent Groups

To obtain a more comprehensive picture, analysis was also conducted on perception differences between respondent groups.

Table 6. Perceptions Based on Respondent Group

Respondent Group	Total Perception Mean
Textile SMK Students	4.09
Textile SMK Teachers	4.16
Textile Craft Students	4.18
Textile Craft Lecturers	4.21
Textile Artists	4.14
Batik Enthusiasts	4.05

The analysis results show that the academic group, particularly textile craft lecturers, gave the highest assessments of the quality of batik designs originating from generative AI. This can be interpreted that academics see the potential of AI technology as a design exploration tool that can help expand creative possibilities in textile design.

Conversely, the batik enthusiast group gave relatively lower scores compared to other groups. This finding indicates that the general public still has more cautious perceptions of the use of AI technology in the batik creation process.

Qualitative Findings from Participant Observation

Thematic analysis of observational field notes and training documentation produced three primary themes. Theme 1 — Learning Curve and Prompt Mastery: Participants initially struggled with text prompting due to limited familiarity with AI platform interfaces. By the second training day, most demonstrated improved prompting effectiveness, particularly when batik-specific cultural descriptors were incorporated. Facilitators played critical roles bridging cultural vocabulary with AI prompt language. Theme 2 — Cultural Gatekeeper Role: Participants with stronger traditional batik knowledge (artisans and teachers) were observed evaluating AI-generated outputs for cultural appropriateness and filtering designs inconsistent with regional batik traditions — consistent with the theoretical proposition that human cultural expertise is a critical mediating variable in human-AI co-creation quality. Theme 3 — Emergence of Hybrid Roles: Documentation revealed spontaneous role differentiation: some participants gravitated toward prompt optimization (AI Batik Prompter role) and others toward design evaluation and curation (Visual Batik Stylist role), independently of formal instruction, suggesting that human-AI collaboration itself induces occupational differentiation.

Discussion

Theoretical Alignment: Human-AI Co-Creation in the Context of Traditional Crafts

The findings of this research provide substantial empirical support for the theoretical framework of human–AI co-creation in the creative domain while also revealing unique dynamics specific to traditional crafts. The high acceptance scores observed across all four dimensions (motif originality (4.18), motif composition (4.24), technical visual quality (4.15), and philosophical meaning (3.96)) indicate that generative AI can function as an effective collaborative partner in batik design innovation, consistent with the broader literature on human–AI collaborative creativity (Hughes et al., 2021). These findings reinforce the conceptualization of AI not as a replacement for human creativity but as an augmentative tool that expands artisans' creative capacities while preserving their essential roles in aesthetic judgment and cultural interpretation.

The theoretical proposition that AI enhances creative efficiency and expands design exploration Putjorn (2024) is supported (although not causally confirmed, given the descriptive research design) by the generation of 300 batik design simulations featuring traditional motifs such as parang, kawung, and megamendung. This quantitative expansion of design possibilities represents a significant departure from the conventional batik design process, which is typically constrained by time-intensive manual sketching and limited opportunities for iterative development.

The findings of this research also resonate with Zhang (2023) three-tiered framework for human-centered AI co-creation, which emphasizes enabling users to adjust the degree of AI

involvement according to their creative preferences and needs. In the Kampung Batik AI program, participants demonstrated varying levels of AI engagement, ranging from using AI primarily for initial ideation to employing it throughout the design-refinement process. This variation indicates that flexible collaboration models are essential for accommodating diverse creative workflows and levels of technological proficiency.

Nevertheless, the relatively lower score for philosophical meaning (3.96), compared with the scores for the other dimensions, presents an important theoretical challenge to the assumption that AI can be seamlessly integrated into culturally embedded creative practices. This finding suggests that although AI excels at generating visually coherent and compositionally sound designs, it remains limited in its ability to encode and express the profound symbolic and philosophical meanings that have traditionally characterized batik motifs. This observation is consistent with Adeleye's (2024) concerns regarding the potential loss of the human touch in AI-assisted design and extends the theoretical discourse concerning the boundaries of computational creativity. The gap between technical visual quality and philosophical depth suggests that human–AI co-creation in traditional crafts operates within a complementary framework: AI provides computational capabilities for formal design exploration, whereas human artisans retain primary authority over cultural meaning-making and symbolic interpretation.

The findings of this research also contribute to refining the theoretical model of collaborative creativity by highlighting the importance of domain-specific knowledge in human–AI partnerships. Unlike generic design tasks, in which AI may operate with minimal contextual understanding, batik design requires extensive cultural literacy concerning motif symbolism, regional variations, and philosophical associations. The finding that the academic group, particularly lecturers (4.21), provided the highest ratings suggests that individuals with greater cultural and theoretical knowledge may be better positioned to evaluate and guide AI-generated outputs, thereby serving as cultural gatekeepers in the co-creation process. This finding challenges the notion of AI as an inherently democratizing force in creative production. Instead, it suggests that effective human–AI collaboration in traditional crafts requires substantial domain expertise to ensure that the resulting designs are culturally authentic, contextually appropriate, and respectful of established traditions.

Furthermore, this research extends the theoretical understanding of co-creative systems by demonstrating that successful human–AI collaboration in traditional crafts depends not only on technological capabilities but also on the social and educational infrastructure that supports technology adoption. The Kampung Batik AI program's emphasis on training and community engagement reflects the importance integration of human designers' creative judgment (including intuition, emotion, and cultural understanding) with AI's strengths in data processing and rapid ideation. This combination of technological and pedagogical approaches represents a holistic model of human–AI co-creation that recognizes the sociotechnical nature of creative innovation within traditional craft communities.

Advancing Knowledge: Contributions to Human-AI Co-Creation and Cultural Heritage Preservation

This research makes several significant contributions to the emerging field of human-AI co-creation in the context of traditional crafts, addressing critical gaps in both theoretical understanding and practical application. First, this research provides one of the first comprehensive empirical investigations of generative AI implementation in Indonesian batik design, a domain underexplored in international literature despite batik's status as a UNESCO-recognized intangible cultural heritage. While previous studies have examined AI applications in Malaysian batik Tang (2023); Latiff (2024) and Thai textiles Putjorn (2024), this research uniquely focuses on the Indonesian context, where batik holds profound cultural significance and faces distinct challenges related to artisan regeneration and design innovation capacity.

This research's mixed-method approach, combining observational data from the training program with a large-scale perception survey involving 300 respondents across six stakeholder groups, represents a methodological advancement over previous studies that have typically relied on smaller samples or focused exclusively on technical system development (Hughes et al., 2021). By systematically examining perceptions across different stakeholder segments (including SMK

students and teachers, textile craft university students and lecturers, textile artists, and batik enthusiasts) this research provides a nuanced understanding of how different communities within the batik ecosystem evaluate AI-assisted designs. The finding that academic groups provided higher ratings (4.21) compared to general batik enthusiasts (4.05) reveals important insights into the role of cultural expertise in mediating acceptance of technology-mediated creative outputs, a dimension that has received limited attention in previous literature.

A particularly novel contribution lies in the identification and conceptualization of emerging professional roles within the AI-augmented batik ecosystem, specifically the AI Batik Prompter and Visual Batik Stylist. These roles represent a new category of creative workforce bridging traditional craft knowledge with digital literacy, challenging conventional boundaries between artisans, designers, and technologists. This finding extends the work of Freese (2023), who explored collaborative processes between generative AI tools and designers, by demonstrating how human-AI co-creation can catalyze professional diversification and create new pathways for participation in the traditional craft industry. The emergence of these roles has significant implications for design education and workforce development, suggesting that future training programs should develop hybrid competencies integrating cultural knowledge, aesthetic judgment, and technological fluency.

This research also contributes to the theoretical discourse on computational creativity by providing empirical evidence for the differential performance of AI across dimensions of creative output. The finding that AI-assisted designs scored highest on motif composition (4.24) and technical visual quality (4.15) but lowest on philosophical meaning (3.96) offers important insights into the capabilities and limitations of current generative AI systems. This pattern suggests that while AI excels at formal design tasks involving pattern arrangement, symmetry, and visual coherence, capabilities aligned with its training on large visual datasets, it struggles with the semantic and symbolic dimensions of design that require cultural contextualization and interpretive depth. This finding resonates with concerns raised by Hughes (2021) regarding the "black-box" nature of AI systems and their limited capacity for cultural reasoning, while also supporting Bagnato's (2023) argument that human-AI collaboration should be structured to leverage the complementary strengths of each partner.

Moreover, this research enriches the literature on cultural heritage preservation in the digital era by demonstrating that technology integration need not compromise cultural authenticity. The successful generation of designs featuring traditional motifs such as *parang*, *kawung*, and *megamendung* (each carrying specific cultural and philosophical meanings) demonstrates that generative AI can be trained and guided to respect cultural boundaries while still enabling creative exploration. This finding challenges deterministic narratives about technology's homogenizing effects on cultural production and instead supports a more nuanced view where technology serves as a tool for both cultural continuity and adaptation. This research aligns with Song's (2024) work on LoRA models for traditional fabric patterning, which similarly shows that AI can support cultural sustainability and inspire innovative artistic expression while maintaining heritage values.

This research also provides important contributions to understanding the social dimensions of technology adoption in traditional craft communities. Unlike studies that primarily focus on technical system performance or individual user experience, this research examines human-AI co-creation as a community-level phenomenon embedded in specific institutional contexts (the APPBI training program) and geographical settings (Cirebon and Bandung). This socially situated approach reveals that successful technology integration depends not only on system capabilities but also on community engagement, peer learning, and institutional support structures. The finding that participants from different community groups showed varying levels of acceptance suggests that technology diffusion in the traditional craft sector follows complex social dynamics that must be carefully navigated through culturally sensitive implementation strategies.

Finally, this research contributes to the growing literature on design education in the AI era by demonstrating how generative AI can be integrated into capacity-building programs for traditional craft practitioners. The Kampung Batik AI program represents an innovative pedagogical model combining hands-on training with AI tools, cultural education about

traditional motifs, and collaborative design practice. This approach addresses the gap identified by Chandrasekera (2024) regarding the need for educational frameworks that balance cognitive load management with creativity enhancement. The findings of this research suggest that when properly structured, AI-assisted design education can lower the barrier to entry for aspiring batik designers while simultaneously deepening engagement with cultural heritage, thus supporting both innovation and preservation goals.

Practical Implications: Transformation of Batik Design Practice and Industry

The findings of this study have significant practical implications for the batik ecosystem, encompassing artisans, designers, educators, entrepreneurs, and policymakers. Generative AI has proven effective in expanding design exploration and accelerating the iterative process, thereby helping to address the shortage of skilled designers without compromising cultural authenticity. This technology also democratizes access to design tools, enabling artisans without formal design backgrounds to generate motif variations rapidly and reducing barriers to entry into the industry.

For artisans and small and medium-sized enterprises (SMEs), AI enhances productivity and competitiveness. Previously time-consuming design processes can now be accelerated by generating and simulating hundreds of design alternatives within a short period. This capability enables more adaptive responses to market trends and improves cost efficiency, aligning with findings that human–AI collaboration increases operational efficiency while allowing individuals to focus on the creative aspects of design.

However, the implementation of AI must carefully consider cultural authenticity. The lower score for the philosophical meaning dimension indicates a gap between AI-generated designs and the cultural depth embedded in traditional batik. Therefore, AI should be positioned as a complementary tool, particularly during the ideation stage, while cultural interpretation, motif validation, and final design decisions remain under human control. This hybrid approach helps maintain a balance between technological innovation and cultural integrity.

In educational contexts, the integration of AI into batik training has proven effective when grounded in cultural understanding, collaborative practice, and experiential learning. This integration creates opportunities to develop new curricula that combine traditional craftsmanship with digital competencies. The emergence of new roles, such as AI Batik Prompt Designer and Digital Batik Visual Stylist, indicates a growing need for hybrid creative and technological skills. From a business perspective, AI supports product diversification, strengthens innovation-oriented branding, and offers considerable commercial potential, although AI-generated products must still be supported by strong and credible cultural narratives.

From a policy perspective, support for training, technological infrastructure, intellectual property protection, and quality standards is necessary to ensure the sustainable adoption of AI. In addition, AI can contribute to environmental sustainability by reducing material waste during the design and prototyping stages. A community-based approach has proven effective in promoting inclusive, culturally responsible, and sustainable technology adoption within Indonesian creative communities.

CONCLUSION

Although the overall findings of this research support the potential of AI to enhance creative processes, several results deviate from the initial hypotheses and reveal important tensions. One of the main findings is the difference in acceptance levels among stakeholders: academics provided higher ratings (4.21) than general batik enthusiasts (4.05). This result contradicts the assumption that the general public would be more receptive to AI-generated designs. Instead, it suggests that deeper theoretical and cultural knowledge may increase appreciation for AI-assisted designs.

This phenomenon may be explained by academics' capacity to evaluate designs comprehensively, extending beyond aesthetic qualities to include composition, cultural relevance, and innovation potential. Conversely, the general public may rely more heavily on intuitive judgments that emphasize traditional authenticity. This finding also highlights the paradox of AI democratization: although design production becomes more accessible, evaluating design quality still requires specialized expertise.

Furthermore, the difference between the highest-rated assessment dimension, motif composition (4.24), and the lowest-rated dimension, philosophical meaning (3.96), is relatively small. This result may indicate that respondents applied different evaluation standards to AI-generated designs or that the human-in-the-loop approach successfully preserved cultural relevance through human curation. Thus, Human–AI collaboration is essential for maintaining a balance between innovation and cultural meaning. Other findings indicate minimal resistance to AI technology, particularly when AI is positioned as a collaborative tool within a community context. However, potential selection bias and the study's limited time frame warrant caution when interpreting its long-term implications.

The use of AI also tends to support incremental innovation rather than radical experimentation, reflecting both cultural and market considerations. At the same time, tension emerges between efficiency and creative satisfaction because traditional processes retain significant reflective, experiential, and educational value. Therefore, AI integration should be designed in a balanced manner to support the long-term sustainability of creative practices, cultural knowledge, and traditional batik craftsmanship.

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AUTHOR CONTRIBUTION STATEMENT

All authors contributed equally to this research. Denny Boy Sitanggang, I Dewa Ketut Kerta Widana, and Dewi Puspaningtyas Faeni collaboratively participated in the conceptualization of the study, research design, data collection, data analysis, interpretation of results, and manuscript writing. All authors have read and approved the final version of the manuscript and agree to be accountable for all aspects of the work.

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