



HUMAN-AI CO-CREATION IN TEXTILE DESIGN: EXPLORING GENERATIVE AI FOR INNOVATIVE TEXTILE PATTERN DEVELOPMENT

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Abstract:

Artificial Intelligence (AI) is increasingly influencing the creative processes of the textile and fashion industries, particularly through Generative AI, which can produce visual concepts from textual prompts. This study explores the potential of Human-AI co-creation in textile design, with specific focus on the development of innovative textile patterns using Generative AI. The study examines how AI can support textile designers in generating design ideas, exploring pattern variations, developing colour combinations and refining surface design concepts while retaining human creativity and decision-making. A design-based exploratory approach is adopted in which textile design concepts are developed through AI-assisted generation and subsequently reviewed and refined by the designer. The study also considers the advantages and limitations of integrating Generative AI into the textile design process, including creative exploration, design efficiency, originality, cultural representation and the continuing importance of human intervention. The findings indicate that Generative AI can function as a creative support tool rather than a replacement for the textile designer. Human judgement remains essential for selecting, modifying and adapting AI-generated concepts according to aesthetic, functional and textile-specific requirements. The study highlights the potential of Human-AI collaboration to provide new directions for contemporary textile pattern development and digital textile design practices.

Keywords: Artificial Intelligence, Generative AI, Textile Design, Pattern Development, Human-AI Co-Creation, Surface Design.

Introduction:

Textile design is an important creative area of the textile and fashion industry that involves the development of motifs, patterns, colour arrangements and surface compositions for different textile applications. Traditionally, textile designers have used hand sketching, visual references, trend information and computer-aided design techniques to develop and refine textile patterns. The advancement of digital technologies has gradually changed this process by providing designers with faster and more flexible methods for visualising and modifying design concepts. In recent years, Artificial Intelligence (AI) has emerged as a developing technology that offers new possibilities for creative design practices. Generative Artificial Intelligence (Generative AI) is a branch of AI that can create new visual, textual or other forms of content based on user-provided instructions. In textile design, Generative AI can assist in producing different motif arrangements, pattern concepts, colour combinations and surface design ideas within a short period. A recent study on digital textile design using image-generative AI demonstrated the use of AI tools such as ChatGPT and Midjourney for analysing textile trends and developing digital textile design concepts. The study also highlighted the potential of combining the creative sensitivity of designers with the broader generation capabilities of AI [1]. The use of Generative AI in textile-specific design is particularly significant because textile patterns require careful consideration of motif placement, repetition, scale, colour relationships and overall visual balance. AI-based systems can generate several design alternatives, allowing designers to explore different creative directions during the initial stages of design development.

Wu and Li investigated the application of generative AI specifically for knitted textile design and reported that AI-generated textile designs could demonstrate creative qualities and practical usefulness for supporting the fashion design process [2]. Their work indicates that AI can be applied not only to general fashion concepts but also to the development of textile-focused visual designs. The integration of AI into textile design does not necessarily mean replacing the human designer. Instead, it provides an opportunity for collaboration between human creativity and machine-generated possibilities. The designer can determine the design theme, provide suitable prompts, evaluate the generated outputs and make necessary modifications according to aesthetic and textile-related requirements. This collaborative process can be understood as Human-AI co-creation, in which AI contributes rapid idea generation while the human designer contributes experience, creativity, contextual understanding and critical judgement. Recent research on AI in fabric design also identifies the changing relationship between technological capabilities and human creativity as an important area within contemporary textile and fashion design [3]. Generative AI may also provide advantages in the early conceptual stage of textile design by enabling designers to explore a greater number of visual alternatives without developing every concept manually. This can support experimentation with different motifs, compositions and stylistic directions. However, AI-generated outputs may also contain unsuitable visual elements, inconsistencies, repetitive ideas or designs that require considerable human refinement. Questions related to originality, authorship, cultural representation and the appropriate use of AI-generated

content also need to be considered when integrating AI into creative textile practices [1,3]. Therefore, the role of the textile designer remains essential in transforming AI-generated concepts into meaningful textile design outcomes. Rather than considering Generative AI as an independent designer, it can be approached as a creative support tool that expands the designer's ability to explore and refine ideas. The interaction between human judgement and AI-generated alternatives can create an iterative design process in which concepts are generated, selected, modified and developed according to the intended textile application. Hence, the present study focuses on Human–AI Co-Creation in Textile Design, with particular emphasis on the use of Generative AI for innovative textile pattern development. The study explores how Generative AI can support the generation of textile pattern concepts and how human intervention can contribute to their selection, refinement and development. It further examines the opportunities and limitations of integrating Generative AI into contemporary textile design practices. The study aims to highlight a collaborative approach in which technological capabilities and human creative expertise work together to support innovative textile pattern development.

2. Research Methodology

2.1 Research Design

The present study adopted a qualitative and exploratory design-based research approach to investigate the application of Generative Artificial Intelligence (Generative AI) in textile pattern development. Previous studies have demonstrated the application of image-generative AI and Generative AI in digital and knitted textile design, providing a basis for exploring AI-assisted textile design development [1,2]. The present study therefore focused on the interaction between AI-generated design concepts and human creative intervention rather than laboratory-based fabric testing.

2.2 Selection of Textile Design Theme

A specific textile design theme was selected as the creative foundation for the study. The selected theme was translated into design characteristics such as motif type, colour palette, pattern style, composition and visual appearance. Defining these characteristics before AI generation helped establish a clear design direction and ensured that the generated concepts were developed according to a predetermined textile design objective.

2.3 Development of AI Prompts

Text-based prompts were prepared according to the selected textile design requirements. Each prompt included relevant textile characteristics such as motif, colour, composition, pattern arrangement and surface appearance. The prompts were modified progressively according to the quality and relevance of the generated outputs. The use of structured prompts and iterative generation was considered important for directing Generative AI towards textile-specific design outcomes [1,2].

2.4 Generation of Textile Pattern Concepts

The developed prompts were entered into a Generative AI image-generation system to produce textile pattern concepts. Multiple design alternatives were generated for each design direction to provide a broader range of visual possibilities. The generated concepts were collected and organized according to their motif characteristics, colour arrangements and pattern compositions. The AI-generated outputs were treated as preliminary design concepts rather than final textile designs.

2.5 Selection of AI-Generated Designs

The generated textile pattern concepts were examined by the researcher and the most suitable designs were selected for further development. Selection was based on motif clarity, colour harmony, visual balance, pattern composition, originality and suitability for textile application. This stage allowed human creative judgement to guide the selection process and reduced the dependence on automatic AI-generated outputs.

2.6 Human Intervention and Design Refinement

The selected AI-generated concepts were further reviewed and refined by the researcher. Human intervention included modification of motifs, colour arrangements, pattern composition, scale and other visual elements where necessary. The process allowed the researcher to combine AI-generated possibilities with textile design knowledge and personal creative judgement. Such interaction represents the Human–AI co-creation approach, where AI contributes alternative design possibilities while the human designer maintains creative direction and decision-making [1,3].

2.7 Evaluation Criteria

The developed textile patterns were evaluated through qualitative design criteria. The criteria included motif quality, colour harmony, pattern composition, visual balance, originality, aesthetic appeal and suitability for textile application. These criteria were used to examine the strengths and limitations of the AI-generated concepts and the improvements achieved through human refinement. The evaluation was based on visual and design analysis rather than laboratory or instrumental testing.

2.8 Comparative Analysis

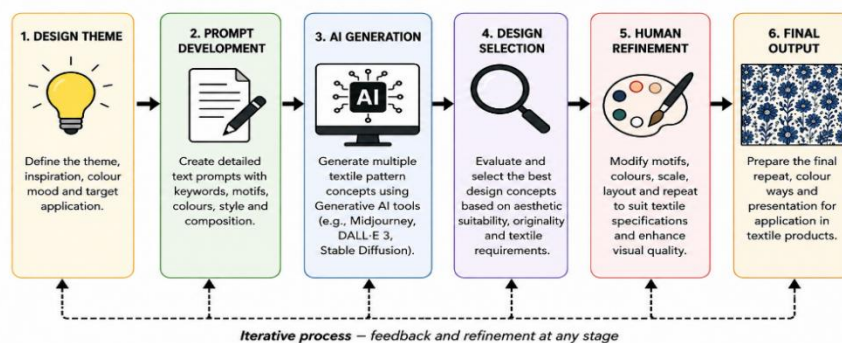
The initial AI-generated concepts and the human-refined textile patterns were compared to identify the contribution of AI and human intervention at different stages of the design process. The comparison considered changes in motif arrangement, colour application, pattern structure, visual complexity and overall design suitability. The analysis helped determine how human intervention influenced the development of the initial AI-generated concepts.

2.9 Data Analysis

The observations obtained from the generated and refined textile patterns were analysed using qualitative descriptive analysis. The designs were organized according to the identified design characteristics and stages of the Human–AI co-creation process. The analysis focused on the creative possibilities, efficiency, design flexibility, originality and limitations associated with the use of Generative AI in textile pattern development [1–3]. No physical fabric production, laboratory testing or instrumental testing was conducted in the study.

2.10 Ethical and Originality Considerations

The study considered originality and responsible use of Generative AI during the design development process. AI-generated concepts were considered as creative inputs and were subjected to human selection, interpretation and refinement. The researcher maintained creative control over the final design decisions. Existing textile motifs and cultural references were considered carefully to avoid direct reproduction or inappropriate representation. The final textile concepts were therefore developed through an iterative process involving AI-assisted generation and human creative intervention.



(Fig 1. Human-AI Co-Creation Workflow in Textile Pattern Development)

3. Results and Discussion

3.1 Development of AI-Assisted Textile Pattern Concepts

The use of Generative Artificial Intelligence resulted in the development of multiple textile pattern concepts from the selected design theme and structured text prompts. The generated concepts showed variations in motif arrangement, colour combinations, scale, composition and visual style. The ability to obtain several design alternatives from a single creative direction provided a broader space for design exploration. Similar potential has been reported in textile-specific research, where different generative AI platforms were explored for developing textile design outcomes and establishing an AI-assisted textile design process [4].

The generated designs demonstrated that Generative AI can be useful during the initial ideation stage of textile design. Instead of developing every preliminary motif manually, the designer can use AI-generated alternatives as starting points for further creative exploration. However, the generated outputs were not considered final textile designs because their visual quality and suitability varied between different generations.

3.2 Effect of Prompt Development on Design Output

The study observed that the quality and direction of the generated textile patterns were influenced by the information included in the prompts. Prompts containing specific instructions related to textile motifs, colour, composition and pattern arrangement produced more focused design concepts than broad and general descriptions. Modification of the prompts also resulted in changes in the visual characteristics of the generated patterns.

This observation indicates that prompt development is an important creative activity within an AI-assisted textile design workflow. The designer does not simply enter a prompt and accept the first output; instead, the designer interacts with the AI system through repeated instructions and visual evaluation. This creates an iterative process in which the designer gradually directs the AI towards a preferred design outcome. The importance of structured AI-assisted textile design processes has also been highlighted by Baek and Lee [4].

3.3 Visual Characteristics of the Generated Patterns

The AI-generated textile patterns displayed a wide range of visual characteristics. Floral and ornamental motifs produced relatively detailed compositions, while geometric prompts generated more structured arrangements. Abstract prompts resulted in more unpredictable combinations of shapes and colours. This variation demonstrated the ability of Generative AI to explore different visual directions within the same overall design theme.

The major advantage observed was the speed of visual exploration. Multiple alternatives could be considered before selecting a suitable concept. This is particularly useful during the early design stage, where designers often explore several possibilities before deciding on a final direction. However, increased variation did not always result in improved design quality. Some generated concepts were visually complex or contained unnecessary elements that reduced their suitability for textile application.

3.4 Human Selection and Design Refinement

Human intervention was found to be an essential stage in the development of the final textile pattern concepts. The researcher selected the most appropriate AI-generated outputs and refined their motifs, colour relationships, composition and visual balance. Through this process, the designer's knowledge and aesthetic judgement were combined with the generative ability of AI.

The results suggest that the role of the designer changes from producing every design element manually to directing, evaluating and refining AI-assisted concepts. Generative AI therefore functioned as a creative support mechanism rather than an independent designer. This finding is important because research on AI-supported creativity has shown that the effect of Generative AI can vary according to the user and the way the technology is incorporated into the creative process [5].

3.5 Comparison of AI-Generated and Human-Refined Designs

The comparison between the initial AI-generated concepts and the human-refined designs (Table.1) showed that human intervention improved the control and organization of the design outcomes.

Design Parameter	AI-Generated Concept	Human-Refined Concept
Motif arrangement	Varied and sometimes unpredictable	Selected and systematically arranged
Colour combination	Multiple colour possibilities	Harmonised according to design intention
Composition	Experimental and diverse	More balanced and controlled
Visual complexity	May contain excessive elements	Unnecessary elements reduced
Originality	Unexpected combinations possible	Further developed through designer interpretation
Textile suitability	Requires evaluation	Adapted to intended textile application

Table 1: AI-Generated and Human-Refined Designs

The comparison demonstrates that AI can provide a large number of creative possibilities, while human intervention is necessary to identify and improve the most appropriate concepts. Therefore, the final design outcome can be considered a result of interaction between machine-generated possibilities and human creative judgement.

3.6 Creative Exploration and Design Diversity

One of the important findings was the ability of Generative AI to increase the number of visual alternatives available to the designer. Different prompts could be used to explore changes in motif style, colour direction and composition without completely restarting the design process. This provided opportunities for rapid experimentation and visual comparison.

However, greater design diversity should not automatically be interpreted as greater creativity. GenAI-supported design outputs could receive higher evaluations for creativity and unconventionality, while other aspects such as usefulness and visual appeal did not necessarily improve to the same extent [5]. This supports the present observation that AI-generated textile designs need to be critically evaluated rather than selected solely because they appear novel.

3.7 Role of Generative AI in Textile Design Development

The findings indicate that Generative AI can contribute at several stages of textile pattern development, particularly in ideation, visual experimentation and alternative generation. It can assist designers in exploring motifs, colour combinations and compositions that may not have been considered during the initial design stage.

A textile-specific study by Baek and Lee [4] also examined the application of Generative AI through different design platforms and proposed an AI-integrated textile design process. This supports the present finding that AI can be incorporated into textile design as part of a structured workflow rather than being used only for producing isolated images.

3.8 Limitations of AI-Generated Textile Patterns

Despite its creative possibilities, the study identified limitations in the generated textile patterns. Some outputs required modification because of unsuitable motif proportions, excessive visual details, inconsistent arrangements or a lack of clear textile repeat structure. These limitations indicate that an aesthetically attractive AI-generated image cannot automatically be considered a technically appropriate textile pattern.

Another important limitation is the possibility of design fixation. Research investigating AI-generated images during visual ideation found that exposure to an initial AI-generated example could influence subsequent ideas and potentially reduce variety and originality in some situations [6]. Therefore, textile designers should avoid depending exclusively on AI outputs and should continue to develop independent design ideas alongside AI-assisted exploration.

3.9 Human–AI Co-Creation in Textile Pattern Development

The overall design process can be represented as:

Design Theme → Prompt Development → AI Generation → Design Selection → Human Refinement → Final Textile Pattern Concept

This process demonstrates that Human–AI co-creation involves continuous interaction rather than one-time AI generation. The designer establishes the creative intention, communicates it through prompts, evaluates the generated outputs and modifies the selected concepts. AI contributes rapid visual generation and variation, while the designer provides contextual understanding, aesthetic judgement and final decision-making.

The emerging relationship between AI and creative practice has also been discussed in fashion design research, which highlights the potential of Generative AI to reshape creative workflows while raising aesthetic, ethical and cultural considerations [7]. The present study similarly suggests that AI is most valuable when integrated into a human-directed design process.

3.10 Overall Discussion

The results demonstrate that Generative AI has considerable potential as a supporting tool for textile pattern development. Its ability to rapidly generate different visual alternatives can expand the designer's initial creative exploration and reduce the time required for developing preliminary concepts. However, the results also demonstrate that AI-generated designs require human evaluation and refinement before they can be considered appropriate textile design outcomes.

The study therefore supports a Human–AI co-creation model rather than an AI-replacement model. AI provides speed, variation and unexpected visual possibilities, whereas the human designer contributes creativity, judgement, cultural awareness and textile-specific design knowledge. The most effective approach is consequently not to replace conventional textile design expertise but to combine it with the exploratory capabilities of Generative AI.

The findings further suggest that the future role of the textile designer may increasingly involve prompt development, AI-assisted ideation, critical evaluation, visual curation and creative refinement. When used responsibly, Generative AI can therefore expand the possibilities of textile pattern development while maintaining human control over the creative outcome.

4. Conclusion

The present study explored the potential of Generative Artificial Intelligence as a creative support tool for textile pattern development through a Human–AI co-creation approach. The study demonstrated that Generative AI can provide textile designers with multiple pattern concepts, motif variations, colour combinations and visual compositions within a short period. This capability can support creative exploration, particularly during the initial stages of textile design development.

The findings indicate that AI-generated concepts are most effective when combined with human creative judgement. Although Generative AI can produce diverse and visually interesting design alternatives, the generated outputs may require modification to achieve appropriate motif arrangement, colour harmony, visual balance, originality and textile suitability. Human intervention therefore remains essential for selecting, interpreting and refining AI-generated concepts.

The study further concludes that Human–AI co-creation provides a collaborative alternative to both conventional manual design and fully automated design generation. In this approach, AI contributes speed, variation and creative possibilities, while the textile designer contributes design knowledge, aesthetic judgement, contextual understanding and final decision-making. Therefore, Generative AI should be viewed as a complementary tool rather than a replacement for the creativity and expertise of textile designers.

Overall, the integration of Generative AI into textile pattern development has the potential to support innovative and efficient design practices. Responsible use of AI, combined with strong human creative control, can create new opportunities for contemporary textile designers and contribute to the future development of digital textile design.

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