

ZERO-WASTE SURFACE ORNAMENTATION: INNOVATIVE TECHNIQUES FOR SUSTAINABLE FASHION DESIGN

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ABSTRACT

The fashion and textile industry is associated with substantial resource consumption, material waste and environmental pollution throughout the stages of fibre production, textile manufacturing, garment construction and disposal. Conventional fashion production frequently generates pre-consumer textile waste in the form of cutting scraps, fabric remnants, selvedges, rejected materials and production leftovers. At the same time, surface ornamentation processes may involve additional materials such as threads, trims, sequins, beads, appliqué components and synthetic embellishments. Sustainable surface ornamentation provides an opportunity to transform these discarded or surplus materials into aesthetically valuable design elements while reducing dependence on virgin resources.

This research paper explores the concept of **zero-waste surface ornamentation** as an innovative approach to sustainable fashion design. The study examines techniques including textile scrap appliqué, patchwork, fabric manipulation, fabric weaving, braided waste, corded ornamentation, reconstructed embellishment, layered textile surfaces, waste-based embroidery and modular surface development. A conceptual design framework is proposed in which textile waste is first classified according to fibre, colour, size, texture and form and subsequently transformed into functional and decorative fashion components. The paper further discusses the relationship between zero-waste design, circular economy principles, aesthetic innovation and responsible production.

Existing research demonstrates that pre-consumer textile waste can be incorporated into surface design and that zero-waste pattern cutting can achieve very high levels of fabric utilisation. One published study reported fabric utilisation above 98% for selected garment styles using zero-waste pattern cutting. Research on textile-waste-based surface ornamentation has also demonstrated the potential of integrating and disintegrating fabric waste to create durable decorative surfaces. Therefore, zero-waste surface ornamentation can be understood not merely as a waste-management strategy but as a design methodology capable of generating new material aesthetics, extending material value and supporting circular fashion systems.

Keywords: Zero-waste fashion, surface ornamentation, textile waste, sustainable fashion, upcycling, circular fashion, textile scraps, sustainable design, fabric manipulation, circular economy.

INTRODUCTION

Fashion is one of the world's most creative and culturally significant industries; however, its conventional linear production model follows a predominantly “take–make–use–dispose” pattern. Increasing production and consumption have intensified concerns related to resource depletion, textile waste, pollution and greenhouse-gas emissions. The Ellen MacArthur Foundation describes the transition towards circular fashion as a shift towards products that are used more, made to be made again and produced from safe, recycled or renewable inputs.

The textile industry generates waste at different stages of production. During garment manufacturing, fabric remnants are produced through marker planning, pattern cutting and sampling. Additional waste may originate from defective materials, rejected garments, unused trims and leftover stocks. A circular approach therefore requires designers to consider waste reduction at the design stage rather than treating waste only as a problem at the end of the production process.

Zero-waste fashion design addresses this issue by considering material utilisation during the development of the garment. Research on zero-waste pattern cutting has demonstrated that design, pattern development and material utilisation can be integrated into a single creative process. Ramkalaon and Sayem reported fabric utilisation exceeding 98% for two tested garment styles through a zero-waste pattern-cutting framework.

Surface ornamentation provides another important area for sustainability intervention. Traditional embroidery, appliqué, patchwork, quilting, fabric manipulation and decorative construction techniques can be adapted to incorporate textile remnants. Instead of discarding small pieces of fabric, designers can transform them into decorative motifs, panels, trims, textures and three-dimensional surfaces.

A study by Shah on innovative surface ornamentation using pre-consumer textile waste explored the use of fabric waste through processes of disintegration and integration. The study demonstrated the potential of shredded textile waste to create decorative fabric surfaces suitable for fashion applications.

Therefore, the present study proposes zero-waste surface ornamentation as an integrated design approach in which textile waste is treated as a **design resource rather than a production residue**.

Textile Waste → Sorting → Re-design → Surface Ornamentation → Fashion Product → Extended Use → Reuse/Recycling



Figure 1. Conceptual circular pathway for transforming textile waste into sustainable surface-ornamented fashion products.

BACKGROUND OF THE STUDY

The environmental consequences of textile production are associated with resource extraction, chemical processing, energy consumption, water use and waste generation. UNEP identifies the textile and fashion sector as an important area for addressing climate change, biodiversity loss, pollution and waste and advocates a transition towards sustainable and circular textile value chains.

The Ellen MacArthur Foundation similarly identifies the current textile system as predominantly linear and argues for a circular model in which products and materials remain in use at their highest value for as long as possible.

Within this context, zero-waste design can operate at several levels:

1. Reduction of cutting waste.
2. Reuse of pre-consumer textile remnants.
3. Upcycling of discarded garments.
4. Transformation of small textile pieces into surface designs.
5. Development of modular and repairable decorative components.
6. Use of recyclable or biodegradable ornamentation materials.
7. Designing products for longer use and future material recovery.

Zero-waste pattern cutting has already received significant academic attention. Studies have classified zero-waste fashion approaches into methods such as cut-and-sew, folding, draping and non-woven construction.

However, surface ornamentation deserves greater attention because it can provide a practical solution for **very small textile remnants that cannot easily be incorporated into conventional garment panels**.

PROBLEM STATEMENT

The conventional garment-production system generates considerable quantities of textile remnants during cutting and manufacturing. Small fabric pieces are frequently considered economically insignificant and may be discarded even though they retain material, colour, texture and aesthetic value.

At the same time, conventional surface ornamentation may depend on additional decorative materials such as synthetic trims, plastic sequins, metallic components and commercially manufactured embellishments. When these materials are combined with different fibre types and adhesives, subsequent recycling may become more difficult.

The problem addressed in this study is therefore:

How can textile waste and surplus materials be transformed through innovative surface ornamentation techniques to create aesthetically appealing, functional and sustainable fashion products while reducing material waste?

RESEARCH GAP

Existing literature has established the importance of zero-waste pattern cutting and sustainable fashion design. Research has demonstrated that zero-waste pattern cutting can substantially increase fabric utilisation and can alter the conventional relationship between fashion design and pattern development.

Research has also explored the transformation of pre-consumer textile waste into innovative surface ornamentation.

However, there remains scope for a systematic design framework that connects:

- textile waste classification,
- zero-waste thinking,
- surface ornamentation,
- aesthetic development,
- functional performance,
- material recovery and
- sustainable fashion production.

The present study addresses this gap by proposing an integrated approach to zero-waste surface ornamentation.

AIM OF THE STUDY

The primary aim of this study is to explore innovative zero-waste surface ornamentation techniques that can transform textile waste into aesthetically appealing and sustainable fashion design applications.

OBJECTIVES OF THE STUDY

The study has the following objectives:

1. To examine the potential of textile waste as a resource for surface ornamentation.
2. To identify innovative surface ornamentation techniques suitable for textile waste.
3. To classify textile waste according to material, colour, size, texture and usability.
4. To develop a conceptual framework for zero-waste surface ornamentation.
5. To explore the aesthetic and functional possibilities of waste-based surface design.
6. To examine the contribution of zero-waste ornamentation to sustainable fashion production.
7. To encourage the integration of traditional and contemporary textile techniques with waste materials.
8. To identify opportunities for extending the useful life of textile materials through surface design.
9. To suggest future directions for research and commercial application.

RESEARCH QUESTIONS

The study seeks to answer the following research questions:

RQ1: What types of textile waste are suitable for surface ornamentation?

RQ2: Which surface ornamentation techniques can effectively utilise textile waste?

RQ3: How can zero-waste surface ornamentation contribute to sustainable fashion design?

RQ4: Can waste-based ornamentation create aesthetically valuable and commercially viable fashion products?

RQ5: How can designers integrate circular design principles into surface ornamentation?

CONCEPT OF ZERO-WASTE SURFACE ORNAMENTATION

Zero-waste surface ornamentation refers to the design and application of decorative textile surfaces in which surplus, discarded or leftover materials are reused, transformed or incorporated into the final product with minimal additional waste.

The concept combines two important approaches:

1. Zero-Waste Design

Zero-waste design aims to prevent materials from becoming waste through careful planning, cutting, construction and reuse.

2 Surface Ornamentation

Surface ornamentation involves modifying or decorating the surface of a textile to improve its visual, tactile or functional qualities.

When these concepts are combined, textile waste can become an integral part of the design rather than an unwanted by-product.

TYPES OF TEXTILE WASTE SUITABLE FOR ORNAMENTATION

Textile waste can be classified into the following categories:

Type of Waste	Examples	Possible Application
Fabric scraps	Cotton, linen, silk, denim	Appliqué, patchwork
Narrow strips	Cutting leftovers, selvages	Braiding, weaving
Small pieces	Geometric or irregular scraps	Mosaic appliqué
Thread waste	Embroidery/sewing threads	Decorative stitching
Yarn waste	Knitting/weaving leftovers	Surface texture
Garment waste	Old shirts, jeans, sarees	Upcycling
Lace remnants	Decorative trims	Layering and appliqué
Denim waste	Jeans remnants	Quilting, patchwork
Knitted waste	Knitted panels	Textural surfaces
Textile ribbons	Production remnants	Braiding and tassels

INNOVATIVE ZERO-WASTE SURFACE ORNAMENTATION TECHNIQUES

1 Waste-Fabric Appliqué

Appliqué involves attaching pieces of fabric to a base textile to create decorative motifs or patterns. Small fabric remnants can be cut into geometric, floral, abstract or figurative forms.

The technique is particularly useful because scraps of different shapes and sizes can be incorporated into a single design.

Sustainability benefit:

It extends the useful life of textile remnants and reduces the requirement for new decorative fabrics.

2 Scrap Patchwork

Patchwork involves joining several pieces of fabric to create a larger decorative surface.

Instead of purchasing new fabrics for patchwork, designers can use cutting-room waste. Different textures, colours and patterns can be deliberately combined to create unique surfaces.

Applications:

- Jackets

- Skirts
- Bags
- Cushions
- Waistcoats
- Accessories
- Contemporary ethnic garments

3 Textile Scrap Mosaic

Very small scraps that are unsuitable for conventional patchwork can be arranged as a mosaic.

The scraps may be:

- triangular,
- square,
- circular,
- irregular,
- shredded or
- layered.

These pieces can be stitched or secured using low-impact construction methods.



Figure 2. Textile scrap mosaic developed by arranging small fabric remnants into a decorative surface.

4 Fabric Strip Weaving

Narrow fabric strips and selvages can be interwoven to create new textile surfaces.

The technique may combine:

- horizontal strips,
- vertical strips,
- braided strips,
- contrasting textures,
- different fabric weights.

This method converts narrow remnants that are often difficult to reuse into a new decorative material.



Figure 3. Proposed framework for zero-waste surface ornamentation and sustainable fashion product development.

5 Fabric Braiding

Fabric strips can be braided manually or mechanically.

Three-strand, four-strand and multi-strand braids can be developed into:

- neckline trims,
- belts,
- bag handles,
- garment borders,
- decorative panels,
- cords and
- accessories.

Fabric braiding is particularly useful for narrow scraps and elongated remnants.

6 Zero-Waste Embroidery

Embroidery can be redesigned to incorporate textile waste as part of the motif.

Instead of relying exclusively on new embroidery materials, designers can combine:

- waste threads,
- yarn remnants,
- fabric strips,
- loose fibres,
- recycled textile fragments.

Decorative stitches can include:

- running stitch,
- chain stitch,
- couching,
- blanket stitch,
- satin stitch,
- French knots,
- cross stitch.

The result can combine traditional craftsmanship with contemporary sustainable design.

7 Shredded Textile Surface

Small textile pieces can be shredded or cut into fibres and fragments and incorporated into new decorative surfaces. A similar integration/disintegration approach has been explored in research on pre-consumer textile waste, demonstrating the potential of shredded textile materials for surface development.

Potential applications include:

- jackets,
- fashion panels,
- handbags,
- accessories,
- decorative home textiles.

8 Fabric Manipulation Using Waste

Textile scraps can be transformed through:

- pleating,
- gathering,
- tucking,
- folding,
- twisting,
- knotting,
- coiling,
- layering.

These techniques create three-dimensional surfaces without requiring extensive additional materials.

9 Waste-Based Quilting

Quilting traditionally combines layers of textile materials.

For sustainable fashion, waste fabrics can be arranged into patchwork layers and stitched together.

The technique can transform multiple small scraps into a durable decorative material.

Potential applications:

- coats,
- jackets,
- bags,
- footwear components,
- home textiles,
- accessories.

10 Textile Waste Coiling

Narrow fabric strips can be twisted or coiled and stitched together to create decorative surfaces.

Coiling can generate:

- circular motifs,
- spirals,
- floral forms,
- geometric patterns,
- sculptural details.

It is especially suitable for denim and heavier cotton waste.

11 Reconstructed Surface Embellishment

Instead of using conventional embellishments, designers can create decorative elements from discarded garments.

For example:

- old buttons can become decorative clusters,

- garment labels can become design details,
- damaged lace can become appliqué,
- old pockets can become functional ornamentation,
- discarded seams can become surface lines.

This approach transforms existing garment components into new design features.

TRADITIONAL TECHNIQUES AS ZERO-WASTE STRATEGIES

Traditional textile practices provide valuable knowledge for sustainable surface development.

Techniques such as:

- Kantha,
- patchwork,
- appliqué,
- quilting,
- darning,
- embroidery,
- weaving,
- crochet and
- fabric manipulation

can be adapted to incorporate textile waste.

Kantha, for example, traditionally involves the reuse and layering of old textiles. Contemporary designers can reinterpret this principle using production remnants while retaining the aesthetic and material character of handcraft. The combination of traditional knowledge and contemporary waste materials can create a design language that is both culturally meaningful and environmentally responsible.

PROPOSED DESIGN DEVELOPMENT FRAMEWORK

The proposed framework consists of seven stages.

Stage 1: Waste Collection

Collect textile remnants from:

- garment-production units,
- tailoring units,
- embroidery workshops,
- weaving units,
- educational institutions and
- household sources.

Stage 2: Waste Classification

Sort materials according to:

- fibre,
- colour,
- texture,
- size,
- thickness,
- condition and
- potential application.

Stage 3: Material Preparation

The waste should be:

- cleaned,
- sorted,
- trimmed,

- shredded,
- cut or
- prepared according to the selected technique.

Stage 4: Concept Development

Develop a design concept based on:

- colour story,
- inspiration,
- motif,
- texture,
- garment category and
- target consumer.

Stage 5: Surface Experimentation

Experiment with multiple techniques such as:

Appliqué + embroidery

Patchwork + quilting

Scrap weaving + braiding

Fabric manipulation + stitching

Waste strips + couching

Stage 6: Product Development

Apply the developed surface to:

- garments,
- accessories,
- bags,
- footwear,
- lifestyle products or
- home textiles.

Stage 7: Evaluation

Evaluate the developed products on:

- aesthetic appeal,
- functionality,
- durability,
- comfort,
- material utilisation,
- uniqueness,
- consumer acceptance and
- sustainability potential.



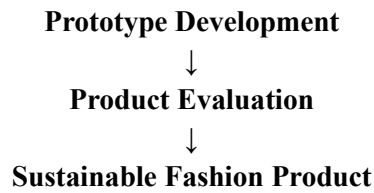


Figure 4: Sustainable fashion collection

MATERIAL SELECTION

Material selection is an important component of sustainable surface ornamentation.

Preferred materials include:

- natural-fibre remnants,
- organic cotton scraps,
- linen waste,
- silk remnants,
- wool waste,
- recycled denim,
- biodegradable fibres,
- discarded garments and
- production leftovers.

Where mixed or synthetic materials are used, designers should consider their future recyclability and the possibility of separating components.

The circular economy approach encourages fashion products to be designed from safe, recycled or renewable inputs and to remain useful for longer periods.

DESIGN PRINCIPLES FOR ZERO-WASTE SURFACE ORNAMENTATION

The following principles may guide designers:

1 Material Efficiency

Use the maximum possible quantity of available waste.

2 Design for Longevity

The ornamentation should contribute to a durable and desirable product.

3 Minimum Additional Material

Avoid introducing unnecessary new trims, adhesives or synthetic components.

4 Repairability

Decorative components should preferably be repairable or replaceable.

5 Modularity

Modular surface elements can be removed and reused on another product.

6 Aesthetic Value

Sustainable products must provide visual and tactile appeal.

7 Functional Integration

Whenever possible, ornamentation should provide additional functionality such as reinforcement, pockets, closures or structural support.

8 Material Compatibility

Materials with similar care and end-of-life characteristics should preferably be combined.

AESTHETIC POSSIBILITIES

Zero-waste surface ornamentation can generate distinctive visual characteristics.

These may include:

- irregular textures,
- layered surfaces,
- contrasting colours,
- tactile relief,
- asymmetrical compositions,
- visible stitching,
- reconstructed motifs,
- three-dimensional structures and
- experimental material combinations.

The unpredictability of textile remnants can become a creative advantage. Rather than attempting to conceal irregularity, designers can deliberately celebrate material variation as part of the design language. Research on zero-waste fashion design has identified characteristics such as decorative beauty, structural flexibility, unexpected visual properties and innovative forms.



Figure 5: Fabric scrap appliqué process

ROLE OF DIGITAL TECHNOLOGY

Digital tools can enhance zero-waste surface ornamentation by helping designers visualise and optimise materials before physical production.

Useful technologies include:

- CAD pattern development,
- digital textile design,
- 3D garment simulation,
- digital embroidery,
- laser cutting,
- digital printing,
- computerised marker planning and

- digital material libraries.

Research has highlighted the potential of 3D digital tools to transform the relationship between garment design, pattern cutting and waste in zero-waste fashion practice.

Digital technology can therefore support:

1. virtual prototyping,
2. material optimisation,
3. motif placement,
4. waste mapping,
5. pattern development and
6. product visualisation.

SUSTAINABILITY BENEFITS

Zero-waste surface ornamentation can contribute to sustainability in several ways.

1. Reduction of Textile Waste

Small scraps are diverted from disposal and incorporated into new products.

2. Reduction in Virgin Material Demand

Waste materials can substitute for newly purchased decorative fabrics and trims.

3. Extension of Material Life

Existing textiles remain in productive use for longer.

4. Promotion of Circular Design

The approach supports the broader circular economy principle of keeping materials in use at their highest value.

5. Support for Craft-Based Production

Many waste-based ornamentation techniques can be performed manually, creating opportunities for craft-based and small-scale production.

6. Product Uniqueness

Because waste materials vary in colour, texture and form, the resulting products may possess unique characteristics.

ECONOMIC AND SOCIAL POTENTIAL

Zero-waste surface ornamentation may also have economic and social implications.

Small-scale designers, artisans, students, self-help groups and micro-enterprises can collect local textile waste and convert it into value-added products.

Possible products include:

- scarves,
- bags,
- jackets,
- fashion accessories,
- jewellery,
- footwear,
- home furnishings,
- wall décor and
- lifestyle products.

This model can create a relationship between waste management and livelihood generation.

A successful model should, however, ensure that labour is fairly compensated and that sustainability claims do not rely on unpaid or undervalued craft labour.

PROPOSED EXPERIMENTAL DESIGN FOR FUTURE VALIDATION

To empirically validate the proposed framework, an experimental study may be conducted using selected textile waste materials.

Sample

Approximately 20–30 kg of pre-consumer textile waste may be collected from selected garment or tailoring units.

Material Classification

The waste can be classified according to:

- fibre composition,
- size,
- colour,
- texture and
- thickness.

Technique Selection

Five to eight techniques may be selected for experimentation:

1. Appliqué
2. Patchwork
3. Scrap weaving
4. Fabric braiding
5. Waste embroidery
6. Shredded textile surface
7. Quilting
8. Fabric manipulation

Prototype Development

A minimum of 10–15 surface samples can be developed.

Parameter	Evaluation
Aesthetic appeal	1–5
Innovation	1–5
Texture	1–5
Colour harmony	1–5
Functionality	1–5
Craftsmanship	1–5
Sustainability perception	1–5
Consumer acceptance	1–5
Commercial potential	1–5

Important: These values are proposed evaluation criteria, not fabricated research results.

PROPOSED EVALUATION MATRIX

Technique	Waste Utilisation	Aesthetic Potential	Skill Requirement	Product Application
Appliqué	High	High	Medium	Garments, bags
Patchwork	High	High	Medium	Jackets, skirts
Scrap weaving	Very High	High	Medium	Panels, accessories
Fabric braiding	High	Medium–High	Low–Medium	Trims, belts
Waste embroidery	Medium	Very High	High	Garments, accessories
Textile quilting	Very High	High	Medium	Jackets, bags
Shredded textile surface	Very High	High	Medium	Panels, garments

Technique	Waste Utilisation	Aesthetic Potential	Skill Requirement	Product Application
Fabric manipulation	Medium–High	Very High	Medium–High	Fashion garments



Figure 6. Classification of textile remnants by material, colour, size and texture.

DISCUSSION

The literature indicates that zero-waste fashion should not be understood solely as a technical method of reducing cutting waste. It can also transform the creative process of fashion design.

Zero-waste pattern-cutting research indicates that pattern development and fashion design may need to progress simultaneously rather than as separate sequential stages. Similarly, recent research has identified fabric width, pattern arrangement, adjustable silhouettes and the reuse of surplus material as important considerations in zero-waste fashion design.

Surface ornamentation expands this approach further. Instead of focusing only on large fabric pieces, designers can address small remnants that remain after cutting. These materials can be transformed through patchwork, appliqué, embroidery, weaving and manipulation.

The major conceptual shift is therefore:

Waste → Material → Surface → Design Value → Product → Extended Use

This approach challenges the conventional assumption that waste has no design value.

CHALLENGES OF ZERO-WASTE SURFACE ORNAMENTATION

Despite its potential, several challenges need to be addressed.

1. Material Inconsistency

Waste materials may vary in:

- colour,
- fibre,
- thickness,
- size and
- quality.

This makes standardised production difficult.

2. Labour Intensity

Hand-based techniques can require significant time and skilled labour.

3. Scalability

A technique that works well for one-off products may be difficult to implement in large-scale manufacturing.

4. Consumer Perception

Some consumers may associate waste-derived products with poor quality unless the design clearly communicates value and craftsmanship.

5. Durability

Different fabrics may respond differently to washing, abrasion and repeated use.

6. End-of-Life Challenges

Combining multiple materials with adhesives or synthetic components may make recycling difficult.

7. Standardisation

Developing consistent quality standards for waste-based surface ornamentation remains challenging.



Figure 7. Fabric braiding

STRATEGIES TO OVERCOME THE CHALLENGES

The following strategies are recommended:

1. Develop standardised waste-sorting systems.
2. Create digital libraries of available textile waste.
3. Categorise materials according to fibre composition.
4. Use compatible materials within individual products.
5. Prefer stitching and mechanical joining over permanent adhesives where possible.
6. Develop modular ornamentation.
7. Establish quality-control procedures.
8. Conduct durability and wash testing.
9. Use digital tools for design planning.
10. Develop consumer education and sustainability labelling.
11. Collaborate with artisans and local enterprises.
12. Design products for repair, disassembly and future reuse.



Figure 8: Waste-based embroidery

CIRCULAR DESIGN MODEL

The proposed circular model for zero-waste surface ornamentation can be represented as:

PRE-CONSUMER TEXTILE WASTE



This model aligns with the circular-fashion vision of keeping garments and fibres in use and avoiding unnecessary waste.



Figure 9: Waste-based quilting

ENVIRONMENTAL SIGNIFICANCE

The environmental significance of zero-waste surface ornamentation lies primarily in its ability to prevent potentially usable textile material from becoming waste.

The Ellen MacArthur Foundation reports that more than 80% of the textile waste stream is currently incinerated, landfilled or lost to the environment, while textile-to-textile recycling remains below 1%.

These figures highlight the importance of interventions that occur before disposal. Surface ornamentation is particularly relevant because it can utilise textile remnants that may be too small for conventional garment construction but still possess substantial material and aesthetic value.

Consequently, zero-waste ornamentation should be viewed as one component of a broader hierarchy:

Avoid → Reduce → Reuse → Repair → Remake → Recycle → Dispose

The greatest sustainability benefit is achieved when waste is prevented or materials are kept at their highest value for longer periods.

CONTRIBUTION TO SUSTAINABLE DEVELOPMENT

Zero-waste surface ornamentation can contribute to several Sustainable Development Goals, particularly:

SDG 8 – Decent Work and Economic Growth

Craft-based waste utilisation can create opportunities for responsible employment and small-scale enterprises.

SDG 9 – Industry, Innovation and Infrastructure

The development of innovative material and production methods supports sustainable industrial innovation.

SDG 12 – Responsible Consumption and Production

Waste reduction, reuse and material efficiency directly support responsible production and consumption.

SDG 13 – Climate Action

Reducing unnecessary material production and waste can contribute to lower environmental impacts.



Figure 10: Final sustainable fashion products

FUTURE SCOPE OF THE STUDY

Future research may focus on:

1. Quantifying the amount of textile waste diverted through each technique.
2. Comparing conventional and zero-waste surface ornamentation.
3. Conducting consumer acceptance studies.
4. Testing the durability of waste-based surfaces.
5. Evaluating washing and abrasion performance.
6. Conducting life-cycle assessments.
7. Developing commercial-scale production models.
8. Exploring biodegradable joining methods.
9. Integrating AI and digital design into waste classification.
10. Developing digital databases of textile waste.
11. Studying regional craft techniques as zero-waste strategies.
12. Exploring the use of agricultural and natural waste with textile remnants.

13. Developing zero-waste fashion curricula for design education.
14. Studying the economic feasibility of waste-based surface ornamentation.
15. Developing circular business models for small and medium fashion enterprises.

CONCLUSION

Zero-waste surface ornamentation represents an important opportunity for transforming the relationship between textile waste and fashion design. Instead of considering scraps, remnants and discarded textiles as production residues, designers can treat them as valuable creative resources.

The integration of appliqué, patchwork, scrap weaving, braiding, embroidery, quilting, fabric manipulation and reconstructed embellishment provides multiple possibilities for transforming textile waste into aesthetically appealing fashion surfaces.

The literature demonstrates that zero-waste approaches can substantially improve material utilisation and can transform conventional fashion-design processes. Research on waste-based surface ornamentation further indicates that pre-consumer textile remnants can be transformed into innovative decorative materials.

The proposed framework demonstrates that sustainability should be incorporated at the beginning of the design process rather than addressed only after production. Effective zero-waste surface ornamentation requires designers to consider material selection, waste classification, design development, construction, durability, functionality and end-of-life simultaneously.

Ultimately, the value of zero-waste surface ornamentation lies not only in reducing waste but also in **redefining waste as a source of creativity, cultural expression, material innovation and economic value**. Its successful adoption can contribute to the transition from a linear fashion system towards a more circular, responsible and regenerative model.

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