

Upcycling: A conceptual process model and perspectives of undergraduate students pursuing fashion design in a Kenyan university

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Abstract

The global fashion industry generates substantial quantities of textile waste. Much of the Global North's discarded clothing is exported to African countries, including Kenya, where it is often disposed of in landfills, water bodies, or incinerators, worsening pollution and climate change. Upcycling offers a sustainable solution, transforming this waste into higher-value products. Fashion Design and Textile Technology students at Kirinyaga University struggle to afford project materials, and many are unfamiliar with upcycling's environmental, social, economic, and cultural benefits; upcycled products are often perceived as unattractive, low-quality, or cheap. This study examined students' perspectives on upcycling's processes, products, perceptions, and practices.

Method: This case study of 26 students purposively selected 12 project portfolios containing upcycled products, analyzed using thematic analysis.

Results: Creativity, skills, innovation, and planning produced durable, functional, and aesthetic upcycled apparel and fashion accessories, inspired by costumes, fashion movements, nature, African culture and prints, and refashioning. Denim, the most-used material, reflects its availability as consumers' wardrobe staple; satin, *kitenge*, and felt produced elegant and sustainable products. Upcycling proved cost-effective and time-intensive, and students expressed both positive and negative views.

Conclusion: Upcycling provides a creative and affordable approach to reducing textile solid waste and promoting sustainable fashion in Kenyan university, Kirinyaga University. It requires time, creativity, skill, and knowledge, and should be integrated into design studio courses. Further study could enhance understanding of consumers' attitudes toward upcycled fashion products and soft furnishings. The study proposes an eight-phase upcycling framework that contributes to United Nations Sustainable Development Goals 9 (Industry, Innovation, and Infrastructure), 12 (Responsible Consumption and Production), and 13 (Climate Action).

Keywords

Denim; Solid waste; Upcycling; Sustainable fashion; Circular economy; Student perspectives

Introduction

Fashion is more than a piece of fabric. Rather, fashion is a form of non-verbal communication and one of the most important ways of expressing a person's identity due to its myriad signs, codes, and meanings [1]. In addition, fashion does not exist in a vacuum: it is created/produced and consumed by designers and end-users respectively. Hence, the stakeholders are responsible for their decisions which affect the environmental, economic, social, and cultural dynamics of a society.

The clothing and textile sector is a highly significant economic player in many countries, contributing to revenue generation, job creation, innovation, and competitiveness [2]. Regarding earnings, clothing sales have risen by about 60% over the past ten years [3]. However, the current 'take-make-use-dispose' linear model of the fashion industry urgently calls for a transition to a more sustainable circular regenerative system [4], such as upcycling.

The global fashion industry's unsustainable production processes result in environmental degradation, especially from solid waste [2]. Despite modest progress, fashion has not yet taken its environmental responsibilities seriously [3]. For instance, jeans are a global wardrobe staple with a profound environmental impact: 6 billion pairs of jeans are produced annually, consuming 65 litres of water per pair, and a paltry 15% undergo upcycling or recycling [5].

According to [6], over-production of clothing directly relates to over-consumption. The former is promoted by the rapidly expanding manufacturing particularly in China. Over-consumption is fostered by fast fashion, drop in retail prices, availability of new products, and reduction of global trade tariffs. Fast fashion refers to garments produced quickly, and cheaply, of poorer quality make and materials, and for short-term use then discarded in favour of newer styles [6]. Hence, there is need to implement sustainable fashion solid waste management practices.

Most textile solid waste originates from household sources, and some during garment manufacture [7]. Textile and fashion waste from households include *inter alia* clothing, soft furnishings, fashion accessories, trimmings such as lace, ribbons, and fasteners [6]. In clothing manufacturing, the cloth-cutting phase accounts for 20% of waste fabric [3] such as fabric off-cuts, faulty/defective/damaged fabric, excess fabric spreading loss, and end-of-roll pieces. In production other waste includes clothing samples [8], rejected clothing as well as fasteners, sewing notions, used plastic packets, broken cloth hangers, empty bobbins [7] and packaging especially from the retail space.

Methods of solid textile and fashion disposal vary. In Australia, 60% of donated used clothing is exported to developing countries. The remainder, approximately 40%

goes to landfills [6]. In Russia about 97% of clothing waste generated is disposed of in open landfills and dumps, resulting in alienation of significant land—approximately 1,000 hectares, a decrease in the socio-economic attractiveness of adjacent residential areas, and damage to public health [8]. Other textile waste may be incinerated (with or without energy production), or recycled (impacting resource depletion and climate change) [3].

Fashion solid waste disposal encounters challenges. In Thailand, limited knowledge of solid waste management within households and lack of cooperation in waste sorting before disposal, caused mishandling of solid waste in the community level [9]. The unsustainable practice of fashion's solid waste disposal calls for intentional counter approaches, specifically, upcycling.

The increasingly monumental climate crisis partly attributed to unsustainable fashion practices, calls for climate action through practical solutions. Many questions arise about the possibility of sustainable fashion. Upcycling offers a potential transition to a circular regenerative system in the fashion industry. There is no formal definition of upcycling. Upcycling is defined as an umbrella concept incorporating a variety of design and/or material processes based on used or waste products, components, and materials in order to create new or modified products, artefacts, or materials of higher quality or value than the compositional elements [10]. Upcycling is a design, business, and social practice that transforms waste into new products or materials of higher quality and/or value than the compositional elements [11]. Upcycling adds value to an object through its recovery [12]. Upcycling is remaking unworn garments into new forms by deconstructing and reassembling, often in combination with components from other garments or the addition of new fabrics [6]. Upcycling in fashion is therefore understood as a design practice that creatively transforms textile and fashion solid waste (both pre-consumer and post-consumer) into higher value or quality than compositional elements to create unique, functional, timeless, and aesthetic fashion products and soft furnishings using a variety of techniques and processes. Unique pieces are created using techniques such as redesigning, cutting, and making from scratch an entirely new garment or parts of one from used pieces of fabrics (which may be vintage) and accessories [12]. Other techniques employed in upcycling are 'creative' or 'innovative' repair, refurbishment, redesign, upgrade, and remanufacture, all part of the circular economy [10]. These time-intensive techniques add to the labour cost of an upcycled product thus its price. Vintage fabrics add unique, aesthetic, and timeless touch to fashion products. In addition, they are sustainable because they reduce the demand for producing new materials.

Upcycling is seldom practiced in everyday life. However, when it becomes a real experience, it encourages changes in consumption patterns and behaviours [13]. A common misconception exists that sustainable products are definitely ugly or not durable [14] or cheap. Upcycling entails among other processes, materials selection, deconstruction (extraction/recovery of valuable waste components), pattern-making, cutting, assembling, as well as fitting/validating and alterations (where necessary). Products obtained from the process are consumed in different ways.

This study is premised on three United Nations (UN) Sustainable Development Goals (SDG) namely 9: industry, innovation, and infrastructure; 12: responsible consumption and production, and 13: climate action on sustainable production and take action to combat climate variability and its negative impact [15]. The purpose of the study was to reconstruct a subjective visual interpretation of the process of upcycling textile and fashion solid waste for creative production of fashion products by students pursuing a fashion design undergraduate degree.

Fashion and waste

Waste is not only an environmental challenge, but demonstrates an economic inefficiency and a lost opportunity. [6] posits that slow fashion counters fast fashion. The former is produced with alternative values and methods, to satisfy fashion in less materialistic ways. Slow fashion emphasizes the durability of emotional relationships between consumers and products as a means of reducing consumption. Therefore, designing fashionable garments should create many opportunities for future acts of reuse or remaking, hence extending their use [6], such as upcycling. The effort shall minimize the amount of waste generated and discarded by consumers.

Upcycling

Design and production

The circular economy stresses on fashion stakeholders to think systematically and make plans for waste use at every stage of the life-cycle: fibre growth and manufacture, product development, remanufacturing, and remaking. The product's end-of-life is continually considered for its impact on the environment and society [16].

According to [17], waste is connected to ever-changing notions of value: can move in and out of them. A consumer's decision to discard clothing signifies a failed relationship with the garment [4]. In addition, a consumer can discard a garment she/he has outgrown, or it has lost its fashion appeal, or has some defect, or was for a particular occasion like a wedding and never to be worn again, among other reasons. Items, goods, and leftovers formerly considered waste can be re-categorized and re-

claimed with fresh value ascribed to them [17]. For example, the brand Insecta Shoes collects clothing from second-hand stores to make printed fabric shoes with recycled rubber soles. Agustina Comas produces luxury clothes using upcycled scraps and defective or sub-standard apparel. The firm employs single-piece production lines methods and the products are sold online and at sustainable fashion events [17].

Upcycling has been adopted by fashion brands as well as the online do-it-yourself (DIY) community [6]. For instance, Turkish designer Gönül Paksoy upcycles her own waste including brocade, raw silk crêpe, and silk velvet to create a harmonious reflection of the past and future described as "timeless simplicity" [18]: upcycling with a purpose.

An increasing number of Dutch independent fashion designers are prioritizing craftsmanship and designing with sustainability, focusing on environmental (timeless design, zero-waste), social, and cultural sustainability [19]. Regarding social sustainability, a sewing club in Portugal called Vintage for a Cause promotes interaction and companionship for women via the redesign of vintage garments. The women, aged over fifty years create individual pieces, which are sold at markets and stores. The project collaborates with Katty Xiomara one of Portugal's prestigious fashion designers who offers her knowledge and skills voluntarily [20]. Socially, upcycling may be employed for activism, for instance to promote social justice among other concerns. [1] used an Art-based research project to tell refugee children's challenging stories in accessing education. The authors used a second-hand dome (normally provided to refugees in camps) to construct a two-piece tent dress: a cape and dress adorned with embroidered quotes from published literature and drawings. The authors call on upcycling designers and fashion designers to incorporate social justice more frequently and overtly into designs.

Sri Lanka's House of Lonali, a sustainable fashion brand focuses on environmental sustainability. The brand uses the export apparel industry's textile waste (discarded odd-shaped off-cut and defective fabrics and trims) as the basis for designing their clothing and shoes collections [21]. The uniqueness of upcycled products is achieved by leveraging the unique characteristics of the material, while the use of recurring designs, patterns, and jigs ensures efficiency [22]. An upcycling designer may encounter fabrics or garments with intricate motifs. The designer is then challenged on how to incorporate the unique features in a design.

Economically, upcycling creates opportunities to establish new sustainable innovation business models that advocate for growth which is not based on high volumes of production, but rather on redefining what value means [23]. Examples include social innovation business models, service innovation business models, and sustainable

product service systems (S.PSS) all applicable in the fashion industry [16]. Upcycling for community empowerment is demonstrated by [10] in a project that brings together rural women to upcycle waste fabric/off-cuts from a clothing factory. The women engage in the project when it is not the farming season. The women are empowered with skills to produce fashion accessories, apparel, and soft furnishings. The products are sold or for home consumption. The former promotes the women's economic empowerment.

Upcycling process ranges from conception to production, employing soft skills as well as technical skills and knowledge. Design thinking approach, creativity, innovation, and high-quality artistry, are essential in upcycling to foster products' longevity/durability, hence eliminating their premature disposal. Durability/longevity, classified as emotional, physical, or stylistic extends the use of apparel [24]. Design and creativity are essential in the value proposition of upcycling through repurposing. Hence upcycling practitioners behave in a manner similar to many other designer-makers of unique craft objects [25]. Creativity is the capacity to produce, bring into existence something new through imaginative skill. Additionally, creativity is a shift from traditional ways of doing things to new alternative ways of providing solutions. Creativity stimulates curiosity, prompting individuals to ponder, question, and seek answers to varied issues [26], such as unsustainable fashion production and consumption with its negative environmental impact. Innovation involves transforming creative concepts into outcomes: new products, ideas, methods, services, or solutions. Therefore, innovation improves efficiency and effectiveness, and addresses unmet needs. Both creativity and innovation have the power to harness individuals' talents and abilities for positive change within communities and globally [26].

In South Africa, Company Two's objective was aimed at zero-waste through pattern development, carefully planned cutting processes, and donating waste for paper production. The company reuses/reworks/recycles and repairs its used or unsold wedding dress stock or clients' old/used garments into newly designed wedding dresses. Quality and longevity are emphasized. Company Three, either reconfigures waste into innovative fashion accessories or donates to non-profit organizations [27]. Upcycled products include apparel [17], shoes [23], toys from upcycled clothes [28], and soft/textile furnishings [29].

Craft production techniques is a defining characteristic of upcycling based on repurposing. Keeping production at craft/artisan techniques and low volume for small players makes it easy to find workers with the skills required and keep costs relatively low. However, small players create high-margin products that appeal to niche customer segments, which are sold via narrow distribution channels,

such as direct online sales, local retailers, or specialized e-commerce platforms [30].

Scaling-up upcycling

Despite its benefits, upcycling remains a niche practice, thus calling for scaling-up into the mainstream of design or a business-as-usual practice to attain its full potential [11]. Scaling-up upcycling offers designers the possibility of working sustainably, meaningfully, and viably while increasing material circularity [31]. Fashion designers are both communicators and educators and can trigger new behaviour [30] among consumers and students such as upcycling textile and fashion solid waste. The next generation of designers must be educated in all sustainability fields and in subjects such as upcycling, zero-waste design, and disassembly, preferably in the first years of design education. Hence, they can grow with the idea of sustainability [3] both in executing course projects and upon entering the industry as practitioners. Upcoming designers can be exposed to Design for Sustainability (DfS) competitions and events. For instance, in the EcoChic fashion competition which aims at highlighting the universality of sustainable fashion challenge, young designers from Asia (initially) and across the globe are tasked to create and showcase collections based on minimal textile waste using upcycling, among other techniques. The award-winners gain placement with participating industry partners [31]. Higher education institutions [HEIs] should review their curriculum to offer sustainable fashion design courses [27; 32], particularly upcycling. The knowledge and skills acquired by the students are subsequently transferred to the industry [27]. Curriculum review can be undertaken because the faculty members understand and are knowledgeable about the benefits of sustainable fashion [32]. The study revealed that the faculty members impart on the students, knowledge and skills related to sustainable fashion, such as upcycling. Through the lecturers' encouragement, instruction, and guidance, the students employ sustainable design approaches in course projects [32]. Further, co-creation/participatory design should be employed with actual customers to design dematerialized solutions [31], specifically upcycling. Co-design fosters end-users' emotional attachment to the product, identify with it, as well as gain an understanding of materials' properties and environmental impact. Hence, the end-users make more informed fashion decisions.

Upcycling embraces digital platforms to offer solutions for enhanced visibility and adoption. FABIO app brings together multiple stakeholders to upcycle denims/jeans: designers, researchers, cotton farmers, tailors, and consumers. The app is renowned for efficient technology solutions comprising nine functional components including, upcycling made easy; support from local tailors; reward points; material marketplace; show sustainable denim;

showcase your creativity; digital sustainability; eco-conscious lifestyle; and social media [5].

Upcycling may be scaled-up by adopting different sustainable business models such as S.PSS which offers a promising solution to a service-based society where product access is promoted over product ownership [16; 3]. S.PSS

...offers a model providing an integrated mix of products and services that are together able to fulfil a particular customer demand (to deliver a "unit of satisfaction"), based on innovative interactions between the stakeholders of the value production system (satisfaction system), where the ownership of the product/s and/or its life cycle responsibilities remain with the provider/s so that the economic interest of the providers continually seek and provide new environmentally and/or socio-ethically beneficial solutions [3].

Manufacturing companies must offer the product's function, not the product itself. S.PSS views products as services that can change the production and consumption patterns. Such an approach can advocate for high use intensities, the extension of products' lifespan, and other value chain optimizations that leads to resource efficiency and dematerialization [2; 3].

Fashion designers practising upcycling must adopt information transparency and communication to attract more consumers. Such measures include eco-labels and cause marketing [31]. For instance, a designer's website states their sustainability vision and mission.

Diverse measures can be adopted to motivate and sustain communities to participate in waste management and upcycling. The measures include knowledge and technology transfer namely, integrating design knowledge into workshops to enhance creative reuse, innovation, creative thinking, and upcycling. Communication is essential which entails communicating tangible benefits of participation; providing clear communication of roles and responsibilities within the participation process; providing explicit waste separation guidelines; and using external incentives and recognition [23]. Further, [13] proposes the establishment of reuse centres equipped with websites with data repositories, detailed design facilities, detailed design of products (offer tutorials and documentation of product collections in open-source learning), and content development to engage donors and partners. Upcycling and waste management must be aligned with community culture and lifestyle; [23].

Upcycling spans multiple dimensions, namely labour empowerment; community building; risk mitigation; responsible and mindful lifestyle among consumers; societal awareness, and technology sustainability all contributing to sustainable fashion [5].

Perceptions of upcycling

Positive and negative perceptions of upcycling influence its adoption. According to [33], 15% of Zimbabwe's consumers prefer upcycled clothes mainly to promote sustainability and local designers, possess exclusive design, save money, set new trends, or unique fashion styles. Nonetheless, consumers disregard upcycled garments due to negative perceptions. Garments made from post-consumer waste can be deemed as less valuable and unappealing due to designers' lack of creativity thus denting sales prospects. The garments are associated with poverty. Further, culture prohibits wearing of second-hand clothes and lack knowledge of sustainable fashion practices and the benefits therein [33].

Practise of upcycling

The key motivating factor among Zimbabwe's fashion designers in adopting upcycling is to try out new design ideas and working with worn-out or spoiled garment sections [33]. Fashion upcycling practitioners should consider different strategies to evoke consumers' emotional responses, to increase their satisfaction towards upcycled clothing and products. Five factors to consider include aesthetic, wearability, makes the wearer look and feel good, cultural elements, and the memories they evoke [4]. The strategies, lead to emotional attachment and prolonged use of the products. Emotional attachment can be fostered through handcrafting such as beadwork embroidery with used beads to embellish a product. The effort creates individuality and appreciation among consumers. Moreover, emotional attachment may be enhanced by branding products with unique names that tell a story and inspire end-users, for instance, *malkia tote bag*.

According to [28], Preloved, a Canadian brand pioneered upcycling used garments ("knits") to create mass-produced fashionable new styles. Preloved sources its sweater knits from Canadian rag houses. Clothes are screened for damages and panel sizes to determine their use. Small panels may be used for producing children's wear, accessories, and home décor lines. Unsuitable cast-off products may be donated to other designers engaged in reconstruction, to schools for children's art and craft projects, and any remaining products are returned to rag houses. The selected garments are washed which also serves as a quality control measure. If a garment gets damaged at the washing phase, it is discarded. The brand developed and strictly observes guidelines for each design produced. Preloved's mass-produced merchandise incorporates "deadstock" fabrics (left-over bolts of fabrics from other brands or wholesalers) for a consistent look. The firm adds bits of upcycled pieces to create uniqueness in their collections. The garments are bundled, cut, and sewn. The textile waste generated in upcycling is used to produce home décor throws and pillows and slippers that employ small fabric pieces. The brand has a strong online presence [28].

Upcycling is more prominent among fashion designers who manage their brands. Zimbabwe's fashion designers purchase oversize shirts from second-hand dealers to produce an array of products such as bum shorts and mini-skirts. The products are designed based on the inherent properties of the waste materials [33].

Benefits of upcycling

Sustainability, which may have among other strategies upcycling is central to business resilience, profitability, competitiveness, and regeneration. Fashion firms can build their brand identity on sustainability values. Sustainability performance is becoming a business metric. The United Nations' (UN) Global Compact on environment stipulates three principles for businesses to comply with. The principles are (a) support a precautionary approach to environmental challenges; (b) undertake initiatives to promote greater environmental responsibility; and (c) encourage the development and diffusion of environmentally friendly technologies [34]. Environmentally, upcycling reduces the amount of waste going to landfills and water bodies, conserves natural resources [33], increases resource/material efficiency, lowers industrial energy and water consumption involved in mass production with virgin materials thus transiting toward net zero [11], and dematerialization- eliminates production of new materials.

Economically, upcycling is a cost-effective way to create new products, promotes development of craft industries, creates green jobs, helps businesses and individuals to think creatively, find new ways to use waste materials [33]. In addition, upcycling stimulates innovation, and reduces cost of producing new materials.

Socially, upcycling enhances households' emotional/psychological well-being [11] because individuals are proud to participate in environmental conservation among other worthy causes. Upcycling workshops conducted had positive impact within commonly excluded social groups, such as the elderly, children with mental health problems (mainly autism), and the unemployed. Upcycling also creates awareness of social injustice, such as gender, racial, and ethnic discrimination, and promotes skills development for economic empowerment [13].

Regarding cultural benefits, upcycling may use ethnic/indigenous materials and techniques in the creations to preserve cultures for posterity. For example, using African print off-cut fabrics to construct or embellish a fashion product preserves the culture. Further, use of indigenous dyeing techniques such as *tritik* to reclaim a pre-loved soft furnishing.

Challenges/tensions of upcycling

According to [33], the major challenge hindering adopting of upcycling by fashion designers is lack of awareness of circular economy. Other tensions include lack of skill and training, materials' sourcing and sorting, decision on

whether to use pre-consumer or post-consumer waste, and limited infrastructure. Additional tensions relate to high cost of production because upcycling follows the standard design procedure, and high level of creativity required to create products of superior aesthetic appeal that consumers can purchase.

Statement of the problem

Undergraduate students studying Fashion Design and Textile Technology at Kirinyaga University often struggle to afford new materials for their semester projects. Many students are also unfamiliar with upcycling and its benefits: environmental, social, economic, cultural, and ethical. In addition, upcycled products are often wrongly perceived as unattractive, low-quality, or cheap. The author consistently encourages and guides the students to procure and utilize textile and fashion solid waste for their semester projects. The initiative demonstrates the author's commitment to sustainable fashion and creating a generation of designers with a sustainability mindset. This study examined undergraduate students' perspectives on upcycling, focusing on the process, products, perceptions, and practice.

Materials and methods

The study adopted narrative inquiry research design which aims to reveal unique perspectives and deeper understanding of a situation/phenomenon [35], in this study, students' perspectives about upcycling: process, perceptions, and practice. The knowledge about the phenomenon was obtained from students' project portfolios. The advantage of the approach is it reveals in-depth detail of a situation or life experience. The limitations of narrative inquiry include, time-consuming due to copious amount of data collected, relies heavily on the memory of the subject which can sometimes fail, researcher must be heavily embedded in the topic requiring extensive reading, and the Hawthorne Effect [35]. The latter was not experience because the participants expressed their perspectives before the author requested for their project portfolios. The population comprised 26 students' project portfolios: 11 and 15 second and third year undergraduate part-time students respectively of Kirinyaga University pursuing Bachelor of Science in Fashion Design and Textile Technology. Judgement sampling was employed to select 12 projects portfolios in two units titled *Sustainable and Ethical Fashion and Textiles* and *Design and Development of Fashion Accessories*, the author was teaching. The inclusion criteria were projects that incorporated upcycling for the former unit. Further, for the latter unit the author informed the students of plans to write a journal or conference manuscript based on their project portfolios, and requested them to share via email. Some students submitted which were found to have incorporated upcycling thus they were included in the sample. By sharing their project

portfolios they gave consent. The researcher's position in the study strictly conformed to the scientific principles, knowledge, and skills of research and upcycling. Hence, data collection was conducted scientifically and interpretation was guided by the literature reviewed. Data collection entailed document analysis: students' course project portfolios. Qualitative data analysis was guided by the research objectives and theoretical review. Qualitative thematic analysis was employed as it is historically a conventional practice in qualitative research [35]. The portfolios were read keenly. The data were coded and classified into the various recurrent themes, patterns, and categories that captured the relevant aspects of these data and the underlying threads of continuity. Particular items of data were assigned to those categories. The concepts included upcycled apparel and fashion accessories designed, and perceptions and practice of upcycling. The data are presented in the form of narratives punctuated by photographs/images. The researcher's bias could have occurred in selecting portfolios for the study, probably by giving preference to portfolios with good grades. However, the researcher's bias was minimized by relying on scientific methods namely inclusion criteria and knowledge of upcycling for sample selection, reading student's portfolios several times a technique typically employed in qualitative data analysis to uncover patterns, and interpreting the results guided by the literature reviewed. The students' portfolios are identified starting from FD1 to FD12. The author obtained informed consent from the students.

Results

Upcycling process

Upcycled apparel and fashion accessories designed

The students co-created upcycled apparel and fashion accessories with actual end-users. Upcycled apparel included jackets, dresses, skirts, trousers, and a track suit (Figure 1: Two-piece satin dress; Figure 2: Bell-bottom denim trousers; Figure 3: Felt tracksuit; Figure 4a and b: Reversible denim/*kitenge* casual unisex jacket; and Figure 5a and b: Denim dress). Fashion accessories comprised sandals, bags, and a hat (Figure 6: *Kitenge* sandals; Figure 7: Denim sandals; Figure 8: *Kitenge* tote bag; Figure 9: Rexin duffle bag; Figure 10: Denim duffle bag; Figure 11: Patchwork Tote bag; Figure 12: Woven handbag; Figure 13: Woven tote bag; and Figure 14: Woven sun hat).

Figure 15: Preliminary conceptual framework for upcycling textile and fashion solid waste (both pre-consumer and post-consumer), inductive discourse from students' portfolios, and the author's experience with upcycling. The model has eight phases, including materials acquisition and design phases which are inter-changeable. Other

phases include materials preparation, pattern-making, fabric/cloth or other materials cutting, and product assembly/sewing, communication, finally the product consumption whereby the end-user wears or uses upcycled apparel and fashion accessories.

Perceptions of upcycling

Two themes emerged regarding perceptions of upcycling: positive and negative, focusing on environmental, economic, cultural, and social aspects. Positive attitudes outweigh negative ones.

Among the positive perceptions relate to sources of design inspiration for upcycling. The projects deepened appreciation for nature-inspired creativity and the importance of sustainability in modern fashion (FD4). Designers should give textile solid waste a new lease of life particularly by upcycling (FD2). Materials sourcing enabled the discovery of discover town alleys that stocked them (FD1). People were amazed that rexin scraps can be used produce a functional, and durable bag (FD2). Hence, FD2 created awareness of upcycling in the community.

Economically, upcycling is cost-effective particularly the cost of materials for student's course projects (FD3, FD7, and FD9) and empowers local tailors by finding profitable uses of textile and fashion solid waste (FD6). The findings demonstrate the participants' foresight that it is not enough to produce upcycled fashion products, but to also sell them, preferably using sustainable business models such as S.PSS.

In the practice of upcycling new skills and knowledge were acquired which ignited participants' creativity and innovation in producing diverse fashion products (FD7 and FD8) in addition to spurring eco-entrepreneurship ideas (FD2 and FD8) to create jobs for the idle youth in their locality- social sustainability (FD2). Fashion practitioners engaged in upcycling must be aware of the market needs. There is the ever-growing population of eco-consumers particularly the Gen Z and millennials whose needs can be addressed by designing unique, culturally-inspired, meaningful, and environmentally-friendly upcycled fashion products (FD6 and FD9). Hence, promote responsible consumption and ethical fashion (FD9).

Upcycling is a means to reduce waste in the environment (FD1). Producing fashion accessories from coconut tree leaves provided an eco-friendly way to repurpose organic waste, which would otherwise have been burnt causing environmental pollution. The effort is highly recommended considering their locality lacks a waste management infrastructure (FD1). Likewise, adopting upcycling promotes waste reduction because fabric off-cuts are diverted from landfills, and contributes to the circular economy by giving new life to waste that would otherwise be discarded (FD6 and FD7).

Negative perceptions of upcycling relate to sourcing for waste materials which made FD3 feel like a garbage collector. A negative experience, especially because many

stockists questioned the designer's need for waste materials. Getting pure cotton fabric and the right colours was difficult and time-intensive (FD8).

Practise of upcycling

Three themes emerged from the practice of upcycling: *sources of inspiration, materials used, and construction techniques employed.*

Sources of inspiration: Upcycling was inspired by a variety of sources, including historical costumes, fashion movements, nature, sports, end-user's preference, African culture and prints, environmental consciousness, and refashioning. Historical costumes relate to *American women's gowns dating back to 1949 through 1950s* (FD5); fashion movement includes *waste-to-wardrobe movement* (FD9); nature-inspired relates to *blue skies converging with the ocean from the horizon* (FD3); sports-inspired conveys the *global sports culture that brings people together with their unique jerseys which depict their culture, love for their teams, sense of belonging, tastes, and preferences especially football* (FD7); end-user's preference notably *the need for a unique and stylish dress that expresses her individuality* (FD11); African culture and prints relates to *transforming discarded garments into new, functional pieces that reflect creativity and environmental responsibility; celebrate traditional African culture such as Kikuyu and traditional geometric prints infused with a casual modern look by using kitenge fabric* (FD1; FD7); environmental sustainability relates to *waste reduction* (FD7) and *transform plastic waste into a functional and stylish fashion accessory* (FD9); and refashion entails *to give old denim a new fashionable identity through upcycling* (FD12).

Materials: The types and properties of materials play a critical role in upcycling. The materials used to execute upcycling projects were selected based on participants' textile science and design knowledge. Results reveal a preference for end-of-life fabrics namely denim and *Kitenge*, among other. Denim in the form of used trousers and jackets was widely used due to its durability, breathability, relaxed feel, and timeless/classic look as well as diverse textures and colours. *Kitenge* (100% cotton fabric authentically African) fabric off-cuts were used due to its durability, aesthetics, and to celebrate African culture and prints. In addition, cotton is resilient, absorbent, aesthetic, and abrasion resistant. Satin exudes elegance, luxury, beauty, sophistication, glamour. Worn-out car tyres are resilient and highly durable. Rexin is strong, durable, abrasion resistant, easy to clean, and lightweight. Plastic strips used to tie used-clothing bales are strong, malleable, and aesthetic. Coconut leaves due to their flexibility, lightweight, water resistance, and low cost.

Construction techniques: The techniques included deconstruction of bridesmaid satin gowns, used cardigans, as well as denim trousers and jackets. Deconstruction was

followed with pattern-making, fabric/cloth/material cutting, stitching/assembling using patchwork, weaving, and quilting. Embellishing entailed tie-and-dye using bull's eye technique and *kitenge* trims.

Upcycling is a time-intensive process guided by the design process: conception to production (FD1, FD2, and FD3). In particular, FD1 had to learn and master a new skill, namely weaving, and wove a sun hat. Further, two prototypes were produced before making the final product. Finding effective and creative ways to upcycle textile and fashion solid waste can be time-intensive (FD8).

Discussion

Undergraduate students enrolled for fashion design degree of Kirinyaga University practiced upcycling, thereby engaged in the global discourse in curbing the industry's unsustainable production and consumption. A little practical upcycling by all the fashion actors shall significantly enhance the industry's environmental, social, economic, and cultural sustainability.

Process of upcycling

Similar to a typical design process, upcycling was inspired by diverse sources, including historical costumes, fashion movements, nature, sports, end-user's preference, African culture and prints, environmental consciousness, and refashioning. For instance, "*traditional African culture and a casual modern look*" (FD1) and "*blue skies converging with the ocean from the horizon*" (FD3). Being inspired and incorporating cultural elements in upcycled products leads to emotional attachment [4] hence the products including apparel and fashion accessories shall be used for an extended period before disposal.

Creativity, an essential requirement for upcycling, was used to transform textile and fashion waste into unique, innovative, timeless/classic, functional, fashionable, high-quality, multi-use upcycled apparel and fashion accessories for diverse end-users. *Good-quality craftsmanship or artistry is critical for designing longevity into up-cycled fashion accessories* (FD1). The upcycled fashion products created, contradict a common misconception that sustainable products are ugly or will not last long [14]. Upcycling is a serious design approach which deserves as much attention as designing with new materials. The upcycling course projects were executed with the author's guidance, instruction, and encouragement. Hence, demonstrates the critical role faculty members play in imparting sustainability principles to students [32].

Perceptions of upcycling

The results reveal in-depth awareness of the positive impact of upcycling on environmental, social, economic, and cultural sustainability. Environmental impact: "*reduce or eliminate and repurpose organic waste for environmental sustainability*" (FD1) and economic impact:

“*entrepreneurial aspect to create jobs for youths*” (FD2). Idle youth are easily lured into vices *inter alia* drug-abuse and violence. Therefore, creating jobs for youth through upcycling promotes social and economic sustainability. The results concur with [30] in which a women’s upcycling project earns them income during farming off-peak in addition to skills development. Other than the youth, upcycling initiatives empower the elderly and children with mental health disorders, often marginalized within the community [13]. Moreover, to motivate and sustain communities to participate in waste management and upcycling, design knowledge should be integrated to workshops to enhance creative reuse, innovation, creative thinking, and upcycling [9]. Upcycling designers can tap into their creativity hence foster their social inclusion. Cultural sustainability relates to the use of *kitenge* fabric in constructing a tote bag, a pair of sandals, and embellishing a sun hat. *Kitenge* fabric is associated with African heritage (FD1). Upcycling is used creatively to preserve African culture which is threatened with globalization. The finding echoes [10] who stress on aligning upcycling and waste management with community culture and lifestyle. Other than using African fabrics, upcycling may incorporate other indigenous techniques such as beadwork and fabric colouration for instance tie-and-dye using natural dyes.

Aesthetic is a critical aspect of upcycled fashion products. Upcycled products should be aesthetic and appealing because most fashion consumers are young, fashion conscious, and of middle-class to high-class. “*The pair of kitenge sandals combines functionality with striking African vibrant prints therefore celebrating both artistry and cultural heritage*” (FD1) and “*The bows add a playful yet elegant flair*” (FD3).

Practice of upcycling

Findings reveal awareness of the positive environmental impact of upcycling. Bio-degradable materials such as denim, *kitenge*, and cotton used in the creations promote the circular economy. The designers went to great lengths to select high-quality waste for their collections, that resulted in mixed experiences such as “*discovered alleys that stock waste*” (FD1) and “*felt like a garbage collector*” (FD3).

The most commonly used fabric is denim/jeans probably because it is a wardrobe staple for most fashion consumers. Denim is available in diverse colours and textures, and is sustainable: durable, biodegradable. The results concur with [5] that denim is a global wardrobe staple despite its profound negative environmental impact. Therefore, upcycling denim reduces its profound environmental pollution caused by producing new materials [5].

Upcycling fosters, ignites, and enhances designers’ creativity and innovation, occasioned by the use of materials with diverse characteristics namely odd-shaped, textures, colours, fibre content, quality, and care. Fashion’s solid

waste is creatively upcycled with other waste such as straws and tyres to produce fashion accessories, thus ‘hitting two birds with one stone’. The ability to combine different materials’ characteristics in a creation demonstrates designers’ creativity, deep thought, high-level skilfulness, and knowledge obtained through education and practice. The results contradict [33] in that, consumers deemed upcycled garments as unappealing due to fashion designers’ lack of creativity and knowledge of sustainable fashion practices and the benefits therein. The results hence reinforce [3] who assert the importance of educating the next generation of designers in the first years of design education, in all sustainability fields: environmental, social, and economic, and in subjects such as upcycling, zero-waste design, and disassembly. The participants are empowered to apply sustainability knowledge and skills in future course projects and in the industry.

Upcycling is a time-intensive process, hence raising the production cost particularly labour cost and resultant product prices. Technically, Materials’ preparation was carried out skilfully due to the delicate nature of some waste. For instance, coconut tree leaves (FD1). A car tyre was cleaned thoroughly and cut using a template (FD3). Deconstruction is time-intensive and extreme care is required to avoid damaging the garment in the process. Combining materials with different colours, textures, and motifs among other properties requires extra time and skill for the best outcome seen through a design lens. Upcycling also involved pattern-making from basic to final paper patterns. Further, laying patterns on odd-shaped or defective or intricate motifs fabric and/or garment pieces requires multiple attempts to obtain the correct lay, aesthetic, function, and proportion. Construction techniques used, namely appliqué, patchwork, quilting, and weaving are also time-intensive and require advanced technical proficiency to produce high-quality creations. The finding concurs with [29] who describes the process of creating mass produced upcycled products. Most of the processes are craft/artisan, typical of upcycling [23].

Upcycling has great potential in reducing students’ course projects cost particularly in emerging economies mainly populated by low-income earners. The participants obtained solid waste either for free or at minimal cost from their own wardrobes, past course projects, and upholstery manufacturers among others. Unlike buying new *kitenge* that would cost USD 2.3 per metre. The finding echoes [10] whose participants sourced fabric off-cuts from a clothing factory.

Upcycling is a collaboration and networking practice among multiple fashion stakeholders in which fashion designers (educators, researcher, practitioners) have a responsibility to spearhead its adoption and make it a business-as-usual practice. Other players include *inter alia* consumers, government, policymakers, community, and farmers. Through co-creation end-users are made aware

of how to revalue textile and fashion solid waste, particularly when their own clothes are used, leading to emotional attachment, and material understanding. Further, the end-users learn to value their clothes and textile products thus postpone discarding them, and instead upcycle. As the participants sourced for waste externally for instance, from upholstery producers, the latter were piqued about using rexin scraps to produce a functional, and durable bag [FD2]. Hence, it created awareness on upcycling rather than haphazardly disposing such waste. Apart from creating upcycled products, the outputs need to be disseminated through events, competitions, action workshops, community projects, scientific conferences, publications, digital platforms, and do-it-yourself (DIY) tutorials.

Conclusions

This study contributes to the growing research and discourse about practical possibilities of countering the global fashion industry's unsustainable production and consumption. This paper presents upcycling as an alternative approach that creatively and cost-effectively tackles environmental, social, economic, cultural, and ethical tensions occasioned by unsustainable fashion production and consumption. The study unveils insights into upcycling carried out in an emerging economy by undergraduate students, exploring the process, perceptions, and practise, as well as proposes a conceptual upcycling process model.

Creativity is the most crucial skill required in upcycling because designers encounter pre-consumer and post-consumer solid waste in the form of odd-shaped and defective fabrics, garments, and textile/soft furnishings with different characteristics such as durability, colours, textures, and fibre content. Other skills needed include innovation, imagination, and excellent craftsmanship/artistry. In addition, an in-depth understanding of the environmental impact of textile solid waste materials, knowledge of fabric quality and properties, assembling/manufacturing techniques, and expertise in using work tools are also important. The participants re-categorized and reclaimed waste, while ascribing new meaning and value to waste. The designers created classic/timeless, unique, customized, high-quality, aesthetic, innovative, functional, and fashionable apparel and fashion accessories for diverse end-users. The participants demonstrated their creativity, innovation, knowledge, and skill in all the stages of the upcycling process.

Moreover, upcycling enables student designers to not only reduce course project costs, but to spur their creativity, innovation, and artistry. Upcycling additionally empowers students with versatile skill sets such as material selection and matching, and product development, among others, as well as a local and global outlook toward sustainable fashion. Students' upcycling projects have the potential for

scaling up into commercialization by producing luxury products for a niche market segment of eco-conscious, fashionable, young, middle-class to high-class consumers. Further, commercialization can adopt sustainable business models such as social enterprises and S.PSS. The latter views products as services that can change production and consumption patterns [22].

Nonetheless, upcycling can frustrate and make a designer struggle to produce an intended product. The challenge may be caused by the designer's limited fabrication skills or capacity to produce a particular product. Therefore, upcycling requires a lot of patience, resilience, and perseverance, demonstrated aptly by FD1 who created two prototypes before making the final product.

The Kirinyaga University fashion design degree curriculum comprises many studio-based units in which students buy their own materials. For instance, apparel design for men, women, and children; bespoke techniques; and garment construction project among others. Therefore, embedding upcycling in course projects is a step to producing graduates who shall be change agents to make upcycling an integral aspect of fashion design practice. Further, by practicing upcycling, the participants, who are all trainers in TVET institutions can positively influence behaviour change among their trainees concerning the practical contribution of upcycling to sustainability and reducing course projects costs. The effort shall create a large pool of sustainability-conscious and innovative generations of fashion design trainees and future practitioners. The designers shall hence address the needs of the ever-growing eco-conscious, fashionable, middle-income and high-income Gen Z and millennials fashion consumers by producing unique, culturally-inspired, meaningful, and eco-friendly products. Upcycling applies to all design disciplines including fashion, interior, product, and industrial design.

The study recommends the following,

1. HEIs to review fashion design curriculum and offer courses aligned with sustainability fields and concepts, especially upcycling in studio-based courses so that students practically engage in it. Further, the projects should emphasize on co-creation with actual end-users and commercialization.
2. Students should be exposed to local and overseas sustainability-related competitions/events and fashion brands in a close structured collaboration between HEIs and the fashion industry.
3. Sustainable fashion brands should aggressively market themselves as designers of unique, high-quality, luxurious, fashionable, single-piece products, especially in online platforms to reach a wide range of potential consumers.
4. Sustainable fashion actors: academia, researchers, students, and government to create awareness and

meaningful participation in upcycling through action workshops and establishing upcycling community centres among other initiatives.

5. The government to provide incentives and rebates to individuals or organizations adopting upcycling, hence enhance its uptake.

The study used a small sample that was selected from one institution. Therefore, the findings cannot be generalized to other contexts. The study did not address end-users' perspectives on upcycled fashion products, for whom they were co-designed and constructed. Hence, the products' performance cannot be ascertained. In addition, the participants did not cost the products, which would have ascertained their commercial viability.

Future studies on upcycling could be conducted in multi-institutional and cross-cultural settings, for instance across Africa. Further, tracer studies can enhance understanding of millennial generation women consumers' attitude toward upcycled fashion products and soft furnishings in a co-creation process. Additionally, a study could be undertaken to unravel how upcycling can leverage digital applications and artificial intelligence (AI) particularly for tech-savvy Gen Z and millennials in Africa.

Figures originality

All the figures are original having been collected from the students' portfolios.

List of abbreviations

AI	Artificial Intelligence
DIY	Do-it-yourself
SDG	Sustainable Development Goals
S.PSS	Sustainable Product-Service Systems
TVET	Technical and Vocational Education and Training
UN	United Nations
HEI	Higher education institutions
DfS	Design for Sustainability
FD	Fashion Design

Author Contributions

The author (Sophia N. Njeru) is solely responsible for conceptualization, methodology, formal analysis, investigation, resources, data curation, writing—original draft preparation, writing—review and editing, and visualization. The author has read and agreed to the final version of the manuscript.

Availability of Data and Materials

All the data were obtained from the student's project portfolios with their consent. The data can be made

available electronically to other researchers upon request.

Consent for Publication

One cohort of the students signed a consent form (Attached). The other cohort willingly shared their portfolios upon the author's request as I was planning to write a manuscript on upcycling.

Conflicts of Interest

The author declares "No conflicts of interest" in this manuscript.

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Ethical Approval and Consent to participate:

The study was based on student's project portfolios not the students themselves. Hence, no ethical approval was sought because there was no potential harm to humans.

The author obtained informed consent from the students.

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Declared, none.

AI Declaration

No AI tools were used.

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Figures:



Figure 1: Two-piece satin dress (Source: FD5)



Figure 2: Bell-bottom denim trousers (Source: FD9)



Figure 3: Felt tracksuit (Source: FD7)



Figure 4a and b: Reversible denim/kitege casual unisex jacket (Source: FD6)



Figure 5a and b: Denim dress (Source: F11)

Fashion accessories created



Figure 6: Kitenge sandals (Source: FD1)



Figure 7: Denim sandals (Source FD3)



Figure 8: Kitenge tote bag (Source FD1)



Figure 9: Rexin duffle bag (Source FD2)



Figure 10: Denim duffle bag (Source FD10)



Figure 11: Patchwork Tote bag (Source FD12)



Figure 12: Woven handbag (Source FD7)

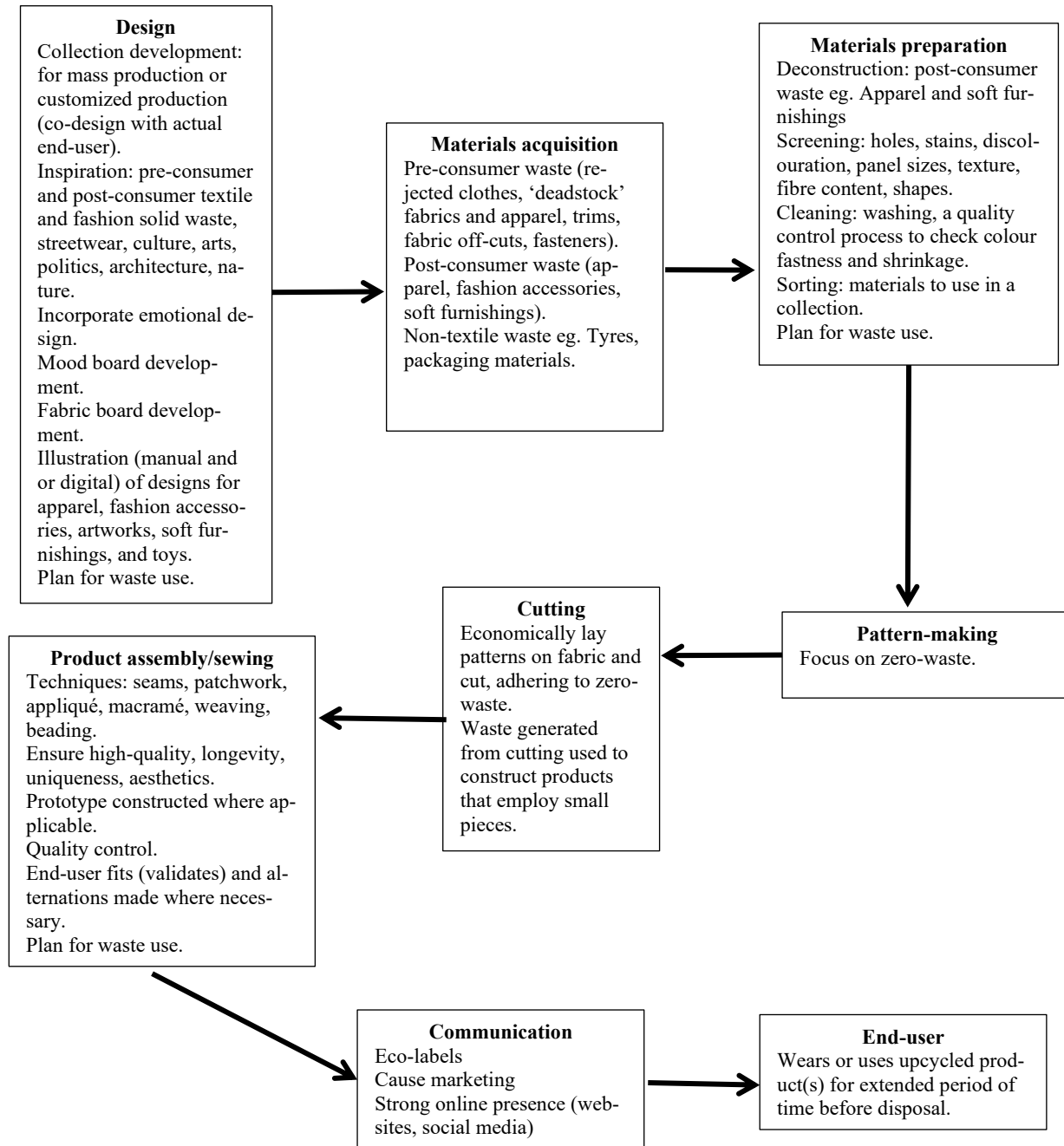


Figure 13: Woven tote bag (Source FD9)



Figure 14: Woven sun hat (Source FD1)

Figure 15: Preliminary conceptual framework for upcycling textile and fashion solid waste (both pre-consumer and post-consumer)



(Source: Author, 2026)