

Article

Integrating Sustainable Concepts into Textile Design Courses: An Effective Teaching Practices

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Abstract: This study investigates the integration of sustainable design practices into the university's textile curriculum through upcycling practices. The objective of this research is to reduce the environmental impact of the textile industry while promoting innovation and providing opportunities for students. This study provides a comprehensive literature review and case studies to outline the approach to textile upcycling. The upcycling approach is then integrated into the university's textile courses, encouraging students to recycle textiles and adopt sustainable design practices. This research analyses the design practices used and identifies considerations and steps for upcycling sustainable design approaches. Ultimately, this research serves as an extension of the university's textile design curriculum, contributing to a more sustainable future for the textile industry.

Keywords: sustainable design; upcycling; university textile courses; design practice.



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1. Introduction

In the textile and clothing sector, an apparel or textile material is considered sustainable if it gives the greatest possible benefit to people while having the least possible impact on the environment (Joy et al., 2012). This demonstrates how excessive consumerism and a throwaway culture contribute to an increase in textile waste, which is a significant environmental concern with the economy's rapid development (Lang & Armstrong, 2018). Overconsumption is a distorted and unsustainable kind of consumption that does not correlate with reality (Håkansson, 2014), is inconsistent with the degree of economic progress, and exceeds basic necessities and the capacity to pay. Fast fashion culture, which has become a trend in recent years with the growth of fast fashion clothing companies such as Zara, H&M, and Uniqlo, is synonymous with disposable culture. It is defined by mass production, high turnover, and commodities designed for a short lifespan (Hall, 2018). With low prices, a variety of styles, and tiny quantities, fast fashion brands quickly catch consumers' attention and completely meet their needs (Lei & ZHANG, 2018). The widespread manufacture of these textile disposables has also led to increased consumption and wasteful circumstances. The widespread manufacture of these textile disposables has also led to increased consumption and wasteful circumstances.

With the ever-increasing volume of textiles comes a close second in terms of textile waste. In the textile and apparel industries, a variety of wastes are generated and are classified into three categories: production waste, pre-consumer waste, and post-consumer waste. Pre-consumer textiles are relatively simple to recycle because their general composition and origin are known, whereas post-consumer textiles are frequently composed of different materials and must be disassembled prior to reuse (Todor et al., 2022). According to Joung, consumers dispose of unwanted apparel differently based on their motivations. Due to economic factors, some consumers consider selling unwanted textiles (Joung, 2013); those who donate textiles are frequently motivated by philanthropy and environmental protection; those with strong environmental awareness and design skills choose to recycle textiles for upcycling; and those motivated by convenience tend to discard unwanted textiles. All of these behaviours are simultaneously impacted by family and friends.

Upcycling is already known to be a better way to dispose of textiles compared to other methods (Bhatt et al., 2019; Cumming, 2016; Koch, 2019; Vadicherla et al., 2017). This method allows consumers and businesses to reuse and recycle waste textiles, thereby reducing textile waste. In addition to this, there are several more explanations, including the following: Upcycling does not require the investment of any new resources; none of the raw materials are lost in the process, and the use of additional resources may be kept to a minimum (Bhatt et al., 2019); According to Stanescu, upcycling can extend the life cycle of textiles by allowing waste textiles to be processed through a further upcycling process that adds value before the waste textiles are downcycled (Stanescu, 2021).

Wide-ranging effects on the industry as a whole result from the inclusion of upcycling in college textile design courses (Khamisani, 2021). This is due to the fact that preparing students for their future careers by equipping them with the necessary knowledge and skills through the understanding and sound application of sustainable design principles, such as how to reduce textile waste, the life cycle of textiles, and carbon emissions, Students who successfully complete their studies and enter the workforce are able to understand how design affects the environment and how to use sustainable design techniques. This is evident in the choice of raw materials, the life cycle of the product, and the eventual disposal (Koroneos et al., 2013). At the same time, incorporating upcycling into the textile design classroom can encourage students to think creatively and critically about the materials and processes involved (Maaruf et al., 2021). This critical thinking approach can be applied to their other professional practices, enabling them to look at problems from more perspectives and seek more solutions to design pain points in their lives. Therefore, the integration of upcycling into textile design education not only promotes sustainability in the academic field but also has the potential to positively impact the broader design industry by creating a generation of designers who are committed to ethical and responsible practises (Sung, 2020).

The goal of this paper is to look at how sustainable design can be taught in university textile classes from the point of view of what actually happens in the classroom. Through reading about upcycling, the best ways to reuse textiles will be found and shown to the students. Students will be encouraged to choose the best methods for upcycling textile designs and to keep track of the steps they took and the results they got. Lastly, the methods of sustainable design that the students used in their design work will be broken down and a full summary will be given.

2. Literature Review

2.1. Upcycling of Textiles

In fact, upcycling textiles is a new idea. A search of the Web of Science and Scopus shows that the first time the keyword was used was in 2009. Hemmings mentions in his publication that Rebecca Earley is one fashion designer who approaches recycling, or rather upcycling, by means of meticulous research. Utilizing cutting-edge eco-friendly technologies, she adds value to used clothing (Hemmings, 2009). Rebecca (Becky) Earley, who is mentioned in the literature, has done a lot of practical work on textile sustainability and textile upcycling, which could be of some help and reference to subsequent researchers. After that, the 7th Textile Bioengineering and Informatics Symposium (TBIS 2014) and 5th Asian Protective Clothing Conference (APCC 2014) mentioned this keyword again. Agarwal describes three common approaches to sustainable design: upcycling, reconstruction, and zero waste (Agarwal, 2020). The literature on textile upcycling is slowly growing, reaching its peak in 2021.

Scholars have elaborated on different aspects of upcycling textiles. Aus summarizes the results of over five years of practice-led research on the use of upcycled design and production methods in the mass production of clothing (Aus et al., 2021). Referring to the fact that many textile wastes from hospitals may carry harmful pathogens and that many fashion garments contain non-biodegradable chemicals, Kamble &

Behera critically examine the challenges of textile waste management and the application of upcycling technologies for waste textiles and explore ways to produce upcycled products from waste textiles (Kamble & Behera, 2021). Cumming addresses textile waste through solutions that intersect with traditional design, production, and end-of-life systems or create new ones, with their project redesigning outdated textiles from company uniforms into children's clothing to address textile waste in the industry and support community wellbeing (Cumming, 2016). It is easy to see from the literature that most of the focus on textile upcycling has been on various recycling techniques and that the final product is mostly clothing.

So, there are many research gaps that deserve further exploration regarding textile waste upcycling, such as recycling garments and upcycling them into everyday textile products using various processes and methods. Upcycling textiles allows more people to feel the significance of recycling textiles, and it also advocates for and supports the sustainability of textiles at the same time. Despite the fact that an increasing number of academics have started to pay attention to this field of textile upcycling, there are now a number of issues: The upcycling of textiles is a novel concept, and more time will be required for both society as a whole and individual customers to grow accustomed to it, comprehend it, and put it into reality.

2.2. Sustainable Design in Textile Design Courses in Universities

In recent years, integrating sustainable design into universities has become an international trend, with many schools incorporating sustainable materials into their design courses, such as fashion and textile design. Some universities even offer majors specifically focused on sustainable design, such as the Biological Design course at Central Saint Martins in the UK, which allows students to explore various organisms that can be cultivated into raw materials for clothing production, addressing the issue of textile waste (Bandoni et al., 2022). As mentioned earlier, the textile industry currently faces significant pollution problems, and sustainable textile design aims to reduce the environmental impact of textile production. Although sustainable design education is a newly emerging field, it has gained popularity in recent times. According to Beringer & Adom̄ent, universities can provide a unique opportunity for sustainable design education, as they possess the resources and expertise to develop and implement sustainable design courses (Beringer & Adom̄ent, 2008). However, integrating sustainable textile design into existing textile design courses may pose a challenge, as it requires a paradigm shift in textile design teaching methods. Therefore, integrating sustainable textile design education into university courses faces several challenges. One of the main challenges, according to Palvia et al. (2021), is the lack of awareness and knowledge of sustainable textile design among textile design students and teachers. Another challenge is the lack of resources and infrastructure to support sustainable textile design education. Additionally, sustainable textile design courses lack standardization and certification, making it difficult for students to evaluate the quality of education they receive (Hur & Cassidy, 2019). Despite the challenges, sustainable textile design education presents several opportunities for universities. Sustainable design education can provide universities with a competitive advantage (Cortese, 2003). Furthermore, sustainable textile design education can foster innovation and creativity, as it requires students to think outside the box and develop new design strategies. Finally, sustainable textile design education can contribute to the development of a sustainable society by promoting responsible consumption and production.

2.3. Cases of Textile Upcycling

In recent years, there are already many case studies on textile upcycling available, which have provided us with a summary of upcycling methods that are suitable for teaching in the classroom. In selecting these methods, we have paid attention to the simplicity of raw materials and the accessibility of tools, as well as the importance of not requiring special sites and tools. This is because students often struggle with the use of cumbersome tools or materials (Linn, 2003). A search of the literature led to the selection of seven textile up-cycling methods, and students were encouraged to try out these seven methods for textile design. The first is a weave. Weaving is the process of interlacing two sets of yarn or threads at right angles to create a fabric or textile (Mamdouh et al., 2022). The weaving technique can be applied to a wide range of textiles, including carpets, blankets, wall hangings, and more, and can also be used to recycle materials such as old clothes. Won Lee collected various types of discarded clothing waste and created four weaving methods based on Chanel's tweed designs. These upcycling methods not only make the most of discarded clothing waste but also give it new life and value (won Lee, 2023).

Crocheting is the process of creating fabric or textiles by interlocking loops of yarn or thread with a hooked needle (Ng, 2004). This technique is suitable for making items such as scarves, hats, gloves, jumpers,

etc. Orzada has managed to transform some discarded textiles into dresses by crocheting, demonstrating the full potential and creativity of this recycling method (Orzada, 2017)

Tie-dyeing is a fabric dyeing technique that involves tying or binding fabric to create patterns before dyeing, resulting in a unique and colorful design (Barasa & Olal, 2020). This technique can be used on textiles such as T-shirts, pillowcases, and curtains, and the result is a unique, colorful pattern. Gausa & Abubakar describe the methods and techniques used by the Jukun people using the tie-dye technique. Using locally spun cotton, the Jukun use blue or black dyes to dye the threads and then weave them together with the cotton threads to create different geometric patterns. They also use gold threads to add grandeur and symbolism to their garments. This upcycling method not only has a unique cultural background and historical value but can also be used in today's textile designs for its unique artistic appeal and practicality (Gausa & Abubakar, 2015).



Patchwork is a form of needlework that involves sewing together small pieces of fabric into a larger design or quilt (Leake et al., 2021). Han et al. mention a British design brand that uses upcycled, discarded T-shirts to create a unique effect by piecing together different materials and patterns of fabric. This upcycling method not only makes use of discarded materials but also enables the creation of personalized fashion products that are environmentally friendly, sustainable, and have implications for the design of modern textiles (Han et al., 2017).




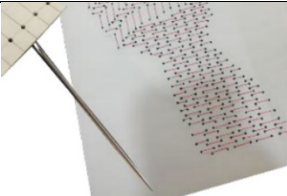
Applique is a needlework technique that involves sewing a smaller piece of fabric onto a larger piece to create a design (Melnik et al., 2021). In their book, Triston and Lombard demonstrate the many ways in which collage can be creatively expressed in contemporary textile art, including layering, piecing, and covering. The book also details different types of collage techniques, such as hand stitching, machine stitching, and heat bonding. These techniques can be applied to different textile materials and design styles, enabling upcycling by creating unique patterns and textures. The book offers a wide range of inspiration and technical guidance for textile designers (Triston & Lombard, 2015).

Printing is the process of transferring a design or image onto a surface using ink or another medium (Sarkodie et al., 2018). According to Teli et al., there are many printing techniques available, including screen printing and digital printing. In the context of the rejuvenation of textiles, printing can be used to transform discarded fabrics into unique and creative products, such as printing on bleached cotton fabrics using reactive dyes or creating new designs on discarded materials using screen printing with reactive dyes (Teli et al., 2015).

Embroidery is the process of decorating fabric or other materials with needle and thread or yarn to create designs (Akinrujumu, 2020). Marques et al.'s research used discarded textiles from aircraft seats and metal fittings from discarded seat belts as the raw material for their designs. During the design process, they used embroidery techniques to stitch together different materials and patterns to create a unique jacket. This upcycled design approach is not only beneficial to the environment and resource conservation, but also enhances the innovation and sustainability of the design, which has important practical and educational implications (Marques et al., 2019).

Table 1. Upcycling Methods

No.	Method(s)	Content(s)	Example(s)	Reference(s)
1.	Weaving	Weaving is the process of interlacing two sets of yarn or threads at right angles to create a fabric or textile. (Mamdouh et al., 2022)	Rugs, blankets, wall hangings	 Won Lee (2023)
2.	Crocheting/ knitting	Crocheting is the process of creating fabric or textile by interlocking loops of yarn or thread with a hooked needle. (Ng, 2004)	Scarves, hats, gloves, sweaters	 Orzada (2017)

No.	Method(s)	Content(s)	Example(s)	Reference(s)
3.	Tie-dyeing	Tie-dyeing is a fabric dyeing technique that involves tying or binding fabric to create patterns before dyeing, resulting in a unique and colorful design (Barasa & Olal, 2020).	T-shirts, pillowcases, curtains	 Gausa & Abubakar (2015)
4.	Patchwork	Patchwork is a form of needlework that involves sewing together small pieces of fabric into a larger design or quilt (Leake et al., 2021).	Quilts, bags, wall hangings	 Han et al. (2017)
5.	Applique	Applique is a needlework technique that involves sewing a smaller piece of fabric onto a larger piece to create a design (Melnyk et al., 2021).	Decorative pillows, wall hangings, clothing	 Triston & Lombard (2015)
6.	Printing	Printing is the process of transferring a design or image onto a surface using ink or another medium (Sarkodie et al., 2018)	Dresses, tablecloths, scarves	 Teli et al. (2015)
7.	Embroidery	Embroidery is the process of decorating fabric or other materials with needle and thread or yarn to create designs (Akinrujomu, 2020)	Jackets, handbags, towels	 Marques et al. (2019)

3. Materials and Methods

The literature review method and the case study method were used in this study. The literature review method is a literature-based research method that helps researchers gain a deeper understanding of a particular issue or topic by summarizing the main ideas, findings, and trends in the field of study through a systematic assessment and analysis of the existing literature (Snyder, 2019). The case study method is used to obtain detailed and comprehensive information about an issue through in-depth analysis and interpretation of one or more actual cases (Hancock et al., 2021).

In this study, the literature review method and the case study method are used to understand the current situation and challenges of textile up-cycling, as well as the pathways and strategies needed to develop sustainable design practices. The combined application of these methods can help us better grasp the core elements and practical skills of textile up-cycling and thus provide strong support for the sustainable

development of university textile courses. Firstly, we conducted a search of the literature on textile upcycling to find methods suitable for use in the classroom and summarized the focus and steps of these methods. We then analyzed student design case studies to identify which methods are appropriate to use in the university classroom and can achieve better design results. The practice of upcycling is divided into seven major steps, which are as follows:

- **Selection of materials:** The selection of materials is a key step in the textile upcycling design process. This is because different waste textiles have different fibre compositions and characteristics, and therefore different design methods and tools need to be selected depending on the situation. For example, for cotton textiles, techniques such as cutting and quilting can be used, while for delicate textiles such as silk, techniques such as embroidery and weaving can be used. Also, for different cellulosic fibres, such as cotton, linen, silk, and wool, the properties and characteristics vary and need to be chosen according to specific needs.
- **Cleaning of materials:** As one of the steps in textile upcycling, the cleaning of materials is very important as it ensures the quality and hygiene standards of the waste materials used. Before cleaning, a careful inspection is required to exclude waste materials that are damaged, deformed, or heavily stained and to select only those parts that can be reused. Next, different cleaning methods can be chosen depending on the material; for example, for natural fibres, water or all-natural detergents can be used; for synthetic fibres, chemical cleaning agents may be required. After cleaning, a thorough disinfection should also be carried out to ensure that the material meets hygiene standards.
- **Design:** Through the initial selection of materials and cleaning and organizing, the design phase requires thorough thought and planning. At this stage, the designer needs to analyze and evaluate the chosen materials, consider their strengths and weaknesses, and determine the most suitable way of applying them. At the same time, the designer also needs to consider how the different materials and textures can be combined to create a unique visual effect and translate this into an actual design drawing.
- **Deconstruction:** Deconstruction is the dismantling and separation of waste textiles in order to obtain components that can be reused. The process of deconstruction requires the use of special tools such as scissors and knives in order to break down the waste textiles into usable components. This process requires patience and fine motor skills, as the separated components need to remain intact in order to be used for upcycling designs.
- **Production:** Based on the preparation of the materials and the conception of the design, the production phase begins. In this stage, the materials prepared earlier will be used to create a new design. The exact production process can vary depending on the design method and tools used, but in general, the production process requires attention to detail to ensure the quality and practicality of the product.
- **Embellishments:** Embellishment is an essential step. Embellishments such as embroidery, beading, or appliqués are used to add detail and interest to the design and can also be used to hide any wear or tears in the original material. These embellishments should be chosen to match the overall style of the design and the characteristics of the material to achieve the best visual effect.
- **Finishing:** by folding, pressing, or ironing, the design can be perfected and made more beautiful. Folding keeps the fabric's edges flat and neat, reducing the likelihood of fraying and tearing. Pressing makes the fabric stronger and increases its longevity, while also adding layers to the design. Ironing gives a flatter, neater finish and removes unwanted folds and wrinkles.

4. Results

After the whole design process, 10 design cases are finally presented. Through the analysis and collation of the design cases and the experience gained in the production process, the following notes are summarized, with slightly different steps for different design methods.





- **Weaving:** Weaving involves cutting fabric into strips and fixing them to a weaving board. A knitting board is a tool specifically designed for knitting that provides a stable base of support. However, students who are trying to knit for the first time do not necessarily need to purchase an additional knitting board. They can use existing materials, such as express cardboard, to create their creations in order to save as much energy and financial costs as possible.

- Crocheting: Usually used to wrap strips of fabric into a ball. When using a crochet hook, you need to choose the right type of hook for the different fabrics and widths in order to ensure that the strips of fabric are crocheted.
- Tie-dyeing: When tie-dyeing, the choice of material is very important, as different materials absorb dyes at different efficiencies. Natural fibres such as cotton, linen, and man-made fibres usually absorb dyes more readily than synthetic fibres such as polyester. Therefore, materials need to be carefully selected and prepared before tie-dyeing to ensure that the best dyeing results are achieved.
- Patchwork: Patchwork can be created in design practise using leftover materials, such as scraps of fabric. During the material preparation stage of quilting, ironing is required to maintain the flatness of the fabric and to select the appropriate fabric colour and texture for the design requirements.
- Appliqué: Similar to quilting, appliqué requires the preparation of materials, including cutting small pieces of fabric and ensuring they are the right shape and size for the overall design. At the same time, a suitable glue or thermal tape needs to be selected to secure the small pieces of fabric to the base fabric.
- Printing: In textile upcycling courses, due to the limitations of some machines and equipment, students often tend to design the pattern and give it to the factory to be printed.
- Embroidery: Embroidery requires the right stitch to be chosen for different fabrics in order to achieve the best results. For example, the delicate silk fabrics used in Su embroidery require a fine embroidery stitch to maintain the detail and delicacy of the pattern. Cross stitch, on the other hand, can be applied to a variety of fabrics, including cotton and linen, as it is a relatively simple stitch. Cotton thread embroidery, on the other hand, is suitable for a wide range of fabrics, including cotton, linen, wool, and silk, and can also be combined with materials such as denim.

Table 2. Textile Upcycling in Practice

No.	Artist(s)	Design Method(s)	Raw material(s)	Artwork(s)
1.	Li Ling-Yu	Weaving crocheting	 Clothes	 Bag
2.	Lin Min	Weaving	 Denim Jeans	 Bag
3.	Pang Yu-Zhen	Crocheting		

No.	Artist(s)	Design Method(s)	Raw material(s)	Artwork(s)
4.	Ye Meng-ling	Applique	 <p data-bbox="868 602 959 629">Skirts</p> <p data-bbox="868 607 959 633">Clothes</p>	 <p data-bbox="1230 277 1278 304">Bag</p> <p data-bbox="1171 602 1337 629">Make-up Bag</p>
5.	Huang Yi	Patchwork	 <p data-bbox="868 943 959 969">Clothes</p>	 <p data-bbox="1142 943 1366 969">Fabric Phone Case</p>
6.	Pang Yu-Zhen	Patchwork	 <p data-bbox="842 1274 983 1301">Tablecloths</p>	 <p data-bbox="1225 1274 1278 1301">Doll</p>
7.	Fang Ping	Patchwork	 <p data-bbox="868 1581 959 1608">Clothes</p>	 <p data-bbox="1230 1581 1278 1608">Bag</p>
8.	Wang Yue-shang	Patchwork	 <p data-bbox="852 1895 975 1921">Bed Sheet</p>	 <p data-bbox="1230 1895 1278 1921">Hat</p>

No.	Artist(s)	Design Method(s)	Raw material(s)	Artwork(s)
9.	Lai Xue-Mei	Smocking	 Denim Jeans	 Fabric Mug Cover
10.	Lin Min	Smocking	 Denim Fabric	 Drawstring Bag

5. Conclusions

The integration of sustainable design principles into textile design courses, as demonstrated by this research project, was effective in providing a new perspective for both students and instructors in the field of design. Through ten design practices, it was observed that almost all students were highly satisfied with their design outcomes and willing to embrace sustainable design principles. This study also confirmed that, among the previously proposed seven design methods, four were widely adopted by the students. To achieve democratic design and ensure that sustainable design practices are accessible to everyone, complex design methods and tools must be avoided, and accessible tools should be utilized to enable individuals to upgrade and repurpose textile waste. This study has some limitations, however. Firstly, only seven upgrading and repurposing methods were introduced, and more possibilities could be offered to encourage student creativity. Additionally, since the participating students were all majoring in textile design, they had a basic theoretical and technical foundation in sewing and cutting. Future research could involve inviting ordinary consumers to participate in design practices and exploring additional methods for upgrading and repurposing textile waste in the literature to encourage more people to engage in sustainable design practices and to promote a trend of sustainable design in society. By doing so, the problem of textile waste and solid pollution resulting from textile waste entering landfills and incinerators can be alleviated, and a positive impact on environmental pollution can be achieved.

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References

- Agarwal, S. (2020). Experimental sustainable practices in fashion education. *Sustainable Development and Social Responsibility—Volume 1: Proceedings of the 2nd American University in the Emirates International Research Conference, AUEIRC'18–Dubai, UAE 2018*
- Akinrujomu, O. S. (2020). Embroidery as a form of decorative stitches in art. *International Journal of Research and Analytical Reviews*, 7(2), 375-378.
- Aus, R., Moora, H., Vihma, M., Unt, R., Kiisa, M., & Kapur, S. (2021). Designing for circular fashion: integrating upcycling into conventional garment manufacturing processes. *Fashion and Textiles*, 8, 1-18.
- Bandoni, A., Almendra, R., & Forman, G. (2022). Interdisciplinarity and Collaboration—A Study Focusing on Experienced Biodesign Practitioners. *Advances in Human Dynamics for the Development of Contemporary Societies*, 25, 77.
- Barasa, N., & Olal, F. O. (2020). Creative designing of fabric patterns by tie-dyeing with synthetic dyes.
- Beringer, A., & Adom̄ent, M. (2008). Sustainable university research and development: inspecting sustainability in higher education research. *Environmental Education Research*, 14(6), 607-623.
- Bhatt, D., Silverman, J., & Dickson, M. A. (2019). Consumer interest in upcycling techniques and purchasing upcycled clothing as an approach to reducing textile waste. *International Journal of Fashion Design, Technology and Education*, 12(1), 118-128.
- Cortese, A. D. (2003). The critical role of higher education in creating a sustainable future. *Planning for higher education*, 31(3), 15-22.
- Cumming, D. (2016). A case study engaging design for textile upcycling. *Journal of Textile Design Research and Practice*, 4(2), 113-128.
- Gausa, S., & Abubakar, E. (2015). Tie-dye (Adire) among the Jukun people. *Mgbakoigba: Journal of African Studies*, 4, 1-13.
- Håkansson, A. (2014). What is overconsumption?—A step towards a common understanding. *International Journal of consumer studies*, 38(6), 692-700.
- Hall, J. (2018). Digital kimono: fast fashion, slow fashion? *Fashion theory*, 22(3), 283-307.
- Han, S. L., Chan, P. Y., Venkatraman, P., Apeagyei, P., Cassidy, T., & Tyler, D. J. (2017). Standard vs. upcycled fashion design and production. *Fashion Practice*, 9(1), 69-94.
- Hemmings, J. (2009). Rebecca Early upcycles style. *Fiberarts*, 35(4), 38-41.
- Hur, E., & Cassidy, T. (2019). Perceptions and attitudes towards sustainable fashion design: challenges and opportunities for implementing sustainability in fashion. *International Journal of Fashion Design, Technology and Education*.
- Joung, H.-M. (2013). Materialism and clothing post-purchase behaviors. *Journal of consumer marketing*.
- Joy, A., Sherry Jr, J. F., Venkatesh, A., Wang, J., & Chan, R. (2012). Fast fashion, sustainability, and the ethical appeal of luxury brands. *Fashion theory*, 16(3), 273-295.
- Kamble, Z., & Behera, B. K. (2021). Upcycling textile wastes: challenges and innovations. *Textile Progress*, 53(2), 65-122.
- Khamisani, N. (2021). Exploring upcycling as a design process through fashion education. *State-of-the-Art Upcycling Research and Practice: Proceedings of the International Upcycling Symposium 2020*.
- Koch, K. (2019). Clothing upcycling, textile waste and the ethics of the global fashion industry. *ZoneModa Journal*, 9(2), 173-184.
- Koroneos, C. J., Achillas, C., Moussiopoulos, N., & Nanaki, E. (2013). Life cycle thinking in the use of natural resources. *Open Environmental Sciences*, 7(1), 1-6.
- Lang, C., & Armstrong, C. M. J. (2018). Collaborative consumption: The influence of fashion leadership, need for uniqueness, and materialism on female consumers' adoption of clothing renting and swapping. *Sustainable Production and Consumption*, 13, 37-47.
- Leake, M., Lai, F., Grossman, T., Wigdor, D., & Lafreniere, B. (2021). PatchProv: Supporting Improvisational Design Practices for Modern Quilting. *Proceedings of the 2021 CHI Conference on Human Factors in Computing Systems*.

- Lei, Y., & ZHANG, J. (2018). Research on the Development Status and Strategy on Sustainable Fashion of Fast Fashion Brands. 2018 International Conference on Energy Development and Environmental Protection (EDEP 2018).
- Linn, M. (2003). Technology and science education: starting points, research programs, and trends. *International journal of science education*, 25(6), 727-758.
- Maaruf, S. Z., Abdul, W. N. N. H. W., & Sabri, M. F. (2021). Upcycling junk art and craft module to nurture creativity of children. *Malaysian Journal of Sustainable Environment*, 8(2), 55-70.
- Mamdouh, F., Reda, M., El-Aziz, A., Atef, H., & Othman, H. A. (2022). Overview of different fabric structures. *Journal of Textiles, Coloration and Polymer Science*, 19(2), 291-306.
- Marques, A. D., Moreira, B., Cunha, J., & Moreira, S. (2019). From waste to fashion—a fashion upcycling contest. *Procedia CIRP*, 84, 1063-1068.
- Melnyk, L., Kyzymchuk, O., & Arabuli, S. (2021). Applique as a means for men's knitwear decoration. *Textile Science and Economy: proceedings of 12th International Scientific-professional conference, Zrenjanin, Republic of Serbia, 10th December 2021. – Zrenjanin : Technical faculty "Mihajlo Pupin", University of Novi Sad, 2021. – P. 139-144.*
- Ng, F. M. (2004). A review of the development of basketry, braiding, crochet, and felting towards the creation of seamless fashion. *Research Journal of Textile and Apparel*, 8(2), 65-75. <https://doi.org/10.1108/RJTA-08-02-2004-B009>
- Orzada, B. T. (2017). Upcycle and Zero Waste Ensemble. *International Textile and Apparel Association Annual Conference Proceedings*,
- Sarkodie, B., Tawiah, B., Agbo, C., & Wizi, J. (2018). Status and development of transfer printing in textiles—A review. *AATCC Journal of Research*, 5(2), 1-18.
- Stanescu, M. D. (2021). State of the art of post-consumer textile waste upcycling to reach the zero waste milestone. *Environmental Science and Pollution Research*, 28(12), 14253-14270.
- Sung, K. (2020). Upcycling for teaching and learning in higher education: Literature review. *Universities as Living Labs for Sustainable Development: Supporting the Implementation of the Sustainable Development Goals*, 371-382.
- Teli, M., Valia, S., Kadu, K., & Dahale, M. (2015). Upcycling of textile materials. *Proceeding of Global Textile Congress, Bangkok, 13-15 Feb 2015.*
- Todor, M., Rackov, M., Kiss, I., & Cioata, V. (2022). Composite solutions with recycled textile wastes. *Journal of Physics: Conference Series*,
- Triston, J., & Lombard, R. (2015). *Contemporary Appliqué: Cutting edge design and techniques in textile art*. Batsford.
- Vadicherla, T., Saravanan, D., Muthu Ram, M., & Suganya, K. (2017). Fashion renovation via upcycling. *Textiles and clothing sustainability: Recycled and upcycled textiles and fashion*, 1-54.
- Won Lee, H. (2023). A study on the production methods of upcycling tweed fabric using clothing waste based on Chanel's tweed design. *Sustainability*, 15(4), 3374. Branscomb, L. M. (2006). Sustainable cities: Safety and security. *Technology in Society*, 28(1–2), 225–234. <https://doi.org/10.1016/j.techsoc.2005.10.004>