



Modular two-look blouse design using Jumputan and Indigo–Tingi Dyeing for sustainable fashion

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Abstract

The fashion industry increasingly demands sustainable alternatives that preserve cultural heritage. This study addresses the gap sustainably by integrating traditional Indonesian batik with contemporary modular design. Using a 4D R&D approach, a 2-look modular blouse was developed with jumputan cross-tie batik and natural indigo-tingi dyeing on organic cotton. Consumer preference testing with 60 respondents (the majority, 58.3%, aged 21-24 years) across Indonesia showed a strong preference for casual design (72 favorable ratings) over semi-formal (42 ratings). The sustainability concept received 75% perfect-fit ratings, with 92% approving the organic cotton material for its comfort, breathability, and suitability for tropical climates. However, the IDR 320,000 price point showed mixed acceptance: 58% found it acceptable, while 43% expressed affordability concerns, particularly among students. Results confirm market viability for sustainable modular fashion that integrates traditional techniques, though the pricing strategy requires refinement to reach student segments. Limitations include geographic concentration and age demographic skew. This research demonstrates the market viability of conventional textile techniques in contemporary sustainable fashion.

Keywords: modular, blouse, jumputan, sustainable

1. Introduction

Fashion and industrial textiles are among the most significant economic sectors worldwide and contribute significantly to the global economy. However, the industry is also known to have a significant adverse environmental impact, including water pollution, hazardous chemicals, and excessive textile waste. (Peleg Mizrachi, M., & Tal, 2024). With the advancement of technology, fashion trends can change rapidly. Other factors affecting fashion development are mass media, entertainment, business, and the Internet. The term that describes this phenomenon is fast fashion. (Fiona May Leman, Soelityowati, 2020). The fast-fashion trend is currently developing rapidly and has had the most significant impact. Another factor that makes Fast Fashion popular is the fast design turnaround and affordable prices. (Joy et al., 2012).

Fast-fashion manufacturers focus solely on mass production, disregarding ethical considerations related to designer copyrights. They pay workers very low wages without regard for their well-being and health. (Kornelis, 2022). The growing global awareness of environmental issues is prompting manufacturers in the fashion and textile industries to

adopt more sustainable production and consumption methods. Various factors, including high levels of waste production, water pollution from textile dyeing, and the unsustainable exploitation of natural resources, cause this. (Fiona May Leman, Soelityowati, 2020). Changes toward more responsible and environmentally friendly business models, such as slow and sustainable fashion, are increasingly important for reducing the industry's negative environmental impact. The sustainable fashion movement has been multiplying lately, in line with the promotion of the Sustainable Development Goals (SDGs) by the United Nations (UN). Especially the 12th goal on Responsible Consumption and Production. These goals include reducing the ecological footprint by reducing waste, improving resource efficiency, and encouraging companies and consumers to switch to greener practices (Almeida et al., 2016).

Modular fashion influences efforts to create a more sustainable fashion industry. Modular fashion is a design concept that allows clothes to be constructed from pieces that can be detached or recombined in various ways, giving users the flexibility to wear a single garment in multiple styles (Zhang et al., 2024). This concept aligns with the principles of sustainable

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fashion, as modular fashion reduces the need to buy many clothes at once, thereby suppressing excessive production and consumption that negatively impact the environment. With modular fashion, consumers can reduce the number of new clothes they buy, extend the life of their clothes, and create a variety of looks from just one item. These two concepts encourage wiser and more sustainable consumption in the fashion industry (Ülkü & Hsuan, 2017). Many fashion materials are designed to make eco-friendly clothes, such as natural fabrics, recycled materials, and biodegradable materials. In other words, rather than treating textile industry production as a primitive process and later damaging the environment, sustainable practices enable us to produce clothes and accessories that are both aesthetically pleasing and ethical (Motte & Ostlund, 2022).

Another natural fiber produced is cotton fiber. Cotton plants are grown in about 80 countries and are used as raw materials or as fabric in about 40% of all textile products, making cotton the most significant crop by production. Fabrics (Basiroen & Wahidiat, 2023). Thus, the selection of cotton remains an essential element for sustainable production, enabling producers and consumers to support the environment, ecosystems, and responsible fashion.

The apparel and textile industry is resource-intensive and accounts for 3 to 10 percent of global carbon dioxide emissions, in addition to generating large amounts of waste (Motte & Ostlund, 2022). In response to this challenge, there is growing awareness of the importance of innovation in the fashion sector to minimize adverse environmental impacts. One promising approach is the development of modular fashion products. Modularity allows clothes to be changed, renewed, and reused, thus reducing the need to purchase new clothes continuously (Carlo Vezzoli, 2008; Niinimäki et al., 2020). In addition, traditional techniques such as jumputan and natural dyeing are of interest for their ability to produce unique, sustainable, and culturally valuable products (Samoh, N., Laisin, N., & Siripool, 2020).

Based on this background, this research aims to create a modular blouse collection using jumputan techniques and indigo-tingi dyeing. After the product is submitted, it is further developed by conducting a preference test. Through this approach, it is hoped that it can produce fashion innovations that are aesthetic, environmentally friendly, and sustainable.

However, studies that explicitly integrate modular fashion with traditional Indonesian textile techniques remain limited. While modular design and traditional

dyeing techniques have been individually documented in the literature, their combined application as a strategy for sustainable fashion innovation, particularly within the Indonesian cultural context, has not been thoroughly explored. This gap presents an opportunity to examine how traditional techniques can enhance modular fashion design while preserving cultural heritage.

Based on this background and identified research gap, this research aims to develop a modular blouse collection using jumputan cross-tie techniques and indigo-tingi natural dyeing on organic cotton. The study includes consumer preference testing to assess market viability and acceptance. This approach seeks to demonstrate that traditional textile techniques can be successfully integrated into contemporary modular fashion design, creating sustainable, culturally meaningful, and commercially viable products.

2. Method

This research employed a Research and Development (R&D) approach using the 4D model (Define, Design, Development, and Disseminate) (Sugiyono, 2013) to develop and evaluate a modular blouse product through a descriptive-quantitative research design targeting young adults aged 17-30 years in Indonesia. Using incidental sampling (justified as appropriate for exploratory R&D product testing phases), 60 respondents aged 17-28 years were recruited via social media to assess consumer preferences across five product dimensions: sustainable concept, semi-formal design, casual design, material quality, and price appropriateness. A structured questionnaire with 11 items (6 demographic and 5 product preference items) was administered using a 4-point Likert scale (Perfect Fit, Appropriate, Not Suitable, Not Appropriate) to discourage neutral responses; the scale was selected for its effectiveness in consumer preference research (Mangifera, 2015). The questionnaire underwent expert review and pilot testing with 15 respondents, demonstrating acceptable internal consistency reliability (Cronbach's alpha $\alpha = 0.72$). Data were collected over four weeks via Google Forms, with informed consent obtained via a digital checkbox, and analyzed using descriptive statistics (frequency distributions, percentages, means, and standard deviations). Methodological limitations include: (1) incidental sampling limits generalizability; (2) geographic concentration in Java region (84.4%) may not represent all Indonesian regions; (3) self-reported

data subject to social desirability bias; (4) cross-sectional design captures preferences at one time point; (5) sample size (n=60) limits subgroup analysis.

3. Result and Discussion

Define stage results

Define is the initial stage of obtaining information to identify the problem. In the age range 17-30, especially the millennial generation and Gen Z, there is a high interest in the value of sustainability in fashion. They tend to be more environmentally conscious and attracted to products that are not only fashionable but also support environmental ethics and local culture. In addition, this population is more interested in innovation and exclusivity in their clothing. With modular fashion, customers can customize their look with their chosen outfits. It provides a personalized and varied experience to customers. Therefore, if matched to traditional Jumputan techniques, modular fashion will provide aesthetic and cultural value. This will provide a unique differentiator and produce a product that is authentic and distinct from others. With modular fashion, customers can customize their appearance according to their preferences, providing an exciting personalization and variety experience. Thus, if the traditional jumputan technique equivalents are used modularly, they will show different aesthetic and cultural values, providing a unique element by producing a product that is authentic and different from other modes.

Results of the design stage

Next is the design stage. The sky and the ground are the sources of ideas for this fashion. Fashion illustrations are made using the iBis Paint application. In Figure 1, the colored bottom design is attached to all clothing components. The picture consists of 2 looks: the first is a casual blouse with length to the pelvis, while look 2 is a casual blouse with length to the waist (crop). The cropped blouse is one example of an identical crop top that opens at the abdomen, a style that developed in the 1970s (Purnama, 2022). The detachable fashion components are connected using the zipper on the bottom of the blouse. In addition, some pockets can be moved, removed, and detached according to the user's taste. The colors used are two harmonious opposites. The motif is made

using the cross-tie jumputan technique and cotton materials.

Results of the development stage

The development stage includes costing materials, making fashion patterns, tying fabrics with cross-tie jumputan techniques, making indigo and tingi dye solutions, dyeing fabrics with indigo and tingi dyes, fixing alum and tunjung for tingi-dyed fabrics, cutting blouse materials, and sewing the blouse.

Blouse patterns are created using the Richpeace CAD application to facilitate production and minimize paper use, so that if a pattern is wrong, it can be corrected immediately in this software. Meanwhile, to determine how much fabric is needed to make a blouse, use Richpeace GMS software. The efficiency of fabric use will be evident in this process, enabling the application of the principle of sustainability. Figure 2 shows the blouse pattern and layout marker.



Figure 1. Illustration design

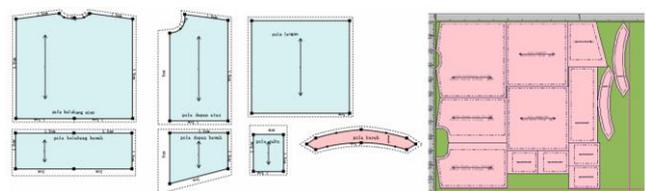


Figure 2. Blouse pattern and layout marker

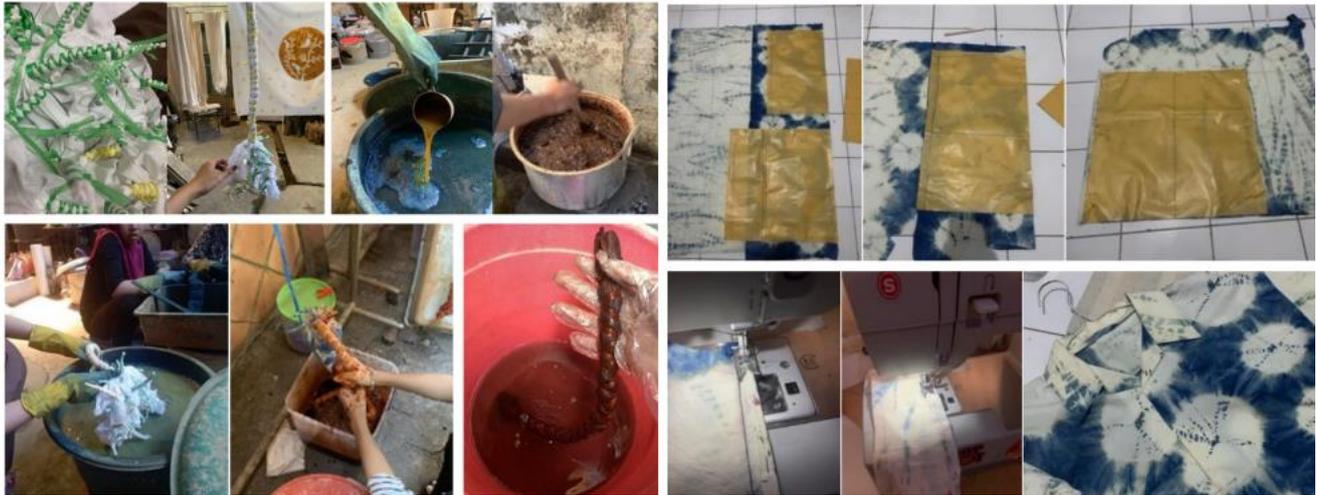


Figure 3. The process of tying, dyeing, cutting, and sewing

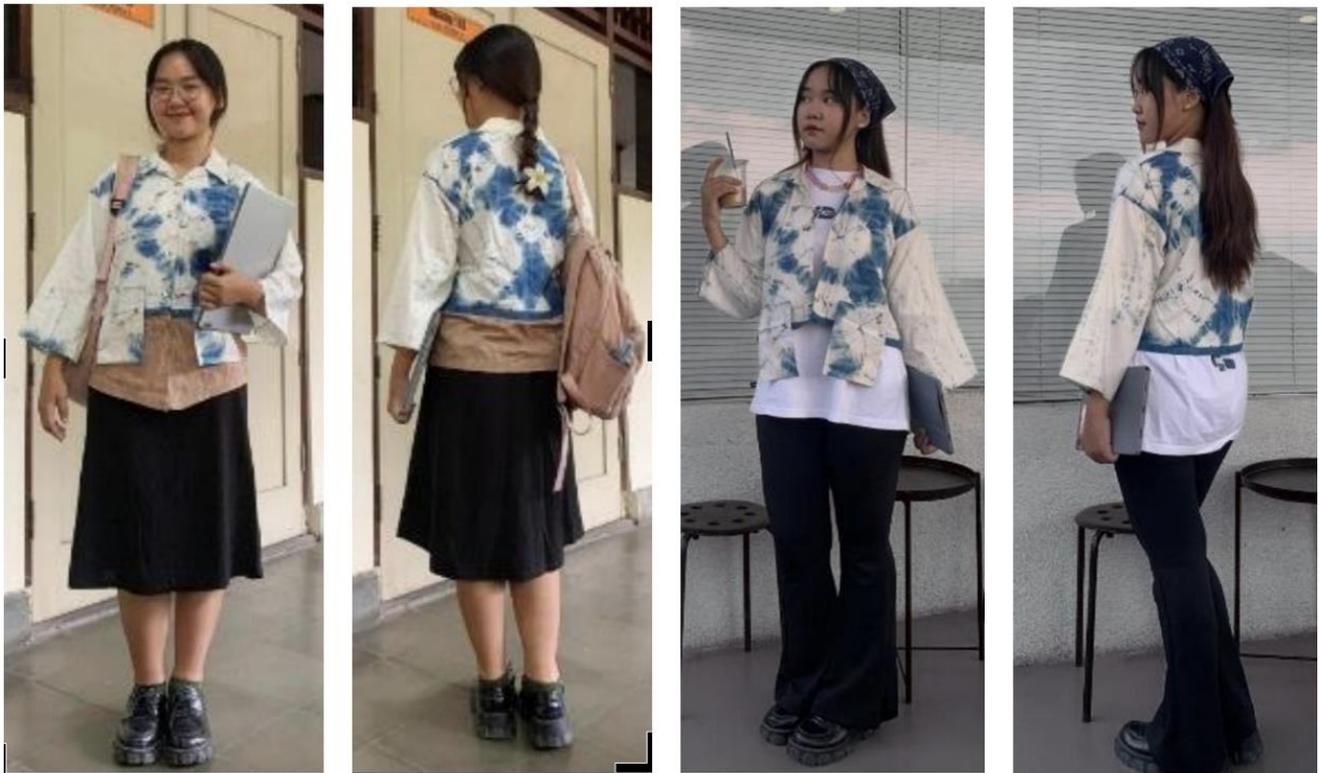


Figure 4. Results of tie-dye blouses

Jumputan is a technique for making fabric motifs by tying them with rope, after which marbles or stone fragments are dipped in dye. Making jumputan motifs begins with tying the fabric according to the planned design. This is followed by the fabric dyeing process, starting with color extraction, dipping into the indigo solution, and fixing and

releasing jumputan bonds. The process is shown in Figure 3.

Next, the pattern is placed on the fabric individually. When cutting materials with sustainability in mind, consider that it does not follow the direction of the fibers, so not much of the fabric is wasted. Then, the cut cloth sheets go

through the fashion sewing process, as seen in the Figure 3. The fashion result is a blouse with modular pockets and detachable body components. Some of the occasions that can be done with this modular blouse are as seen in the Figure 4.

Results of the dissemination stage

After the development stage is complete, the next stage is dissemination. This stage tested the product on 60 respondents. With a participant age range of 17-20 years, 24 participants (21-24 years old), 35 participants (25-28 years old), and 1 participant. The educational background of the respondents comprised 8 participants with the highest education level of junior high school, 48 participants with the highest education level of high school, and 4 participants with the highest education level of S1/D4. Figure 5 shows the profiles of respondents based on domicile. It shows 19 participants were domiciled in DKI Jakarta, 16 in D.I. Yogyakarta, 16 in Central Java, 6 in East Java, 2 in West Java, and 1 in Southeast Sulawesi. The results of the preference test are seen from several aspects as seen in the Table 1. It presents consumer preference assessment across five product aspects. The casual design aspect received the highest positive endorsement (84% combined "Perfect Fit" and "Appropriate"), followed by material selection (83%). In comparison, the price aspect showed the

lowest approval (73%), with notable resistance (26% combined negative responses). The sustainable concept demonstrated strong acceptance (83% positive), validating the integration of traditional natural dyeing with contemporary modular design.

Design effectiveness for modular fashion in the target market

Consumer preference data demonstrate strong design efficacy in meeting identified market needs. The casual design dimension received the highest preference endorsement (140% cumulative positive responses vs. 100% for semi-formal), indicating that the modular blouse's casual silhouette configuration aligns with contemporary consumer preference for versatile, everyday-wear functionality. This finding extends Zhang et al.'s (2024) Thesis that modular garments can be disassembled into multiple parts and enable extended garment lifetime through functional versatility across diverse contexts (Wu et al., 2023). Contemporary consumers increasingly prioritize functional adaptability in apparel selection, reflecting consumption patterns emphasizing wardrobe efficiency over volume accumulation. The modular configuration's capacity to generate two distinct silhouettes from a single garment directly operationalizes this preference pattern.

The lower semi-formal design preference (70% perfect fit vs. 120% casual) warrants critical interpretation. Semi-formal occasions constitute a more limited use context than casual everyday wear; additionally, the modular two-look configuration may not fully address the aesthetic requirements of semi-formal occasions. This limitation suggests that while modular design effectively serves primary-use contexts, its application to specialized-occasion wear may require distinct design approaches or supplementary components. Future iterations might explore modular mechanisms specifically designed for occasion expansion.

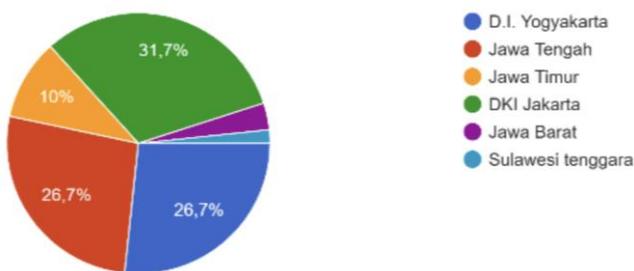


Figure 5. Piechart respondent domicile

Table 1. Likeness test results

Aspects	Perfect Fit	Appropriate	Not Suitable	Not Appropriate
Sustainable concept	45	38	13	3
Semi-formal design aspects	42	42	8	8
Casual design aspect	72	12	12	5
Material	55	28	7	10
Price	35	38	13	13

Sustainability integration and material performance

Sustainability assessment results (75% perfect fit, 63% appropriate) demonstrate strong consumer receptivity to integrating traditional natural dyeing with contemporary modular design. Natural dyes offer biodegradable, renewable, and non-hazardous properties, positioning them as promising alternatives to synthetic dyes despite challenges in color fastness and limited shade palette (Motte & Ostlund, 2022). However, 22% "not suitable" and 5% "not appropriate" responses warrant

examination. Two interpretations merit consideration: (1) respondents may lack familiarity with natural dyeing environmental benefits and perceive traditional methods as outdated; (2) sustainability values may be subordinate to other product attributes in consumer decision hierarchies. This suggests that consumer education about the environmental benefits of natural dyes may not automatically translate into preference adoption absent supplementary marketing communication.

Material assessment demonstrated strong approval (92% perfect fit, 47% appropriate), validating organic cotton selection. Cotton fiber's thermophysiological properties—lightweight, breathable, moisture-absorbing—provide superior performance in tropical climates, while its environmental profile (biodegradability, renewable source) aligns with contemporary sustainability discourse. However, 17% "not appropriate" responses suggest that segment-specific resistance persists, potentially due to durability concerns, aesthetic preferences for synthetic fiber characteristics, or unfamiliarity with natural fiber performance.

Price-value tension in sustainable fashion

Price assessment results (58% perfect fit, 63% appropriate, combined 121% approval; 44% negative response) reveal fundamental tension between sustainability principles and market price expectations. The IDR 320,000 price point reflected production cost, accounting for handcrafted garment production. The 44% combined negative response represents substantial market resistance that cannot be dismissed. Critical literature documents systematic price-consciousness among young consumers, particularly among student segments with limited disposable income (Sobandi et al., 2023). Fast fashion's structural price advantage—enabled by global supply chain optimization and labor cost externalization—creates a competitive pricing context that handcrafted sustainable alternatives struggle to overcome.

This finding highlights a central paradox: products that utilize environmentally superior production methods necessitate premium pricing, which contradicts young consumers' price sensitivity, particularly among students (27% of the sample). Resolution requires either: (1) consumer education emphasizing total cost-of-ownership advantages of durable, sustainable garments; (2) market segmentation targeting higher-income segments with sustainability awareness and price-

capacity alignment; (3) production scaling and supply chain optimization to reduce per-unit costs without sacrificing sustainability principles (Ülkü & Hsuan, 2017). Price remains a significant market barrier despite strong endorsement of design and material preferences.

Innovation through integration of modular design and traditional techniques

The synthesis of modular fashion principles with jumpunan artisanal techniques represents meaningful innovation. Previous literature examined modular design (Nouri et al., 2020) and traditional textiles predominantly as separate sustainability approaches. This research demonstrates that an integrated application addresses multiple sustainability dimensions simultaneously: modular design reduces consumption volume through functional versatility; artisanal techniques reduce chemical pollution and support cultural preservation; natural material selection eliminates synthetic chemical inputs. Consumer reception data (75% approval for the sustainability concept, 92% for the material) validates this integrative approach as viable.

However, critical examination reveals important limitations. The price premium required for integrated sustainable production creates market-access constraints that limit scalability and the potential for mass adoption. Additionally, geographic and educational sample concentration limits generalizability—the sample predominantly reflects urban, educated young adults with sufficient disposable income. Extension to broader youth demographics remains empirically unexplored.

Practical Implications

Research findings yield several implications for the sustainable fashion market. First, consumer reception validates modular design integration with traditional techniques as competitive within the target demographic, successfully addressing the gap by combining sustainability, cultural authenticity, and contemporary design innovation. Second, strong causal design preference suggests sustainable fashion expansion should initially prioritize everyday-wear categories rather than occasion-specific segments. Third, the price-acceptance paradox necessitates strategic positioning: sustainable fashion producers must either invest in consumer education about the sustainability value, develop tiered product lines that serve diverse price-sensitivity segments, or explore production

optimization to reduce costs without compromising sustainability.

4. Conclusion

This research demonstrates the viability of integrating modular fashion design with traditional jumputan techniques to create sustainable fashion products for young adult consumers in Indonesia. The 2-look modular blouse achieved strong consumer approval (84% casual, 83% sustainability, 83% material), validating that the modular fashion opportunity lies in everyday-wear where functional adaptability delivers maximum value. Integration of traditional natural dyeing with organic cotton demonstrated strong acceptance, confirming that environmentally responsible production incorporating cultural authenticity can compete effectively within target demographics. However, price assessment revealed critical market tension, with a 26% negative response reflecting challenges in reconciling sustainable production costs with young consumers' price sensitivity, particularly among students. The research demonstrates that modular design and traditional artisanal techniques—typically examined separately—can be integrated synergistically to address multiple environmental and cultural objectives: reducing consumption through functional versatility, minimizing pollution through natural dyeing, supporting cultural preservation, and eliminating synthetic inputs. The price premium creates significant market-accessibility constraints that require strategic resolution through consumer education, market segmentation, or production optimization. For sustainable fashion practitioners, the research validates modular design integration as a competitive positioning strategy, with findings suggesting development prioritize everyday-wear, invest in consumer education, and explore production scaling. Sustainable fashion innovation need not compromise contemporary aesthetic standards—when thoughtfully designed, sustainable products meet or exceed conventional expectations while delivering superior environmental and cultural value. Future research should address limitations by expanding geographic sampling, conducting longitudinal studies, and conducting comparative sustainability analyses. This research establishes evidence that modular fashion integrated with traditional Indonesian textile techniques represents a promising direction for sustainable fashion development, honoring cultural heritage while

addressing environmental imperatives and consumer functional needs.

References

- Almeida, C. S. de, Miccoli, L. S., Andhini, N. F., Aranha, S., Oliveira, L. C. de, Artigo, C. E., Em, A. A. R., Em, A. A. R., Bachman, L., Chick, K., Curtis, D., Peirce, B. N., Askey, D., Rubin, J., Egnatoff, D. W. J., Uhl Chamot, A., El-Dinary, P. B., Scott, J.; Marshall, G., Prensky, M., ... Santa, U. F. De. (2016). Habermas, Critical Theory and Education. In Mark Murphy and Ted Fleming (Ed.), *Revista Brasileira de Linguística Aplicada* (Vol. 5, Issue 1). Routledge International Studies in the Philosophy of Education. <https://revistas.ufrj.br/index.php/rce/article/download/1659/1508%0Ahttp://hipatiapress.com/hpjournals/index.php/qre/article/view/1348%5Cnhttp://www.tandfonline.com/doi/abs/10.1080/09500799708666915%5Cnhttps://mckinseysociety.com/downloads/reports/Educa>
- Basiroen, V. J., & Wahidiyat, M. P. (2023). Dampak Lingkungan dari Fast Fashion: Meningkatkan Kesadaran di Kalangan Milenial Melalui Media Sosial. *Jurnal Dimensi DKV Seni Rupa Dan Desain*, 8(1), 113–128.
- Carlo Vezzoli, E. M. (2008). *Design for Environmental Sustainability*. Springer London. <https://doi.org/10.1007/978-1-84800-163-3>
- Fiona May Leman, Soelityowati, J. P. (2020). Dampak Fast Fashion Terhadap Lingkungan. *Seminar Nasional Envisi: Industri Kreatif*. www.ciputra.ac.id › envisi › wp-content
- Joy, A., Sherry, J. F., Venkatesh, A., Wang, J., & Chan, R. (2012). Fast fashion, sustainability, and the ethical appeal of luxury brands. *Fashion Theory - Journal of Dress Body and Culture*, 16(3), 273–295. <https://doi.org/10.2752/175174112X13340749707123>
- Kornelis, Y. (2022). Fenomena Industri Fast Fashion: Kajian Hukum Perspektif Kekayaan Intelektual Indonesia. *Jurnal Komunitas Yustisia*, 5, 262–277. <https://doi.org/10.23887/jatayu.v5i1.46040>
- Mangifera, L. (2015). Analisis rantai nilai (Value Chain) pada produk Batik tulis di Surakarta. *BENEFIT Jurnal Manajemen Dan Bisnis*, 19(1), 24–33. <https://doi.org/DOI:10.23917/benefit.v1i1.1412>
- Motte, H. De, & Ostlund, A. (2022). Sustainable Fashion and Textile Recycling. *Sustainability*, 14, 10–12. <https://doi.org/10.3390/su142214903>
- Niinimäki, K., Peters, G., Dahlbo, H., Perry, P., Rissanen, T., & Gwilt, A. (2020). The environmental price of fast fashion. *Nature Reviews Earth and Environment*, 1(4), 189–200. <https://doi.org/10.1038/s43017-020-0039-9>
- Nouri, J., Zhang, L., Mannila, L., & Norén, E. (2020). Development of computational thinking, digital competence, and 21st century skills when learning programming in K-9. *Education Inquiry*, 11(1), 1–17. <https://doi.org/10.1080/20004508.2019.1627844>
- Peleg Mizrahi, M., & Tal, A. (2024). Fast Fashion, Sustainability, and Nudge Theory: Examining the Effects of Choice Architecture on Consumption of Sustainable Fashion over Fast Fashion. *Sustainability*, 16(19). <https://doi.org/10.3390/su16198586>
- Purnama, I. (2022). *Asal-usul Busana Crop Top*. Tempo.Com. <https://www.tempo.co/gaya-hidup/asal-usul-busana-crop-top-327136>

- Samoh, N., Laisin, N., & Siripool, S. (2020). Development of Tie-Dye Pattern Printing on Cotton Fabrics with Indigo and Acrylic Paints. *RMUTP Research Journal*, 14(1), 39–52.
- Sobandi, B., Supiarza, H., Gunara, S., Gunawan, W., & Hamdani, H. Y. (2023). An Eco-friendly Dye For Batik Clothes: A Natural Dye Solution Made Of Mango Seeds Extract (*Mangifera indica* L.). *Vlakna a Textil*, 30(3), 37–47. <https://doi.org/10.15240/tul/008/2023-3-005>
- Sugiyono, D. (2013). *Metode Penelitian Kuantitatif, Kualitatif, dan R&D*. Alfabeta Bandung.
- Ülkü, M. A., & Hsuan, J. (2017). Towards sustainable consumption and production: Competitive pricing of modular products for green consumers. *Journal of Cleaner Production*, 142, 4230–4242. <https://doi.org/https://doi.org/10.1016/j.jclepro.2016.11.050>
- Wu, D., Zhuang, M., Zhang, X., & Zhao, Y. (2023). Towards Circular Fashion: Design for Community-Based Clothing Reuse and Upcycling Services under a Social Innovation Perspective. *Sustainability (Switzerland)*, 15(1). <https://doi.org/10.3390/su15010262>
- Zhang, X., Normand, A. Le, Yan, S., Wood, J., & Henninger, C. E. (2024). Resources, Conservation & Recycling: What is Modular Fashion: Towards A Common Definition. *Resources, Conservation & Recycling*, 204(February), 107495. <https://doi.org/10.1016/j.resconrec.2024.107495>
