ASSESSMENT OF USER DEMOCRATIZATION IN 2D TO 3D GARMENT

ASSEMBLAGE

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A Dissertation

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The Faculty of the Graduate School

At the University of Missouri-Columbia

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In Partial Fulfillment

of the Requirements for the Degree

Doctor of Philosophy

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by

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The undersigned, appointed by the dean of the Graduate School, have examined the

dissertation entitled

ASSESSMENT OF USER DEMOCRATIZATION IN 2D TO 3D GARMENT

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A candidate for the degree of Doctor of Philosophy,

And hereby certify that, in their opinion, it is worthy of acceptance.

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ABSTRACT

This research study aimed to explore strategies for transformable clothing design to engage consumers in the design process, in turn, establish an awareness of sustainable fashion. The first goal of this design research was to create a 2D to 3D apparel design process that places agency in the hands of the user. The 2D to 3D apparel design in this research study was related to the transition of a 2D flat textile into a 3D garment. Therefore, the second goal of this research study was to evaluate the sense of control and connection between a user and a transformable garment. The primary purpose of this process was to investigate whether this involvement was tied to prolonged clothing lifespan. To achieve this goal, this study used the participatory design research method. The information received from the participatory design stage was combined with the researcher's tacit knowledge and the information found in literature about specific design strategies for a 2D to a 3D process to develop the final designs. This study's findings support the underlying argument of democratization, which suggests that design democratization is achieved when designers involve consumers in the final stages of the garment-making process. Democratization can provide the users with a simple hands-on activity and a sense of satisfaction

Chapter 1: Introduction

Waste has long been an issue in the fashion industry. Stall-Meadows and Goudeau (2012) describe textile waste as "unwanted textile and apparel" which is discarded in the garbage (no pagination). In other words, it regards 'unnecessary solid waste', noting that 'every ounce of household clothing and textile items can be recycled in some way' (Stall-Meadows & Goudeau, 2012, no pagination). Each year, the fashion industry generates about "13 kilograms of fashion waste" per every person around the world (*The Issues: Waste*, 2018). According to the U.S. Environmental Protection Agency (EPA), "The main source of textiles in municipal solid waste (MSW) is discarded clothing" ("*Textiles: material-specific Data," n.d.*). Both consumers and the clothing and textile industry are responsible for this significant amount of waste. "The average consumer now buys 400 percent more clothing than 20 years ago" (*The Issues: Waste*, 2018). One of the main reasons for this overconsumption is the existence of fast fashion as an ongoing trend. "In today's fast fashion culture, people dispose of clothes faster and more frequently than ever" (Brewster & Hawley, 2014, p. 1).

Fast fashion, an energy-intensive process, generates waste in each stage of the clothing life cycle, and in the long run causes potential environmental and occupational hazards (Claudio, 2007). "Fast fashion" _the clothing equivalent of fast food_ is the result of globalization and the production of clothing at a lower price. Prices are so low it tempts consumers to purchase, and they then consider the clothing disposable (Claudio, 2007). Compounding this problem is the fact that apparel consumers when purchasing fast fashion, may use an item only once or perhaps not even at all (Laitala et al., 2018).

This increases textile waste that then ends up in landfills with no effective waste management system for recycling.

Poor waste management from the textile industry is not the only reason for this overabundance of textile waste, the lack of consumer awareness also plays a crucial part in causing waste. In fact, "fewer than one percent of garments are recycled into new clothing each year, and only 20 percent of textiles are recycled at all" (*The Issues: Waste*, 2018). Brewster and Hawley (2014) mentioned that consumers "trash clothing when they no longer know of a use for it" (p. 2). Textile items are being trashed and end up in landfills because the majority of consumers/users do not have information and "do not know what else to do with them" (Brewster & Hawley, 2014; Norum, 2017). Therefore, it is critical to this study that the researcher explores how the consumer/users' lack of awareness related to the overabundance of textile waste, impacts their overall consumption of fashion and how long they own fashion before disposal. In this dissertation, the terms consumer and user are being used interchangeably as it refers to individuals who both purchase and ultimately use the product (Olivia, 2011).

In fact, understanding the consumer/users' relationship to their consumption and disposal of fashion will allow for a more detailed understanding of sustainable design practices that may increase the lifespan of garments and minimize the environmental impact. "The length of the period of clothing use is usually referred to as clothing lifespan or lifetime and often expressed in years, or sometimes number of wears, or number of washes" (Laitala et. al, 2018, p. 11). The lifespan of a garment is not only determined by its physical strength and material. Nor is it determined by the low quality of a product or its being out of fashion (Morais & Montagna, 2015). But emotional and

aesthetics considerations also play a crucial part (Laitala et al., 2018, p.14). In fact, one of the main reasons that a user discards his/her garment is the lack of a relationship with the clothing. Therefore, the lifespan of garments is also contingent on how they are appreciated and included in the user's wardrobes. By establishing a relationship with clothing, consumers may be more likely to keep their garments.

Further, many factors can influence the appreciation a user has for a garment. Self-made garments, in comparison to purchased ones, generally have more value associated with attachment for users. Consequently, appreciation of clothing can be improved by user involvement in the design and making process (Hirscher, 2013). Forming positive memories of making and building self-identity are two outcomes from the interactions a user experiences with a product (Hirscher, 2013). The time spent during these interactions with the product is a key to creating a story for the owner. This relationship means that the more a user interacts with the product, the stronger the user's emotional bond with the product will be (Hirscher, 2013). Therefore, objects designed for a longer user engagement are developed to create a sense of ownership and emotional bond.

Moreover, engaging the user in the design and making process builds a sense of democratization for the user. In general, democratization speaks about empowering consumers to have the same design opportunity as designers have (Björgvinsson, Ehn, & Hillgren, 2010; von Hippel, 2005). Democratization of design may offer a deeper insight into the production process, and consequently, develop a changed user attitude towards consumption. This approach questions the status quo of the fashion designer by encouraging transparency as well as democratizing knowledge and information (Hirscher,

2013). Scholars have approached the democratization of design in a variety of ways to make customers more connected with clothing and to raise awareness of sustainability in the apparel industry. When consumers are engaged in the design/production process, they will build a stronger emotional bond with the product, so they will keep the product longer (Cramer, 2011; Diefenbach, Jung, Diller, Franze, & Maciejczyk, 2018; Teichmann, Scholl-Grissemann, & Stokburger-Sauer, 2016). Also, by engaging in this process their awareness of sustainability will be increased (Cramer, 2011).

To achieve increased user awareness of sustainability, this research study will explore, the transformable clothing design to study how this approach supports long-term ownership of the garment. Transformable clothing design is one form of democratization of design by providing the user the possibility of being engaged with the transformation process of the garment's silhouette: a process which supports users' creative contributions (Aflatoony, 2019). As researchers stated, one of the main benefits of this approach is to positively influence consumer behavior towards sustainability by satisfying their need for change and decreasing their need to buy many garments (Koo et al., 2014; Lang & Wei, 2019). The main feature of the transformable garment is to change into multifunctional pieces and have "changeable design functions" (Koo et al. 2014; Morais & Montagna, 2015).

One of the positive results of transformable apparel is the possibility of creating an emotional bond between the consumer and the transformable apparel. This aspect which refers to the hedonic design or emotional design creates emotional values in objects because of their "association to memories, experiences, values, aspirations, people or places" (Orth et al., 2018, p. 102). The ways we spend time with our

possessions, the positive interactions, and memories we have with a product, as well as the greater level of excitement a product provides, these create a story in our minds. And hedonic design explains that the greater the story, excitement, and cheerfulness in consumers the stronger their emotional bonds will be (Chitturi et al., 2008). Therefore, this study aims to explore design strategies that expand the lifespan of a garment so that consumers will continue to use the garment and not prematurely discard the garment.

Purpose of the Study

This research aims to explore strategies for transformable clothing design to engage consumers in the design process, in turn, establish an emotional bond to build the awareness of sustainable fashion. The first goal of this design research is to create a 2D to a 3D apparel design process that places the agency in the hands of the user. The 2D to 3D apparel design in this research relates to the transition of the 2D flat textile into a 3D garment. This falls under the category of transformable clothing design as this dimensional transformation changes the capacity of the textile from a 2D form to a 3D garment by the user input (Aflatoony, 2019). A crucial goal of the design process is to create a series of transformable garments with embedded guidelines, like a map, integrated into the surface design. To that end, a 2D form of the garment as a flat textile will provide a suitable stage for including these guidelines. These guidelines will be intended to assist users in constructing their garment shape variations and deciding how to use different and connected parts in choosing multiple ways to wear the garment (Aflatoony, 2019). Therefore, a second goal is to evaluate the sense of control and connection between a user and a transformable garment. It is hoped that users will create a connection to these garments through their ability to make changes and as a result

personalize them. The primary purpose of this process is to investigate whether this involvement ties to prolonged clothing lifespan (longevity).

This study is based on the participatory design research method. This involves users as "co-designers" and empowers them to generate and develop ideas themselves (Constantine, 2004). Consequently, this study is not only nurtured by the researcher's design development ideas but is also fed by focus group input (participatory design research) conducted prior to the final design product development. The information received from the participatory design stage is combined with the researcher's tacit knowledge as well as the information found in literature about specific design strategies for a 2D to a 3D process to reach the final designs.

Democratization, the theory that guides this project, is that designers need to move away from ownership of the entire process to bring the non-designer/user into the creative process (McQuillan et al., 2018). It is hoped that this design strategy will help the wearer gain a greater connection and sense of ownership of the design process. If so, this should result in a sustainable approach leading to increased product longevity.

Although the main design choices and creative process in this research are conducted by the researcher/designer, democratization occurs by giving the user the ability to manipulate the final garment to various forms from a flat shape to a 3D style. A focus group will provide input into the garment designs and ease of the 2D to 3D process before design development. Users could create a connection to these garments through their own ability to make changes and thus to personalize them. Therefore, this study has three main objectives:

1. Obtain the users' points of view and preferences regarding the design strategy to empower them to contribute to the final garment assembly procedure without a need to have technical skills such as patternmaking and sewing.

2. Design and construct a series of 2D to 3D garments with guidelines for assembly included directly into the surface of the 2D design.

3. Gather final user group's opinions and feedback regarding the designed prototypes to evaluate the sense of control and connection between a user and a transformable garment as well as to obtain feedback about their ability to follow garments' guidelines.

Importance of the Study

This study has three main areas of importance: (1) it provides innovative design solutions of user engagement in making process for consumers/users with limited or no prior garment making knowledge; (2) this study considers user-friendly design strategies and details which guide users through the clothing assembly process with a minimum of difficulty; and (3) this study stimulates consumer awareness of sustainable fashion by engaging them in the clothing assembly process.

According to a recent study, only around 12% of Americans know how to tailor clothing (*Home Improvement: 32% of Americans Lack Basic Household Skills*, 2019). Therefore, the researcher will select participants who have limited or no skill in professional garment construction such as patternmaking and sewing. These users will represent regular consumers because most consumers don't have this basic household task and very few studies have investigated the relationship between users with limited or

no skill in apparel production and their feelings toward completing a transformable garment without requiring any garment construction techniques.

Further, studies have shown that women attract a source of happiness and a positive sense of well-being by sewing their clothing (Martindale and McKinney, 2020). However, the reality is most apparel consumers do not have enough skills or knowledge of making garments. While including users with no construction knowledge may be challenging because there might be a lack of willingness of learning the new task, and frustration surrounding technical issues such as fit and lack of ability to troubleshoot these technical issues. The benefit of including neophyte designers in this study has the potential to create a stronger connection with the garment.

Moreover, this study considers user-friendly design strategies and details which guide users through the clothing assembly process with a minimum of difficulty. McQuillan et.al. (2018) used digital textile printing to create what they defined as a "way-showing system," but found in initial testing that extensive instructions were needed for inexperienced users (McQuillan et al., 2018). Another researcher also suggested that overly complicated designs must be avoided due to hindering the positive experience and positive attachment. Positive feelings of happiness and satisfaction must continuously be present during the process of making (Hirscher, 2013). Certainly, including an assembling guideline into a 3D design requires good communication of structure with meaningful information for the user.

According to Don Norman (2013), a signifier as a communication tool assists the user to find out where action should take place. He emphasized this as one of five fundamental psychological concepts required for a product to gain a discoverability

feature (Norman, 2013). According to Norman (2013), "when we interact with a product, we need to figure out how to work it. This means discovering what it does, how it works, and what operations are possible: discoverability" (p. 10). Therefore, this research investigates ways of design communication techniques to simply lead the non-skilled user throughout this process without creating confusion. This design strategy aims to incorporate discoverability in 2D surface to assist users to assemble their 3D garment.

Finally, this study stimulates consumer awareness of sustainable fashion by engaging them in the clothing assembly process. One of the positive and possible results of involving consumers in the process of transforming the 2D textile to the 3D garment is to trigger their sense of engagement and to create the emotional bond between the consumer and the product. The transformable clothing design in this study aims to provide a positive memory and excitement for the consumers by improving the hedonic features of the garment. This emotional bond between the consumer and the product will result in more sustainable use of apparel as it will be kept for longer.

Research Questions

The scope of this project is to evaluate the sense of control and connection between the user and the transformable garment. Therefore, four main questions guide this research process:

RQ1: How does a hands-on experience shift the roles of users with limited/no clothing making skills from passive consumers to active users?

RQ2: How are design challenges alleviated during the transformable garment design process?

RQ3: What values can be generated by garment changing activities without using professional garment construction techniques?

RQ4: How does transformable garment design impact users/consumers' perception/attitudes towards sustainable fashion?

Chapter 2: Literature Review

Fashion Product Lifecycle and Fashion Consumers

The apparel industry causes considerable environmental and resource depletion problems throughout the production process and during the clothing life cycle (Morais & Montagna, 2015; Gam & Banning, 2011). Fast fashion as, an ineffective production model and a "rubbish generator", creates "over-consumption" (Morais & Montagna, 2015). "If the fashion industry continues on its current path, it will produce 26% of the world's carbon footprint by 2050" (Morgan, 2020). The constant change in trends and availability of cheap disposable clothing caused by the readiness of the supply chain to respond quickly to this system generates a customer desire for frequent change and never-ending consumption (Delong et al., 2013). This phenomenon was a motivational factor for many fashion designers to practice sustainability in design and production (Gam & Banning, 2011). Researchers and designers have studied various design strategies aimed at affecting positively the consumers' behaviors and slowing down this trend of over-consumption over the course of many years.

Industry Practices of Sustainability

"The length of the period of clothing use is usually referred to as clothing lifespan or lifetime and often expressed in years, or sometimes number of wears, or number of washes" (Laitala et. al, 2018, p. 11). According to researchers, the four crucial design aspects that increase clothing lifecycle are: (1) technical quality such as selection of material and finishing to provide durability; (2) improved clothing features such as fit, versatility of use and appearance to augment the use satisfaction; (3) services such as amending, styling, stain decoration, body scanning, together with educating in sewing

and altering; and (4) the design of communication systems among the users as well as clothing designers and producers (Laitala, Boks, and Klepp, 2015).

Currently, some fashion companies are incorporating these practices to increase the clothing lifespan with varying degrees of success. Gurova and Morozova (2018) point out designer interpretations of sustainable fashion focused on fashion production which is slow in the production cycle and reasonable in terms of quantity to respond only to the current demand. To stimulate a prolonged use of clothing, sustainable fashion "utilizes eco-friendly and quality materials, yet it is not cheap." (Gurova & Morozova, 2018). For example, H&M "is moving away from its fast fashion roots with the Conscious collection, made of materials like organic cotton and recycled polyester. By using eco-friendly fabrics and more sustainable production methods, the company hopes to reduce its environmental footprint" (Morgan, 2020). "Customers can also recycle unwanted garments at H&M stores and get a discount for a future purchase. H&M has a goal to use only sustainably sourced materials by 2030" (Morgan, 2020).

The concept of sustainable fashion includes decelerating the pace of fashion as a strategy among designers to create alternatives to fast fashion, extending the life cycle of clothes, augmenting the value of timeless garments, diminishing the quantity of waste, and consequently, decreasing the amount of damage to the environment (Gurova & Morozova, 2018). Beyond all the practices, educating consumers about these strategies has a major role in employing sustainability in fashion (Gurova & Morozova, 2018). From a system thinking perspective, sustainable practices in fashion must be accepted and implemented by all sectors from design, retail, and manufacturing, to consumers (Delong et al., 2013). Therefore, any of these sectors which adopt a particular sustainable

strategy must work with other sectors collaboratively to make sure those sectors benefit from it as well.

Scholars have found several benefits that result from the practice of sustainable fashion. The first positive impact is the way sustainable fashion may alter consumption behavior as well as contribute to increasing the clothing life cycle. "Sustainable fashion creates and supports a discourse that could influence consumer patterns and habits and create opportunities for consumers to be more eco-friendly" (Gurova & Morozova, 2018, p. 410). Sustainable design strategies which augment the interaction between the consumer and a product "improve empathy between product and a potential consumer", consequently, reducing some negative impacts in the life cycle of fashion products (Morais & Montagna, 2015). According to researchers, "The engaging of consumers to invest time and effort in addition to the monetary cost in design" could potentially increase awareness in sustainability, ameliorating local uniqueness, and augmenting "emotional attachment" which results in prolonging the clothing life cycle (Delong et al., 2013, p. 64). Researchers suggest maximizing the future basic wardrobe through more personalized products that are "able to be transformed in multifunctional pieces" (Morais & Montagna, 2015, p. 5818). These transformable garments will be kept for much longer than conventional ones and will not be disposed of easily (Morais & Montagna, 2015).

Another positive impact of practicing sustainability is social. The social impact is felt in "the role of small-scale entrepreneurs in supporting the economy in times of austerity and the role of clothing designers in the life of the local community" (Gurova & Morozova, 2018, p. 410). Sustainable fashion companies such as local small entrepreneurs, support the economy of the local community by creating jobs "especially

for young people and provides opportunities for new products on the market" (Gurova & Morozova, 2018, p. 410). Local small-scale sustainable businesses could not compete financially with giant mass-production overseas, however, their products offer design distinctiveness related to local lifestyles which allows them to remain successful (Delong et al., 2013).

Consumer's Roles in Fashion Sustainability

Consumers have a crucial role in reducing the textile waste and overconsumption. Shifting the industry towards more sustainable products and changing their unsustainable nature, can have a long-term result only if consumers support it by purchasing more sustainable fashion (Mcneill & Moore, 2015). "Increasingly, customers want to have a positive impact on the environment. Research shows that 88% of consumers want brands to help them be more environmentally friendly" (Morgan, 2020). McNeill and Moore (2015) suggest that "fashion consumers' attitudes toward sustainability in their fashion purchasing is determined by their general level of concern for social and environmental well-being, their preconceptions toward sustainable fashion and their prior behavior in relation to ethical consumption actions" (p. 220). Consumers' awareness of sustainability as well as their contribution in sustainable use of fashion items play a crucial role in reducing excessive waste.

Increase consumers' awareness of sustainability. In recent years, as many consumers have begun to seek awareness of the source of their clothes, many top fashion designers and apparel companies have embarked on sustainable fashion design (Top 13 Sustainable, n.d.). These designers include Stella McCartney, Sandra Sandor, Eileen Fisher, Vivienne Westwood, Mara Hoffman, Rag & Bone, John Patrick, and Hillary

Taymour (Top 13 Sustainable, n.d.). As an example, "every aspect of Eileen Fisher's design and manufacturing process is built to be as sustainable and eco-friendly as possible, from the materials used to the ethical treatment of the workers who sew the pieces" (Morgan, 2020). The company also "buys back used items to recycle into new garments or turn into art if the clothing can't be resold" (Morgan, 2020). Another example is Everlane, who "mixes sustainability with transparency by sharing with customers the exact breakdown of the cost of each item and showing the factories where garments are made" (Morgan, 2020). Other companies like Patagonia "not only use sustainable materials in its outerwear, but it also helps customers repair their clothing instead of buying new items" (Morgan, 2020). "Because the products are so durable, customers are encouraged to recycle old Patagonia gear and purchase items second hand" (Morgan, 2020).

Although sustainable fashion companies in recent years want to inform consumers about their services and products, the level of consumer awareness "about sustainability is still an unknown" (Saricam et al., 2017, p. 1). According to Turunen and Halme (2021), "There is growing information about sustainability and growing consumer awareness about these issues, but none of these are readily translating into action" (p. 1). They explained that information provided to consumers regarding sustainability issues is often insufficient and inapplicable. Perez and Lonsdale (2018) indicate that "there is little awareness particularly among young adults on the issues of fashion sustainability" (p. 115) and there is a need for educating consumers about how to use, care, and dispose of fashion products to minimize the overall planet fashion waste (Perez & Lonsdale, 2018). Similarly, according to a study conducted in Turkey with 336 participants, determined the

level of awareness consumers have about sustainable fashion was not so high. Based on this result, "the perception of sustainability is mostly limited to some aspects of sustainable fashion such as "usage of organic materials" and "recycling"" (Saricam et al., 2017, p. 1). Also, Perez and Lonsdale (2018) affirmed that when it comes to sustainable or ethical consumption, many consumers assume that these types of products are either second-hand or could be found in thrift shops. "Related to the negative opinions around second-hand clothing were the views of some participants that sustainably produced fashion items would not look good" (p. 219).

Therefore, consumers must be informed accurately regarding sustainable products (Mcneill & Moore, 2015; Perez & Lonsdale, 2018). Sustainable products should be better advertised and presented on mass and social media to lessen the lack of knowledge towards them and break the existing consumption habits among consumers (Perez & Lonsdale, 2018). "Better awareness of sustainable products in relation to their quality and fashion would reduce some barriers to uptake amongst more hesitant consumers" (Mcneill & Moore, 2015, p. 219).

However, mass and social media are not the only way to communicate effectively with consumers. Perez and Lonsdale (2018) found out that educating consumers could occur "through information and garment label design solutions using innovative communication strategies" as well (P. 115). According to their study, garment labels with QR printed codes linked to an online source provide product information as well as affirming that the product is original and legitimate. Also, Turunen and Halme (2021), suggested these alternative methods of communication with consumers could "offer consumers simple yet comprehensive information about the environmental and human

rights impacts of products with a view to supporting their decision-making processes" (Turunen & Halme, 2021, p. 2). Providing simple and comprehensive information regarding products' sustainability features, not only helps with the consumers' communication but also creates an opportunity for sustainable companies to provide transparent information regarding their sustainable products (Turunen & Halme, 2021).

Şener, Bişkin, and Kılınç (2019) investigated the relationship between increasing consumers' awareness of sustainability and their value perception and purchasing behaviors towards slow fashion among 725 students pursuing higher education (Şener et al., 2019). According to the result of this study, "perceived customer value positively affects the intention to purchase slow fashion and willingness to pay higher prices than other products" (Şener et al., 2019, p. 1555). Sustainable fashion consumers who are aware of the environmental and personal benefits of these types of products continue to purchase these items for several reasons.

According to Lundblad and Davis (2015), longer lasting and higher quality attributes of clothing, which are two features of sustainable apparel, make them more worthy to purchase in consumers' opinion. These two features of fashion items attract consumers due to "benefits of buying less in the long run" (Lundblad and Davis, 2015, p. 154). Therefore, "regular consumers of sustainable fashion see long-lasting benefits of switching to sustainable brands. Although products cost more, the quality, durability and wearability are higher than for high street brands" (p. 154). As a result, "people are motivated to buy sustainable fashion because of value-in-use benefits such as less buying and value for money in the long run" (Lundblad and Davis, 2015, p. 155).

Another feature of sustainable garments which drives consumers to purchase is the link between natural materials in sustainable fashion and fewer health problems for consumers. Natural materials such as bamboo, hemp and organic cotton cause less harm to the skin due to decreased use of pesticides and chemicals throughout their production (Lundblad and Davis, 2015). Another major purchase motivation for many consumers is due to their goal in addressing environmental issues. Values such as "responsibility" and "protect the planet" are two main motivational factors for consumers to change their consumption habits (Lundblad and Davis, 2015, p. 156).

Increase consumers' emotional bonds with garments. "Garments, while sold as a product, are lived as a process, and their durability depends on the way they are appreciated and included in the user's wardrobes" (Laitala et. al, 2018, p. 14). To increase the lifespan of a product, designers must adopt strategies to make them both "enjoyable" and "useful" to increase the level of attachment (Laitala et al., 2015, p. 103). However, there is no global measure of enjoyability, and this directly relates to the subjects' view of the world and their experiences. As an example, Vallgårda, Boer, and Cahill (2017) examined a "wearable device that plays different vibrations on the body as a form of music for the skin" (p. 17). The result of testing their device on different participants indicates that not everyone enjoys the experience at the same level and a level of enjoyment may take longer to develop (Vallgårda et al., 2017). Therefore, when designing a product to provide an enjoyable experience for users, selecting a target market with the same interests and demographic background is crucial.

Designers can enable product attachments to "emerge through using specific design style, aesthetic and quality related attributes, as well as improved functionality"

(Laitala et al., 2015, p. 103). Regarding the quality materials, "using physical strength as the only indicator for lifetime of a garment disregards the fact that life span is also determined by social, emotional, and aesthetic factors" (Laitala, Klepp, & Henry, 2018, p. 14). In terms of reducing consumption, "the type of possession" and the "attitude" of the owner towards their clothes matters most (Alexander & Ussher, 2012, p. 74). For example, in one study evaluating the simple lifestyle and sustainable consumption attitudes, participants emphasized the pleasure resulting from things they had made, repaired, or purchased second-hand (Alexander & Ussher, 2012).

Although, handcraft apparel is overlooked in favor of mass-produced apparel products, it provides a significant chance to promote sustainable fashion consumption (Lee, & DeLong, 2017, p. 68). Researchers found that handcrafted items have a longer period of use in comparison with purchased items, therefore, they are considered more sustainable (Lee, & DeLong, 2017). Customers reported that handcraft apparel items are used "over 5 years", "forever", "until too small" or "until worn out" (Lee, & DeLong, 2017, p. 73). Although not all apparel consumers are able to make, repair, or handcraft fashion products, creating a design system for empowering those consumers to have a greater contribution in apparel construction would augment their sense of involvement and emotional bond with their product.

Researchers found that the creative contribution of customers which is motivated by simplicity fulfills the apparel consumer's demand for novelty and variation. (Ruppert-Stroescu, LeHew, Connell, & Armstrong, 2015). These researchers merged concepts of creativity and sustainability to investigate if the expressions of creativity as a form of sustainable consumption could slow-down the addition of new clothes in the wardrobe of

consumers in a study called "Fashion Detox" for 10 weeks. (Ruppert-Stroescu et. al, 2015, p. 168). They found out by limiting fashion apparel users' acquisitions, consumers shifted from purchasing new items to adopt do-it-yourself strategies such as "sewing new garments from fabrics they already owned, upcycling old clothes, or repairing garments in their possession" (Ruppert-Stroescu et. al, 2015, p. 176). The result of this study shows limiting fashion consumers' acquisition, prompts them to work more with their hands, to become craftier, and this process ultimately awakens their creativity. Therefore, the creative contribution of consumers could reduce the amount of clothing added to their wardrobe and consequently promote sustainable consumption.

By involving consumers who have limited or zero knowledge of garment making into the construction process of apparel products, the current research aims to gain more knowledge and better understanding regarding the creation of the emotional bond between consumers and apparel products. Through involvement in the construction of their garments, consumers would be able to develop a greater appreciation for what they are making. That appreciation will lead to establishing an emotional bond, and that emotional bond will result in a garment that is not thrown away but treasured for a longer period to achieve sustainable goals.

Theoretical Framework

The theoretical framework of this study introduces and describes the importance of democratization in design and the reasons of user involvement in the making process. Two other subjects that used in this theoretical framework are hedonic features and sustainable design. This section is an overview of the literature on the meaning and

purpose of democratization in the design field, sustainable design, hedonic design, and the conceptual model which relates these three subjects together.

Democratization

In general, democratization speaks about empowering consumers to have the same design opportunity as designers have (Björgvinsson, Ehn, & Hillgren, 2010; von Hippel, 2005). As the goal of this research is to involve consumers in garment assemblage and allow them to shape their garments from 2D surface to 3D form, knowing the concept of democratization helps to design and guide this research appropriately. However, the purpose of this research is not to assume and expect consumers to design and create like professional designers as democratization defines, but it rather tries to give them the skills to be able to be involved in a way that is satisfying for them.

Democratization of design is mostly interpreted as the distribution of the innovation and in simple words implies sharing the design resources and production tools with consumers so that they are enabled to design as well as professional designers do (Björgvinsson, Ehn, & Hillgren, 2010; von Hippel, 2005). One of the aspects of democratization described by von Hippel (2005) is the democratization of the opportunity to create. He suggested that when the high-quality resources required for innovation and prototyping become widely available and affordable, the possibility for creating becomes democratized. The growth of communication means, and computer advancements requires the user's involvement as an essential complement to innovate new industrial products (von Hippel, 2005). One of the examples for this type of democratization is the availability of open-source software that allows users to use, create, project, and innovate

(von Hippel, 2005). As he explained, open-source software regards to those that users can "legally download from the internet and legally modify to serve their own specific needs" (von Hippel, 2005, P. 13). One example of those software is sophisticated CAD design tools for hardware and electronics (von Hippel, 2005).

According to Eric von Hippel (2005), both corporations and individual consumers, as users of products and services, are progressively able to innovate for themselves and help the innovation to be more democratized. The benefit of a user-centric innovation over manufacturer-centric innovation is that the innovation done by users is developed based on their exact desire to get precisely what they want which helps them not to rely on manufacturers as their representatives (von Hippel, 2005). According to von Hippel (2005), to give the opportunity of innovation and design to users, manufacturers have three general possibilities:

Producing User-Developed Products. Involves mass-produced user-developed innovations for sale and/or custom manufacturing to specific users. For doing so, often manufacturers combine different innovative ideas developed by lead users to gain competitive advantages (von Hippel, 2005, p. 127). The definition of a lead user will be explained in section 2.2.6.

Supplying Toolkits and/or Platform Products to Users. To ease users' innovation-related process, sell kits of product-design tools, and/or "product platforms". The kit of professional design tools assists users to develop their innovative ideas effectively and professionally (von Hippel, 2005, p. 128).

Providing Complementary Products or Services. Involves selling products or services that fulfill user-developed innovations. Adopting one or a combination of those

strategies by manufacturers could integrate their process into a user-centered innovation system. Complementary products and services could benefit both user innovations and manufacturers as the former use them to develop their product modifications and the latter supply them at a profit (von Hippel, 2005, p. 130).

In terms of the second possibility, Thomke and von Hippel (2002) explained that the users' tool kits must have four fundamental features: First, they must empower people to complete and progress their design by iteration and self-learning. Second, they must be user-friendly. They should not force users to struggle and learn a completely new design language. Third, tool kit components must be pre-tested to make sure consumers do not face the difficulty and are not forced to invent any required tools. Fourth, users must be informed about the potential points and limitations of the production process to make sure the current design is reproducible for the future manufacturing process (Thomke & von Hippel, 2002).

Therefore, these tool kits available to users must be as good as those available to professional designers. Users by having professional tools in their hands reduce the gap between the elegant design in mind and the outcome prototype. Some of these tools for fields ranging from software to electronics to musical composition enable users with very little training to design new products and services, and music and art, at an acceptable professional level. In some cases which include designing a physical product, user-innovators could benefit from computer simulation tools to create a design and run performance testing (von Hippel, 2005).

Having design tool kits per se doesn't make a non-designer capable of designing. In other words, to be fully successful in the design process a consumer needs to be

equipped with design knowledge as well. Therefore, design democratization is not limited to providing users the design tool kits. In this regard, scholars affirmed that teaching design thinking to non-designers is a powerful strategy to democratize innovation and empower users to have the same opportunity to design and innovate as well (Liedtka, Salzman, & Azer, 2017). As Liedtka et al. (2017) mentioned, "Non-designers need significant structure to feel comfortable and competent using design thinking; fear is the biggest impediment to their success" (p. 49). Often, non-designers due to having the fear of failure, lacking creative confidence, and having the anxiety of the design process believe that there is merely one right solution to prove to be true (Liedtka et al., 2017). Therefore, researchers suggest that design thinking can enable users to be comfortable with the process iterations, manage and minimize risks, and have no fear of failure.

Democratization in the Field of Textile and Apparel Design

By involving consumers in the creative process, design, and/or construction of a garment, the emotional bond between the consumer and the product will be stronger and consequently, they will tend to keep the garment for a longer period (Cramer, 2011; Diefenbach, Jung, Diller, Franze, & Maciejczyk, 2018; Teichmann, Scholl-Grissemann, & Stokburger-Sauer, 2016). Cramer (2011) suggests that involving consumers in the design and construction process has two potential results: first giving consumers a voice in design, second encouraging consumers' consumption behavior towards a more sustainable one. He affirmed:

> Offering the user, the opportunity to take part in an object's design, allows them to invest something of themselves in it. The intimate connection this establishes between the user and the object is likely to result in the item being retained for longer, keeping it out of the landfill and postponing the purchase of its

replacement. Designing for longevity therefore is as much about designing emotional durability, as it is physical durability. To this end, open design promises considerable potential for a more sustainable future of fashion. (Cramer, 2011, p. 437)

Although engaging consumers in the design and construction process is an effective strategy to lead them towards a more sustainable consumption behavior, their technical capabilities must be considered. As Cramer (2011) stated "to be successful in this model of producing fashion, the designer must (or should) consider the capabilities of the user, as they are likely to have limited skills and to be easily put off by even a reasonable degree of complexity" (p. 442). Therefore, for successfully involving users in the design or construction process the complexity of this process must be considered.

McQuillan et al. (2018) in their study of *Make/Use: A System for Open Source, User-Modifiable, Zero Waste Fashion Practice* developed and examined an "embedded navigational system by which users can formulate a functional understanding of the form and construction of a garment and its opportunities for manipulation" (p. 7). They defined the "User Modifiable Waste Fashion" (UMZWF) as "garments that can be made and modified by users, with no fabric waste" (p. 8). They explained that to "move from a technocratic to a democratic model of design, the notion of creativity must be explored from the perspective of the user" (McQuillan et al., p. 12). According to this study, producing a custom garment following a variety of construction possibilities by users gave them a "creative agency" (p. 9).

However, the result from the first phase of this study revealed that "unassisted non-expert" users found it difficult to construct the garment appropriately (p. 9). As the researchers stated, "contrary to the aim of placing creative agency back into the hands of

clothing users, this reinforced the perception of ZWF (Zero Waste Fashion) as technocratic" (p. 27). This result confirms the statement of Cramer (2011) about considering the design and technical capabilities when an attempt to involve them in the design or construction process.

Hedonic Design

The concept of hedonic design is used to attract consumers to a product with aesthetic features which is understandable and enjoyable for a group of people with a common sense of reference (Vallgårda et al., 2017). Hedonism in Merriam Webster (2020) is defined as "the doctrine that pleasure or happiness is the sole or chief good in life." Therefore, hedonism in simple words means obtaining enjoyable experiences (Vallgårda et al., 2017). Scholars suggest that by offering higher levels of hedonic benefits, designers and marketers enhance a greater level of excitement, delight, and cheerfulness in consumers. Chitturi et al. found increased customer delight resulted from improved hedonics and positively impacted the customers' loyalty (Chitturi et al., 2008). However, improving the utilitarian benefits of a product such as functionality needs, and expectations also enhance the consumer's satisfaction, but not the excitement and cheerfulness (Chitturi et al., 2008). Not just the product itself, but scholars found out that consumers who pursue products with hedonic attributes also search for a fun, enjoyable, and delightful shopping experience as well (J. Li et al., 2020).

Norman (2004) in his book *Emotional Design: Why we Love (or Hate) Everyday Things*, emphasized the importance of aesthetics in product design. He explained that attractive products associate with people's good feelings and creative thinking. He also described the positive effect of products that are fun and enjoyable; "someone who is

relaxed, happy, in a pleasant mood, is more creative, more able to overlook and cope with minor problems with a device especially if it's fun to work with" (p. 26). To grasp this concept, Norman (2004) compared the emotional design with the strategy that is used commonly in brainstorming sessions: "in brainstorming sessions, it is common to warm up by telling jokes and playing games. Good brainstorming and unusual, creative thinking require the relaxed state induced by positive affect" (p. 27). Creating a pleasant mood and positive effect are part of the hedonic attributes of products which according to Norman (2004) like warming up in brainstorming sessions helps consumers to better communicate and work with the product.

According to Wrigley (2013), the user's emotional satisfaction such as excitement and cheerfulness results from the interaction between the user and a product that is designed to stimulate the user's emotional feelings. However, the emotional response to each product varies from one user to another because of their different backgrounds, knowledge, environment, and culture (Wrigley, 2013). As Norman (2004) stated, "One person's acceptance is another one's rejection. Worse, what is appealing at one moment may not be at another" (p. 33). Other researchers also asserted that the enjoyableness of a product greatly depends on the point of view of the subject who experiences it (Vallgårda et al., 2017). Similarly, Orth et al. (2018) affirmed that "objects are often assigned emotional value for their associations to memories, experiences, values, aspirations, people or places" (p. 102). Therefore, Wrigley (2013) proposes that products that share the same attributes to trigger the users' emotional feeling must be designed and offered to the specific group of target market who share the same experience and background related to that design message. She also highlights the importance of influential outside

variables such as "cost, time to market, brand identity or style, internal organizational communication issues, and resources" and their impact on designers' works. She mentioned, "All of these influences moderate the effectiveness of the consequent design in transmitting its intended messages" (p. 89). According to these statements, different factors must be taken into consideration to both creating a strong design dialogue as well as having a consumer understanding of that design.

Correspondingly, regarding what type of attributes make an experience enjoyable, we need to investigate two main factors. According to Vallgårda et al. (2017), one is the culturally based values that affect our sensations and perceptions of aesthetics. This implies that our previous experiences in social contexts impact directly our appreciation of beauty. Another factor relates to our "relatively similar bodies and sensory systems" that influence our common evaluations from a hedonic point of view (Vallgårda et al., 2017, p. 19). These two factors explain why products are judged and experienced differently by one person to another. Therefore, the authors explained that to create a product that is understandable and enjoyable for a group of people with a "common sense of reference" first the vocabulary of experiences of that group must be developed and then reflected upon to create a design (Vallgårda et al., 2017, p. 19). One of the research questions in this study asks, "What types of values (i.e., enjoyment, creativity, versatility, or ease of use) can be generated by garment changing activities such as altering the garment's silhouette or overall look without using professional garment construction techniques?". As one of the key values in this research question is "enjoyment", it is important to study which garment features provokes this feeling among consumers.

Sustainable Design

In general, designs that ensure reduction in environmental impact are considered sustainable designs (Delong et al., 2013). Based on environmental ethics, designers must consider the values of sustainable fashion, the consequences of their design practices on the environment, and industrial manufacturing procedures required to achieve their design decisions (Niinimäki, 2015). Some of the design practices lead to unsustainable consumption patterns, therefore, it is worthwhile for the fashion industry to focus on modifying underlying beliefs that lead to unsustainable practices (Niinimäki, 2015).

According to scholars, designers who wish to generate a sustainable design should also implement strategies to motivate consumers to adopt sustainable consumption (Delong et al., 2013; Stegall, 2006). Designing and manufacturing a sustainable product doesn't automatically guarantee that it will be truly sustainable unless consumers are responsible for returning and recycling it at the end of its life as well (Stegall, 2006). When designers consciously design a product that promotes positive and responsible social behavior it plays a crucial role in moving toward an ecologically sustainable society (Stegall, 2006).

There is a wide range of sustainable design practices, including designing a long-lasting product for the reduction of waste, designing for longevity, and generating a new desirable product from clothing that is no longer in use (Delong et al., 2013). Understanding the consumer's essential needs of appearance change or emotional experience, also, can lead to products that incorporate those values in new sustainable fashion practices (Niinimäki, 2015). According to scholars, the life span of a product closely relates to how much it is appreciated by the consumer and consequently how much it creates an emotional attachment for the consumer (Delong et al., 2013).

Generating a desirable product that embraces multiple values for a customer as well as creating an item of clothing that consumer finds ways to entrench their personality into it are examples of some design strategies that designers could follow to increase the emotional attachment between the customer and clothing (Delong et al., 2013).

There are various design terms and approaches that contribute to the sustainable use of clothing. These include "slow fashion", "upcycling", "trashion", "zero waste", "minimalism", and "fashion activism". "Slow fashion" as a reaction to fast fashion refers to fashion grounded upon small-scale production, traditional craft techniques, local resources, and local markets (Trejo et al., 2019; Gurova & Morozova, 2018; Delong et al., 2013). Utilizing local resources such as agriculture and design besides encouraging a sustainable model of production, leads to a greater community economic development as well as creating networks to support local farmers and designers (Trejo et al., 2019).

"Upcycling" is one variation of recycling, with the goal of reduction of waste and the reuse of material. Designers in this method, by using creativity, add design ideas to the old garment to create a new one (Gurova & Morozova, 2018; Armstrong et al., 2015). Another form of upcycling is sometimes called "Trashion" which derives from combining "trash" and "fashion" and refers to using creative thinking to produce garments from used materials such as left-over fabrics which are in fashion (Gurova & Morozova, 2018). In "zero waste" designers must either avoid any leftovers or put any leftovers back into the production cycle (Gurova & Morozova, 2018). Another form of the "zero waste" concept is to use biodegradable fabrics which do not cause damage to the environment by returning to the soil (Gurova & Morozova, 2018). "Minimalism" or voluntary simplicity regards the notion of great functionality and comfort in clothing with

less attention to aesthetic aspects. Clothes that satisfy customers in both functionality and comfort should generate less desire for change and therefore as little as possible shopping for new ones (Delong et al., 2013).

Scholars suggest that the key to long-lasting and successful sustainability is also to pay attention to the aesthetic needs of consumers (Delong et al., 2013). "Fashion activism" is a concept that includes a variety of design methods to raise awareness of sustainability issues in the fashion industry and for the consumer. This strategy helps the consumer to gain new skills and become his/her own designer and maker, consequently, develop a greater appreciation towards his/her products as well as the production process (Hirscher, 2013). Therefore, the main concept behind fashion activism is to adopt an approach to empower the consumer with the appropriate knowledge and information to change their role from passive user to an "active and independent individual" (Hirscher, 2013). As researchers affirmed, the process of making creates a strong emotional value which results in a greater product attachment. This would be possible by offering uniqueness in design that helps the consumer to build self-identity and form memories of making (Hirscher, 2013). Examples of fashion activism include co-design, modular clothing, do-it-yourself clothes, participatory fashion workshops, and halfway products.

Sustainable Design Challenges. Designers, to practice sustainable design, face several challenges. One of the major challenges of sustainable fashion is that designers mostly must teach and educate themselves. Self-teaching methods in the area of sustainable production require time and energy as well as repetition. Thus, according to Gurova & Morozova (2018), designers must be proactive in self-educating. Other researchers stressed the challenge of creating more work hours for designers could lead to

the drain of environmental resources indirectly by over-consuming resources including electricity or research development materials (Gam & Banning, 2011).

Therefore, it would be beneficial that each designer shares the knowledge gained in this process with other members of the design community to contribute to the body of knowledge and to reduce the exploring time for the next designer who practices the same method (Gurova & Morozova, 2018). The authors of this study used undergraduate fashion design students as their study participants and suggested the statement based on the result of one recycling design project which each of them accomplished. Therefore, the suggested result might be true, but it cannot be generalized to the whole fashion industry population.

Another problem that challenges sustainability in the designer's practice is the need for constant educating consumers in this regard: consumers who understand and like the idea of sustainability then could support designers financially by choosing their products (Gurova & Morozova, 2018). The fact that other types of products such as mass-produced ones are trendier and often heavily discounted makes it so challenging for the apparel businesses to get consumers to pay attention to sustainability and to motivate them to purchase sustainable products (Delong et al., 2013). As social media has a major role in educating consumers and introducing sustainable fashion to the public (Gurova & Morozova, 2018), it could greatly contribute to sustainability awareness by educating customers and promoting sustainable practice (Delong et al., 2013).

Sustainable design strategies which rely on consumers' participation in the process of making such as do-it-yourself clothing or participatory design solutions, also, are challenging in practice. Researchers found out that getting consumers to participate in

the process of making is not always easy because participation in some of these processes requires extensive technical capabilities such as construction knowledge (Armstrong et al., 2015). Besides this issue, the time required to make a garment as well as practical issues such as having to have sewing equipment are other challenges that consumers face (Armstrong et al., 2015).

Another challenge relates to using upcycling or recycling methods as well as renewable materials. Using upcycling or recycling methods in sustainable fashion is challenging regarding the limitation of available same-type leftover material among recycled clothing and textile second-hand sources. Consequently, many sustainable designers who follow these methods often are coerced to change their initial design to fit their design into the available fabrics in hand (Gam & Banning, 2011). Moreover, the use of renewable materials such as organic fabrics. These types of materials create two major issues for designers: First, organic materials are more costly than conventional fabrics. Second, Organic and renewable fabrics often are limited to few color choices. In case of a second issue caused by lack of variety of color choices, designers sometimes attempt to dye their fabrics with natural dyes which do not always result in the exact previous color after multiple sessions (Gam & Banning, 2011).

This study also used fashion design students as participants who tried to source organic fabrics via online websites as renewable materials for their single project. Thus, this result might not be generalizable for fashion businesses. We must consider the fact that there may be more variety of fabrics for businesses who try to source products and need to order in enough quantity to make it possible. Monetary issues such as concerns about costs of sustainable practice and profitability are another challenge that hampers

the path to convert to more sustainable practices in the apparel industry (Delong et al., 2013).

Conceptual Model of this Study

The conceptual model provides information regarding subjects presented in this chapter and their relationship. The conceptual model is divided into two main areas: theoretical framework, and current practice. The theoretical framework is indicated in blue color and the current practice in yellow. The designers' role, lead-users' role and the consumers' role are divided into these two main groups. Designers as well as lead-users are responsible for providing democratization, implementing of hedonic design, and creating a sustainable design (figure 1). The consumers' role, on the other hand, is to follow the guidelines provided by designers and lead users to assemble the product. The current practice has a hierarchical model in which lower levels are sorted under a hierarchy of successively higher-level unites and presents the process respectively from the top levels towards the lower levels.

According to theoretical framework, the purpose of design democratization is achieved when designers involve consumers in final part of the garment making process to give them a simple hands-on activity and a sense of satisfaction. As the consumers of this study will be selected from a group of non-skilled individuals, their tasks will not require having any professional or technical ability. For the same reason, designers create a complete 2D one-piece pattern with guidelines for consumers to follow and shape a 3D garment. Hedonistic features, transformable features, and discoverability features are included in garment designs by the designer to attract, engage, and guide the consumer during the garment assemblage process. Consumers by following the provided guidelines

will assemble the 2D surface and change its shape to a 3D garment form. The sense of satisfaction from having more than one way of assemblage as well as engaging in a hands-on activity creates an emotional bond between the consumer and their garment in their hand. As a result, consumers use and keep this garment for a longer time (figure 2).

Lead Users

Understanding the concept of a lead user has importance for this study as in the participatory design process and during the first part of the data collection lead users will participate in a focus group to help to develop design strategies for 2D to 3D garments. Knowing the characteristics of lead users helps the researchers in this study to find and select the potential users during the participant recruitment phase. Von Hippel (2005) mentioned, based on several empirical studies, from 10 percent to 40 percent_ attempt to create, amend, or change products. This high percentage of user involvement suggests that users are willing to engage in product development. Studies of innovating users identify these users based on their common traits and call them "lead users".

The development of products by lead users benefits both other users and manufacturers. Studies have shown many products innovated by lead users are appealing to other users too, and consequently, they are more commercially attractive (von Hippel, 2005). Lead users have two main characteristics: (1) They are reacting to the current market trend (s) and experiencing needs that later would be sense and experienced by many users; and (2) They may innovate things, essentially because of the anticipation of high benefits from acquisition a solution to their needs (von Hippel, 2005).

Von Hippel (2005) answers a very important question about which factors drive users to innovate rather than buy. Even though some users are willing and able to pay for

the development of their exactly right products, why they prefer to innovate rather than buy also knowing that manufacturers are specialized and equipped to build custom products for individual users? The answer goes back to two main concepts: (1) Innovating their custom products themselves, reduces the cost of agency for both user firms and individual user-innovators; and (2) The nature of the innovation process brings about enjoyment for users (von Hippel, 2005). Enjoyment or learning are the main factors that motivate user-innovators to innovate rather than buy. According to von Hippel (2005), these individuals are like puzzle solvers that would prefer to work hard to solve a puzzle rather than receive a completed puzzle, therefore, problem-solving has more value for them than the solution (p. 7). Therefore, users who are usually problem-solvers, prefer to innovate or modify their products and enjoy the process of innovation is ideal to participate in the design process of this research.

Özkil (2017), conducted an empirical study to investigate "how designs concurrently evolve through the large and complex network of designers" in 3D design and collaborative platforms (Özkil, 2017). One of the main results of this study confirmed that "only a small portion of the users are designers" (Özkil, 2017, p. 66). According to the result of his study, most publicly available designs from the "Thingaverse" derive from a rather small quantity of designers. This concludes with the notion that those designers must be identified as lead users (Özkil, 2017). Also, he found that a "better understanding of collective design platforms can help design practitioners to identify lead users in their respective domains" (Özkil, 2017, p. 66). Although in this study they couldn't find out if these lead users had previous formal training or expertise,

however, they realized that this group of users had "the ability to frame design solutions, that are not shown by novice users" (p. 84)

Similarly, according to Morris and Ashdown (2018), one of the main issues for involving users in the apparel product development process is to make sure users engaged with this process are qualified and able to make a significant contribution in the process. This type of user is called lead users (LUs) who "have the potential to develop innovative and commercially attractive products in other markets" (Morris & Ashdown, 2018, p. 180). Morris and Ashdown (2018) mentioned, if apparel professionals could find a method to identify characteristics of LUs, they could benefit from inviting LUs and asking them to participate in the apparel product development process (Morris & Ashdown, 2018). According to researchers, three known LU characteristics include "leading-edge status (LES), high expectation of benefits, and technical expertise (TE)". They identified two unknown LU characteristics as "intrinsic motivation (IM) and collaborative orientation (CO)" (Morris & Ashdown, 2018, p. 181).

Morris and Ashdown (2018), to classify project effective collaborators (LUs) conducted a study following three sequential stage processes: (1) develop a measure to separate LUs from NLUs; (2) confirm the characteristics which were recognized during the first stage; and (3) examine to see if users with LU characteristics through physical prototypes could develop concepts which meet users' needs (Morris & Ashdown, 2018). According to the result of this study, to separate LUs from NLUs, researchers found a significant relationship between LU and IM. As they mentioned, "when studying LUs, IM should be included as a characteristic of LUs" (Morris & Ashdown, 2018, p. 195).

On the contrary, CO shouldn't be considered as a measure for identifying LUs.

Researchers also found LUs with high leading-edge status (LES) and intrinsic motivation

(IM) traits are capable of developing concept which will be accepted by peers of the same

user group(Morris & Ashdown, 2018). In this matter, during the participant recruitment

for the focus group in this study, two LES and IM traits will be considered as potential

characteristics of participants.

Figure 2.1.

Conceptual model of this study: theoretical framework
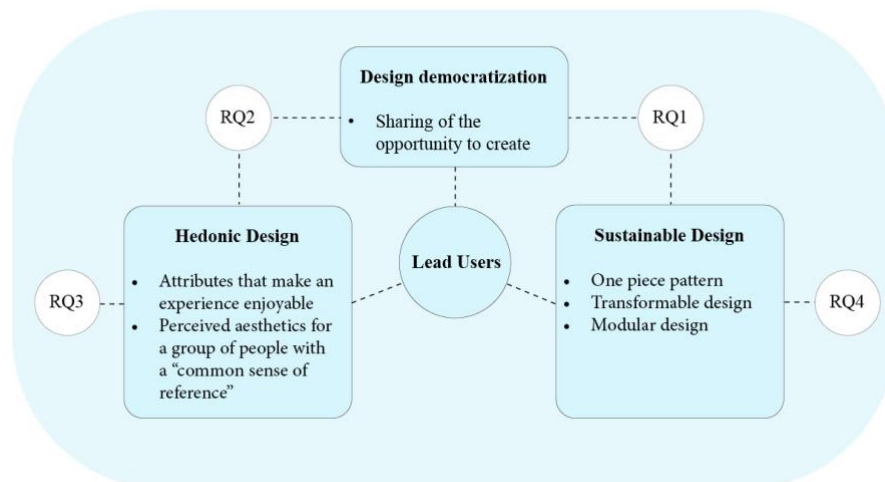
Two Dimensional (2D) to Three Dimensional (3D) shapes in Apparel Design

The concept of 2D (two-dimensional) to 3D (three-dimensional) and vice versa is

used in apparel creative scholarship and in general, refers to the transition of the 2D flat

textile into a 3D garment. For example, McQuillan et al. (2018) in their study of

Make/Use explored a system for open source, user-modifiable, zero waste fashion

practice to involve users in the construction of a garment. In their study, they used 2D as

the zero-waste garment patterns printed into the textile and 3D as the garment form (McQuillan et al., 2018). Thus, by saying 2D to 3D they suggested a user engagement system to use digitally printed patterns on fabrics (2D) and following "embedded navigational systems" to complete the final garment (3D) (McQuillan et al., 2018, p.7).

In another example of 2D to 3D transformation, researchers explored the process of articulation and exchanging the knowledge gained in 2D/3D design among different disciplines (Townsend et al., 2003). The focus of their group's research focus was on the "potential new design relationships and strategies that can be devised by exploring 2-dimensional textile design and 3-dimensional garment shaping techniques in conjunction with new technologies and sustainable concepts" (Townsend et al., 2003, p. 1). Therefore, in this example like the previous one, the term 2D refers to flat surface design such as digitally printed and embroidered fabric _as they stated "innovative surface imagery" _ and the term 3D refers to garment shape or three-dimensional prototypes.

On the contrary, another study explored a 3D shape to the 2D one (Zhang, Innami, Kim, & Takatera 2015). In this study, researchers investigated a 3-dimensional pattern-making method in which patterns are developed for virtual garment models made from a scanned mannequin with a computerized pattern-making system (J. Zhang et al., 2015). After obtaining a 3D garment model of a jacket and designing the patterns directly on the virtual mannequin, they converted the 3D-shaped patterns into 2D patterns using the 3D pattern-making system as a tool (J. Zhang et al., 2015).

Therefore, in this study, 3D to 2D shapes regarded as virtual 3D patternmaking and converting it to 2D flat patterns in the computer-aided program (J. Zhang et al., 2015). Similar to this example, another study explored the 3D to 2D conversion in

pattern-making using computer-aided pattern-making technology (Liu, Zeng, Bruniaux, Tao, Yao, Li, & Wang, 2018). Their process involved 3D adjustment of a garment, smoothing folds and wrinkles, adding design requirements, construction lines, and drawing curves on the surface of the 3D garment to obtain tiny surfaces, and finally obtaining 2D patterns by unfolding all the 3D faces (Liu et al., 2018). Hence, the meaning of 3D to 2D in this study as well implies the conversion of the 3D garment to 2D garment patterns. By using two examples of each form (2D to 3D and vice versa) the dimensional transformation relates to changing the capacity of an object from one form to another. Following in this section, meanings, and some samples of design scholarships in 2D or 3D shapes will be explored.

Figure 2.2.

Current practice
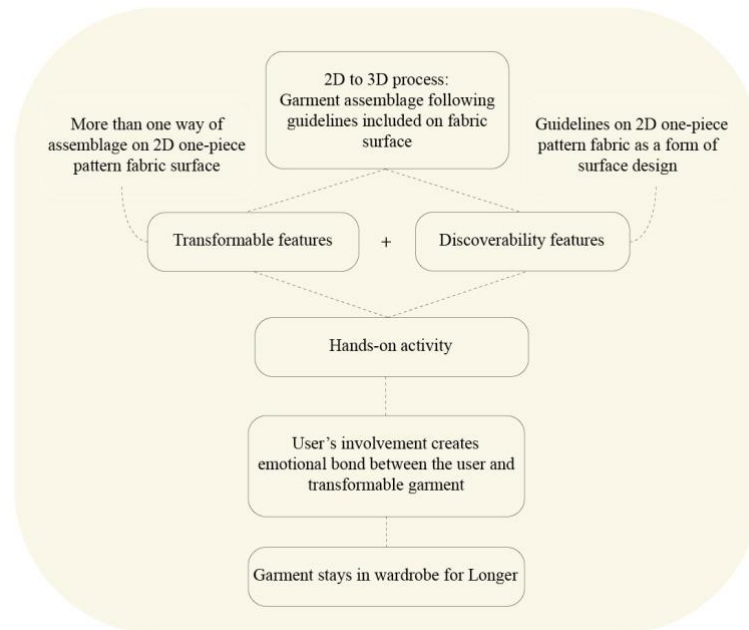
Single/Minimal Pattern Piece Design

One of the design methods which shows the transformation from two-dimensional to three-dimensional forms is the single/minimal-pattern-piece-design which is considered as a sustainable pattern cut technique applied by fashion designers. A one-piece pattern cutting method reduces the manufacturing and pattern cutting by minimizing the number of seams (Cumming & Weaver, 2019; Parsons, 2015). Another benefit of this pattern design development is to create an uninterrupted surface for print and smart/technical textile inclusion such as thermal regulation, moisture management, and wearable technology (Cumming & Weaver, 2019). One-piece pattern designs assist with reducing the fabric waste as well (Cumming & Weaver, 2019). Parsons (2015) in her study of *Historical Patents as Inspiration for Digital Textile and Apparel Design* analyzed the historical patent patterns of coats and jackets "designed to be cut from a single pattern piece" in the United States (p. 281). According to the researcher, one-piece patterns investigated in this study "allowed large expanses of cloth for surface design, especially for creation of engineered digital prints on a single canvas and opened up avenues for creative experimentation" (Parsons, 2015, p. 280).

Cumming and Weaver (2019) investigated a pattern process in one piece cutting for a contoured garment designed for activewear as an alternative method to conventional activewear designs which exclusively rely on high-performance fabrics. In this method, they improved qualities of fit, comfort, and movement by designing patterns with fewer seams. They also repositioned seams and grainline in strategic parts of the body to support body movement and stability needs for the specific sportive activity (Cumming & Weaver, 2019).

Another goal of their research was to reduce the gap between high fashion and activewear by creating athleisure which meets both recreational lifestyle and fashion expectation of active individuals (Cumming & Weaver, 2019). To reach this objective, the directional grainlines of the fabric were placed on curved body lines by draping directly on the live body to observe the fabric behavior using low stretch woven fabric (Cumming & Weaver, 2019). As they mentioned "These provide the garment with defined areas of flexibility and stability for a body in motion and the close fit suppression is removed through the refining of the curved seam lines" (Cumming & Weaver, 2019, p. 264).

For this research, they created an activewear jacket, a hooded jacket, a cape sleeve body, a racerback body, and a crop top (figure 3). The qualitative wear testing at the end of this study indicated that this pattern design method improves the quality of fit, comfort, and movement. As well as the fitting and movement aspects, researchers regarding minimal fabric waste mentioned, "with these advancements one-piece pattern shapes could aid the process of complete garment technology by creating the garment to shape and negating the aspect of fabric waste" (p. 270).

Figure 2.3.

Retrieved from: Cumming, D., & Weaver, N. (2019)
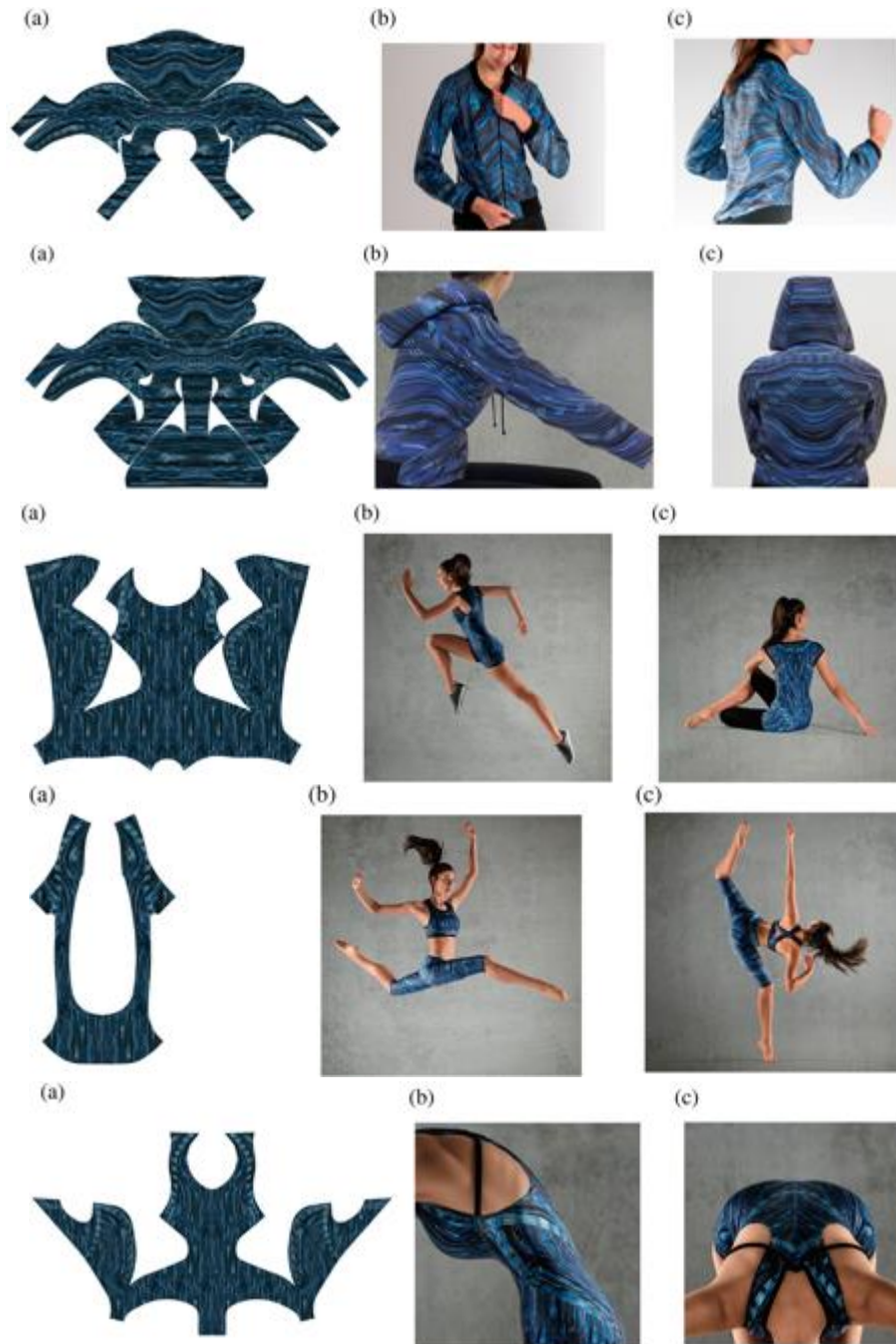
Similarly, Lindqvist (2014), through reverse engineering and design recovery of

the French costume designer Geneviève Sevin-Doering works investigated and proposed

a model for cutting and draping on live models from one piece fabric (Lindqvist, 2014).

His pattern-cutting method was based on a qualitative approximation of the body

"visualized through balance lines and key biomechanical points" (Lindqvist, 2014, p. 1).

They call it a qualitative method of patternmaking and not a quantitative one because

unlike the flat pattern making which deals with numbers and exact measurements this

method emphasizes the cutting with approximation with the purpose of simplifying the

cutting and design process (Lindqvist, 2014). The researcher's experimentations on

sculpturing a single piece of fabric on the moving person resulted in completing a variety

of garments such as a formal jacket and pants from one-piece pattern shapes (figure 4).

The researcher mentioned that this system is proposed to use as a foundation of any type

of garment shape and not just a one-piece garment.

Figure 2.4.

Retrieved from: Lindqvist, R. (2014)
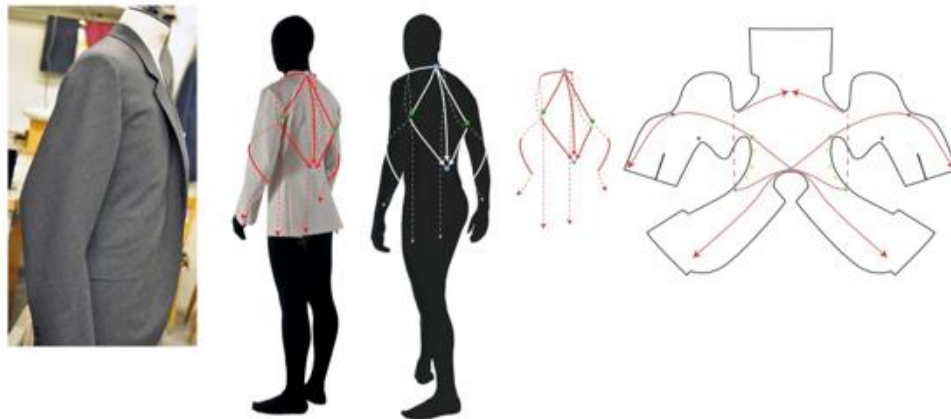
Also, Aflatoony (2019) designed a self-guided system on a 2D surface of a single

pattern piece with the purpose of assisting users in constructing their garment shape

variations (figure 5). As she stated, "similar to mass customization, this design

democratization may help the wearer to gain more connection and ownership of the design process and thus to the products they wear" (p. 1). The goal of the design was to create a 2D to 3D process that places the agency in the hands of the user.

Figure 2.5.

2D to 3D one-piece pattern cut garment (Aflatoony, 2019)

The design process of this project began with experimental ideas on half-scale dress-form. Before beginning draping on a dress form, variety of origami experiments in the form of parallel curves were tested with flat patternmaking method then transferred to the dress form to check the shape as well as to complete the rest of the garment with draping method. When draping of the garment was complete, patterns of each part were constructed, side panels were unified, and any open seam were joined together to form a complete one-piece pattern. Guidelines for the users to follow were drawn on the 2D garment and completed by both embroidery and laser-cut pieces (figure 6). However, as a preliminary project, these were not tested with actual users.

Figure 2.6.

One-piece pattern and guideline details (Aflatoony, 2019)

Transformable/Versatile Garments

An apparel item is transformable when it offers "two or more functional and/or alternative aesthetic styles through various manipulation methods" (Lang & Wei, 2019) Therefore, a transformable garment has modifiable design features (Koo et al., 2014). There are different types of transformability in apparel products. Koo, et al. (2014), based on the literature, proposed a conceptual framework for a transformable garment. According to this framework, transformable garments have the following modifiable features: change in color/pattern, change in size/fit, change in silhouette, change in garment type, and change in design details (Koo et al., 2014). This framework suggests the role of transformable garments in changing the paradigm of consumer behavior and therefore potentially leads to more sustainable consumption.

Lang & Wei (2019) designed a group of transformable garments with both changes in silhouette and changes in garment type and investigated the positive impact of it on consumers' desire for creative choice, environmental beliefs, environmental apparel

knowledge, and attitudes. They designed four groups of garments with detachable pieces by using eyelets and cords to apply the concept of transformational design (figure 7). "Each set of garments could be transformed into different styles by re-lacing the cord" (Lang & Wei, 2019). Participants in this study provided their feedbacks and willingness to purchase transformable garments after seeing the photos of each group of garments and reading a brief description of the transformability features of them. "The results of the structural equation estimation confirmed the positive influences of the tendency for creative choice, environmental beliefs, environmental apparel knowledge, and attitude on female college students' intention to purchase transformable apparel products" (Lang & Wei, 2019).

Figure 2.7.

Four groups of transformable garments (Lang & Wei, 2019)
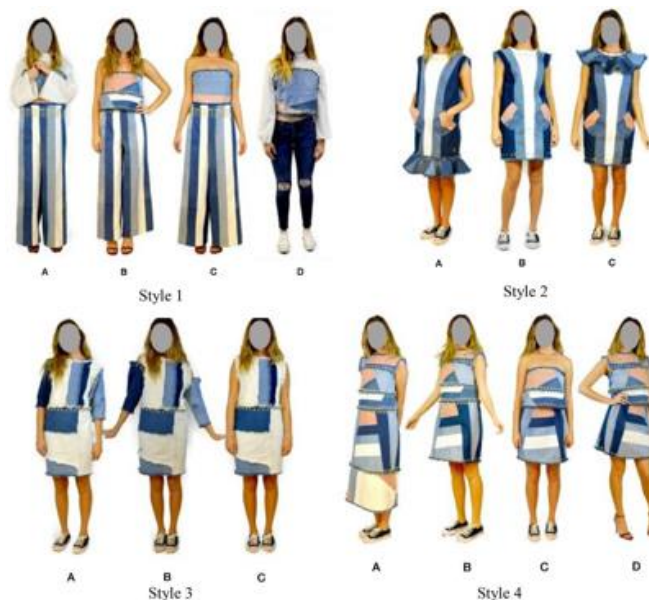
When designing a transformable garment, it is crucial to pay attention to the users' expectations. Designers who follow the strategy of shape-changing designs, as

well as knowledge of radical clothing construction, must consider and recognize the physical and psychological abilities of the end wearer (Morais & Montagna, 2015). According to Koo et al., (2014) who studied "design functions in transformable garments for sustainability" it is important to notice what kinds of modifiable features consumers request in transformable garments. They also suggest that it is important to notice which clothing item is more frequently used and therefore exists more than other clothing items in their wardrobe. Identifying the most frequent item and designing a transformable garment for that specific item helps to replace many items with one that covers all those features for the consumer. The research found that the most frequent item in consumers' wardrobes were tops, which occupy about one-half of the whole wardrobe and offer as means to adopt and transform (Koo et al., 2014).

When designing a transformable top, designers must pay attention to simplifying the process of transformation for consumers and provide enough easy-to-follow guidelines or affordances because having too many changeable features can easily overwhelm and confuse the consumer (Koo et al., 2014). Norman (2013) explained the term affordance as "a relationship between the properties of an object and the capabilities of the agent that determine just how the object could be used" (p. 11). Moreover, the hedonic expectation of a transformable garment is another feature to be considered by designers. According to Koo et al. (2014) transformable garments that are fun, easy to experiment with, and provide a satisfactory process for the consumer offer hedonic expectations.

One of the main benefits of transformable garments is to positively influence consumer behavior towards sustainability. The concept of sustainability for apparel might

be unknown for many consumers or they might have less concern about it. However, as Koo, et al. (2014) point out, "transformable garments have the potential to encourage them to engage in sustainable behavior without being fully aware that they are. Designers can support this behavior by encouraging consumers to consider versatile, transformable fashion that still satisfies their needs and wants" (Koo et al., 2014, p. 16). Similarly, Lang & Wei (2019) stated transformable apparel "is considered a sustainable alternative in the fashion industry to reduce excess clothing consumption" (p. 1).

Featuring great versatility of styles and different ways to wear items is an effective answer to the tiredness of basic wardrobe, as those types of clothing make it possible to construct different silhouettes and textures (Morais & Montagna, 2015). Transformable garments due to their nature of changing into multifunctional pieces are not easily disposed of by the consumer as they answer to their various functional and aesthetic needs (Morais & Montagna, 2015). "Transformable garments are expected to increase the wear rate, postpone disposal, and ultimately expand the garment life cycle as consumers repeatedly transform them" (Koo et al., 2014, p. 10).

Also, Aflatoony (2019) designed a versatile garment with guidelines intended to assist users in constructing their own garment shape variation. The goal of the design was to create a 2D to 3D process that places agency in the hands of the user. To achieve this purpose, different shapes which mirror each other are in different parts of the two-dimensional surface. As a 2D garment there is a gap between each two mirrored shapes. This gap will be concealed after connecting two shapes together to form the garment. This feature, like a puzzle, assists users to more easily find where the action takes place. The user task to assemble the garment is to find mirrored shapes, connect them, and

secure them with closures placed near each one. Towards this goal, a versatile garment has been designed so that if the user feels confused about the assembling process, the garment works in a different style. This versatility allows two different necklines, for instance (figure 8).

Figure 2.8.

2D to 3D versatile garment (Aflatoony, 2019)

Modular Apparel

Modular design is one variation on transformable garments. In this type of design, small components can be detached, used independently, or replaced with other components to form numerous combinations and styles (Koo et al., 2014). As Li, Chen, and Wang (2018) stated "Modular design makes the clothing no longer regarded as a complete product, but as a whole composed of multiple modules" (p. 27). Or as Chen and Lapolla (2021) stated "modular design features small standardized units that can be independently combined in various configurations to create different forms and provide multiple functions" (p. 39).

Modular garments are often designed with more ease like boxy style, therefore, researchers suggest that they can be studied with the purpose of providing more fitted clothing opportunities (Chen & Lapolla, 2021). Modular design can make clothing more interesting, provide the opportunity for consumer engagement in making choices, increase the change of clothing style, and extend the life cycle of the clothing (Li et al.2018). Li et al. (2018) summarized modular design into three main groups: component modular design, geometric modular design, and compounded modular design. Component modular design is defined as a design whose whole structure can break up into two or more pieces.

In this design, each part of the module has a specific function such as pockets, collars, or cuffs. The geometric modular design is slightly different from the previous category. The difference is that the modular design dismantles into geometric shapes such as triangles, quadrangles, or polygons and not into pieces with specific functionality. In this method, the modules, like Lego pieces, can replace each other. The third modular design, compounded design, is a middle zone between component modular design and geometric modular design. In this type of modular design "designers flexibly use different forms of modules to achieve the component module assembly" and combine both component modules and geometric modules in one garment (Li et al.2018, p. 31).

Chen and Lapolla (2021) explored techniques of geometric modular shapes and interlocking systems for the more fitted and aesthetically appealing garments using research through practice approach. They tested samples of modular shapes and interlocking units on half-scale dress forms before creating the final garments. As their initial interlocking units were flat and limited in shaping and contouring, the study

focused on two main practical questions: "How can the modules be modified to create (b) a fitted garment, and (c) sleeve construction?" (Chen & Lapolla, 2021, p. 46). In other stages, they investigated the efficient cutting tools and methods to reduce the overall weight of the garment. After analysis of the initial exploration, three common themes found: "(1) design processes became shorter as experience with the module designs increased, (2) sketches and digital drawings were important tools at the starting point of each data collection phase, and (3) functionality is essential when establishing new design techniques" (Chen & Lapolla, 2021, p. 50).

Discoverability

As part of this dissertation includes designing a collection of 2D to 3D transformable garments with guidelines for users to follow, having knowledge about how to make a discoverable design is essential. The focus of this section is to talk about the meaning and reason of incorporating discoverability in design. According to Donald Norman (2013), two of the essential traits of good design are discoverability and understanding. Although he explains these design principles in his book called "The Design of Everyday Things" mostly in the domain of industrial and interaction design, however, these values could be generalized into other fields of design such as fashion design. He mentioned that when designers want to incorporate discoverability in their design, they must ask a fundamental question: "Is it possible to even figure out what actions are possible and where and how to perform them?" (Norman, 2013, p. 3). He affirmed "design is concerned with how things work, and how they are controlled" (Norman, 2013, P. 5). When the design is done well, "the results are brilliant, pleasurable products. When done badly, the products are unusable, leading to great frustration and

irritation. Or they might be usable but force us to behave the way the product wishes rather than as we wish" (Norman, 2013, p. 5).

Norman (2013) describes that discoverability results from "an appropriate application of five fundamental psychological concepts: affordances, signifiers, constraints, mapping, and feedback" (p. 10). The term affordance regards "a relationship between the properties of an object and the capabilities of the agent that determine just how the object could possibly be used" (Norman, 2013, p. 11). If the affordance defines what type of actions are possible, signifiers "communicate where the action should take place" (Norman, 2013, p. 14). Therefore, the term signifier refers to "any mark or sound, any perceivable indicator that communicates appropriate behavior to a person" (Norman, 2013, P. 14). Mapping "is an important concept in the design and layout of controls and displays" (Norman, 2013, p. 21). Natural mappings follow the principles of perception and allow for the natural grouping or patterning of controls. These controls should be close to the item being controlled (Norman, 2013, p. 22). And finally, the feedback regards "some way of letting you know that the system is working on your request" (Norman, 2013, P. 23). Therefore, the concept of feedback is a way for "communicating the results of an action" (Norman, 2013, p. 23).

It is crucial to remember that not all these fundamental psychological concepts of discoverability explained by Norman (2013) are applicable in fashion design. For instance, the concept of feedback is more relevant for machines and electronic devices as he exemplified rather than a garment. Also, he mentioned that "poor feedback can be worse than no feedback at all because it is distracting, uninformative, and in many cases irritating and anxiety-provoking" (Norman, 2013, p. 23). Therefore, eliminating the

concept of feedback is possible, if the other concepts of discoverability were used appropriately to guide the user toward the functionality of a product.

Summary

In this chapter, the term sustainability in the fashion industry has been defined as procedures and actions followed by the industry that has a corporate social responsibility to sustain the environment without reducing it. However, the constant change of trends and availability of cheap disposable clothing caused by the readiness of the supply chain to respond quickly to this system generates a customer desire for frequent change and never-ending consumption, consequently, jeopardizing and reducing the environmental resources at a fast pace. This phenomenon was a motivational factor for many fashion designers to practice sustainability in design and production. To apply sustainability effectively, sustainable practices in fashion must be accepted and implemented by all sectors from design, retail, manufacturing, to consumers.

There is a wide range of sustainable design practices, including designing a long-lasting product for the reduction of waste, designing for longevity, and generating a new desirable product from clothing that is no longer in use. In this chapter, three sustainable garment design strategies as a form of 2D to 3D shapes have been explained: single/minimal pattern piece design, transformable/versatile garments, and modular design. 2D to 3D shapes, in general, refer to the transition of the 2-dimensional flat textile into a 3-dimensional garment. A single/minimal pattern piece design method refers to the reduction of pattern cutting by minimizing the number of seams. A transformable/versatile garment design refers to an apparel item that offers two or more functional and/or alternative aesthetic styles through various manipulation methods. And

finally, the modular design refers to an apparel item in which the small components can be detached, used independently, or replaced with other components to form numerous combinations and styles.

Chapter 3: Methodology

Chapter 3 contains the following sections: (a) qualitative approach; (b) participatory design research approach; (c) data collection; and (d) data analysis.

Research Objectives

This research aims to explore strategies for transformable clothing design to engage consumers in the design process and in turn, establish an emotional bond to build awareness of sustainable fashion. The transformable clothing in this research is a 2D to 3D apparel design that places agency in the hands of the user. A crucial goal of the design process is to create a series of garments with embedded guidelines, like a map, integrated into the surface design. These guidelines will assist users in constructing their garment shape variations, even when there are different and connected parts or multiple ways to wear the garment.

The practice of generating 2D to 3D transformable garments in this study is not only nurtured by the researcher's design development ideas but is also fed by participatory design research conducted prior to design development stage. In other words, the design and practice in this study are led with the information received from the focus group in the participatory design stage before the design development stage. The researcher then combines the information received from the prior stage with their tacit knowledge to reach the final designs. Review of the literature at the first stage will help acquire relevant information needed to develop designs.

The context that guides this project is that designers need to move away from ownership of the entire process to bring the non-designer/user into the creative process (McQuillan et al., 2018). This design strategy may help the wearer gain more connection

and ownership of the design process and thus to the products they wear. Such democratization of design, via a user-modified model, is a sustainable approach, as this increased sense of connection, is intended to lead to increased product longevity.

Although the main design choices and creative process in this research are conducted by the researcher/designer, democratization occurs by giving the user the ability to manipulate the final garment to various forms from a flat shape to a 3D style. A focus group will provide input into the garment designs and ease of the 2D to 3D process before design development. Users could create a connection to these garments through their own ability to make changes and thus to personalize them. Therefore, this study has three main objectives:

- It provides innovative design solutions through user engagement by providing a creation process for consumers/users with limited or no prior garment making knowledge.

- Considers user-friendly design strategies and details which guides users through the clothing assembly process with minimum of difficulty.

- Stimulates consumer awareness of sustainable fashion by engaging them in the clothing assembly process.

Methodological Approach

In this section, the aim is to provide an overview of different research methodologies and traditions that will be employed in this participatory design research to help the researcher with the process of gathering, analyzing, and interpreting data. The contextual review and description of some methods utilized in this chapter were

presented in chapter two. This chapter focuses on the application of those methods in detail.

The focus group in this investigation will be organized to gather firsthand data from skilled participants regarding possible design strategies which aim to empower potential users to contribute to the final garment assembly procedure. The researcher's technical skills and background experience in apparel design provide a knowledge base that supports designing and construction of the garment prototypes after collecting and analyzing data in the focus group.

In-depth interviews will take place at the end of this process to ask final users' opinions regarding the garment prototypes, to evaluate their ability to follow signifiers (Norman, 2013), and to assess the sense of control and connection between the users and prototypes. According to Norman (2013) signifiers "are signs and perceptible signals of what can be done" for communicating with users who "search for clues, for any sign that might help them cope and understand" the product's functionality (Norman, 2013, P. 14). At this stage, the final user group will be selected from less skilled individuals who are interested in the craft. Being interested in craft is an important criterion to make sure participants have interest as well as basic skills to work with transformable garments, to follow signifiers, and to change the shape of garments from 2D to 3D form.

Qualitative Research

Qualitative research is "an attempt to offer an alternative to a natural science model of the social sciences" (Karp, 1980, p. 255). In this type of research approach, the meaning of the data depends on its context, therefore, the researcher must adopt an appropriate data collection instrument and analyzing method to effectively find the

underlying meanings hidden in data (Merriam, 2009). Denzin and Lincoln (2005) offered

the qualitative definition as:

> Qualitative research is a situated activity that locates the observer in the world. It
>
> consists of a set of interpretive, material practices that make the world visible.
>
> These practices transform the world. They turn the world into a series of
>
> representations, including field notes, interviews, conversations, photographs,
>
> recordings, and memos. At this level, qualitative research involves an interpretive,
>
> naturalistic approach to the world. (p. 4)

As Karp (1980) explained, people respond to their everyday experiences through

the lens of culture. They live by intention, purposes, values, and interpretations.

Therefore, as humans have distinct systems of meanings and values, the basic mission of

a qualitative study is to understand humans' interpretations to reflect the true values

behind their actions (Karp, 1980). This is what Denzin and Lincoln (2005) called "the art

of interpretation". Similarly, Merriam (2009) confirmed that qualitative research is about

"finding the meaning of a phenomenon for those involved, how people interpret their

experiences, how they build their worlds, and what meaning they give to their

experience" (p. 5).

There are four main criteria by which each qualitative study can be judged:

naturalistic observation, contextualization, maximized comparisons, and sensitized

concepts (Karp, 1980). Likewise, according to Tracy (2010), high-quality qualitative

research must have these eight criteria: "(a) worthy topic; (b) rich rigor; (c) sincerity; (d)

credibility; (e) resonance; (f) significant contribution; (g) ethics; and (h) meaningful

coherence" (p. 839). Each of these criteria has sets of meanings, practices, and methods

through which to achieve the criteria. As an example, to achieve the "resonance" in qualitative research, the research must affect a variety of audiences by applying aesthetic and evocative representations, naturalistic generalization, and transferable findings (Tracy 2010). According to the author, all these components of quality qualitative research are essential but not sufficient if other criteria are not applied and presented.

In the qualitative research method, the researcher must employ a variety of methods to collect empirical materials. Some of these include interviewing, direct observation, the use of visual materials, and the use of personal experience (Denzin & Lincoln, 2005). Researchers will provide a field text derived from field notes and documents gathered from the field (Denzin & Lincoln, 2005). Researchers then provide an interpretation of the field text as their role changes to writer-as-interpreter. Writers in this text must reflect and make sense of what they learned from the field text. At the end of this process, the researcher provides a public text which aims to communicate with the reader (Denzin & Lincoln, 2005).

This research follows rules and regulations of a qualitative research approach in an interpretive paradigm. One of the main reasons for choosing a qualitative research method over a quantitative one in this study is the need for having a direct interaction with individuals in various stages of the study. In other words, the nature of this design research like many other design research methods requires the implementation of qualitative data collection methods such as focus group, in-depth interview, direct observation, reflexive journal, audio recording, and so on (Denzin & Lincoln, 2005; Merriam, 2009). In this study, the researcher employs a variety of qualitative methods to collect empirical data. Some of these include interviewing, direct observation, organizing

focus groups, the use of visual materials, and the use of personal experience (Denzin & Lincoln, 2005). The method of interpretation and evaluation in this study also follows qualitative methods.

Participatory Design Research

To achieve the objectives of this research, a participatory approach to design research (PD) was determined to be the best approach as this methodology encourages collaboration between users and designers in the design process, with the view that knowledge from both is equally valid and important (Ehn, 2008).

Participatory design (PD) is a design methodology that emerged in the 1970s in Scandinavia as an approach to actively involve users in the design process and apply their feedback during the production process (Ehn, 2008). PD derived from a democratization movement at work in Scandinavian countries aiming for empowering participatory and cooperative decision-making in workplaces (Spinuzzi, 2002). PD emerged from the political view that those affected by a design should be involved in the design process (Spinuzzi, 2002).

While experts define participatory experience and participatory design in multiple ways, there are similarities in their definitions. For Elizabeth B.N. Sanders, "participatory experience is not simply a method or set of methodologies, it is a mindset and an attitude about people. It is the belief that all people have something to offer to the design process and that they can be both articulate and creative when given appropriate tools with which to express themselves" (Sanders, 2003). Sanders pinpoints three ways in which researchers have accessed user experiences: through saying, doing, and making and argues that participatory design can benefit from what people make (Sanders, 2003).

In comparison with other design approaches, the participatory design method tends to involve users more deeply in the design process as co-designers and empowers them to generate and develop ideas themselves (Constantine, 2004). In fact, active participation of users and social inclusion are requirements of PD; it is essential that users feel they are empowered and entirely involved. Moreover, their insights must be considered in the design and development process (Constantine, 2004). PD aims to provide learning opportunities for both end-users and designers who collaboratively develop a technique based on end-user's realistic expectations. It encourages cooperation between users and designers in developing novel products and believes that the knowledge gained through this process is equally valid and important (Steen, Kuijt-Evers, & Klok, 2007).

Drain and Sanders (2019), proposed to PD researchers that the focus in this type of study "must be placed on designer-participant collaboration and the factors that influence this collaboration" (p. 39). For this reason, they presented the PD collaboration system model as a point of reference for researchers to plan and evaluate PD projects. This model (figure 1) consists of several components including designer and participant knowledge, activities (for making, telling, and enacting), design environment and materials, society and culture, and the participants' capacity to participate (Drain & Sanders, 2019). Also, this model has two main values: first, it suggests that the collaborative relationship is contingent upon the society and culture where it takes place. Second, "it shows that effective PD collaboration is a product of the activities and materials that a designer uses, the participant's capacity to participate, and the environments in which the collaboration takes place" (Drain & Sanders, 2019, p. 43).

Figure 3.1.

Participatory design collaboration system model (Drain & Sanders, 2019)
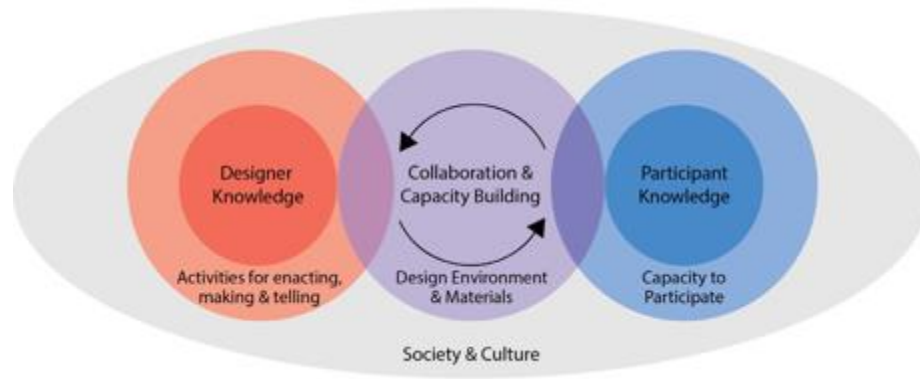
Based on the aim of the project the activities used in the PD project are varied (Drain & Sanders, 2019). Tools and techniques in practical situations assist participants to articulate their specific needs and ideas (Luck, 2018). Tools are "material components that are used in the activity" and techniques reference the way those tools are utilized (Drain & Sanders, 2019). Hence, it is crucial to design tools and activities of the participatory design research in the way that they empower participants' abilities to articulate their opinions diligently.

Another factor in PD is the design environment. The design environment regards the location of the PD activity where designer and participants interact and could be anywhere such as designer space or user space to community predefined area (Drain & Sanders, 2019). Key factors defining the location for meetings, workshops, and focus groups are to plan interaction, facilities, size of the group, and length of the meeting beforehand.

When involving the user in the design process, the participants' capacity also must be considered. Participants' capacity to participate means to utilize skills such as communication and tacit knowledge during the activities (Drain & Sanders, 2019). User involvement in the design process is a hard task to involve a non-professional user that requires complex prior knowledge (Z. Zhang et al., 2015). As researchers suggested "the users often care nothing about a detail design process, design methods used in the design, or manufacturing operations required to produce the product. What they care most are the product function that a product can offer to them" (Zhang et al., 2015, p. 268). Therefore, designers are required to plan for effective and supportive activities to motivate participants to utilize their basic knowledge and capacities to participate in PD research.

For this study, it is essential to collect first-hand data with focus groups in response to the first research question: How does a hands-on experience shift the roles of users with limited/no clothing making skills from passive consumers to active users? Also, the focus group will assist to answer a question regarding the design part of this study: which technical solutions and guidelines will potentially assist a user with limited/no sewing and patternmaking skills to assemble a 2D to 3D garment? A participatory approach to design research particularly leads throughout focus group section.

Research Framework/Model

For this study a conceptual framework was developed to demonstrate the five major stages that will guide the research study (Figure 2).

Figure 3.2.

Research design, methods, and research questions related to each stage
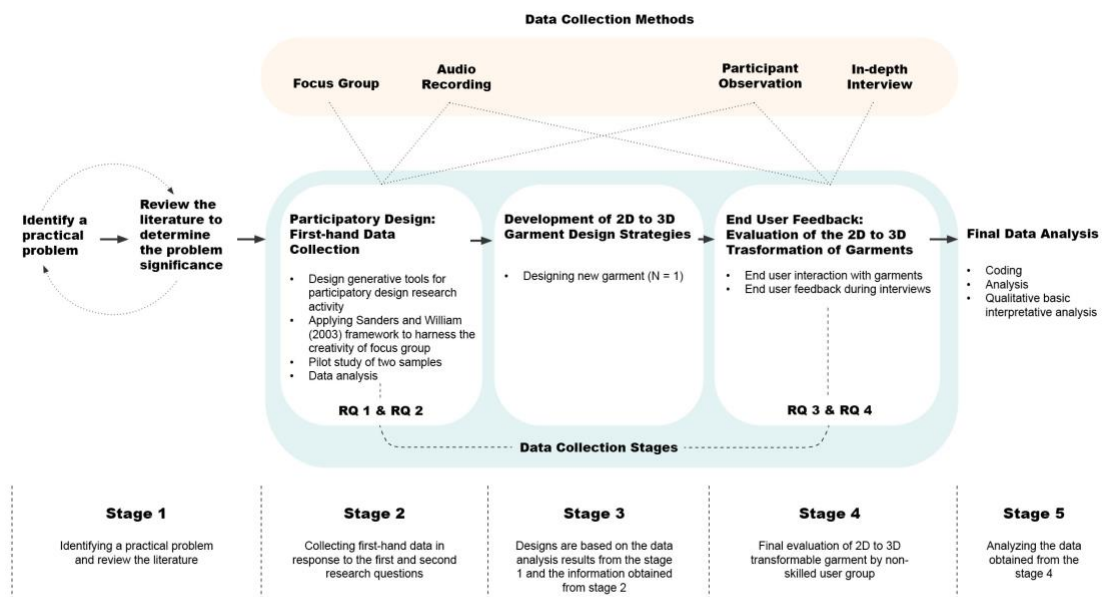
First Stage. The first stage relates to identifying the practical problem, reviewing the literature to determine the significance of the problem, identifying research questions, and iterating this process to make sure about the uniqueness and need of this study. This was an iterative process of constantly reviewing the literature and adjusting the research question and practical problem to ensure the uniqueness and significance of the research problem under the investigation.

Identify a practical problem and review the literature. In qualitative research, the researcher must identify the practical problem to be studied, review the literature to determine the significance of the problem, identify research questions, and iterate this process to make sure about the uniqueness and essentiality of this study. This process is included and accomplished in most types of qualitative research. As Merriam (2009)

stated, a step-by-step process of designing qualitative research includes conducting a literature review, identifying a research problem, crafting, and sharpening research questions, and conducting purposive sampling.

According to the author, "the structure of a problem statement, which essentially lays out the logic of the study, can be compared to a funnel shape —broad at the top and narrow at the bottom" (Merriam, 2009, p. 59). In the broad area at the top of the funnel, the researcher introduces key concepts and topics related to this concept that has been previously studied as well as justifying why this topic is important. The narrow part of the funnel belongs to the specific questions the researcher has. At this point, the lack of knowledge concerning this topic must be emphasized. Merriam (2009) explained, "Perhaps nothing in the literature addresses your question, or there may be some research, but for reasons you make clear, it is inadequate or flawed in some important way" (p. 59). This part of the study has been covered in the second chapter.

Following that approach, this study reviews five topics: sustainability, hedonic design, democratization, two-dimensional to three-dimensional shapes in apparel design, and design scholarship. Then, narrowing those topics into questions, the study introduces four main research questions: (1) How does a hands-on experience shift the roles of users with limited/no clothing making skills from passive consumers to active users?; (2) How are design challenges alleviated during the transformable garment design process?; (3) What values can be generated by garment changing activities without using professional garment construction techniques?; and (4) How does transformable garment design impacts users/consumers' perception/attitudes towards sustainable fashion?

Second Stage. The second stage regards collecting first-hand data in response to the first research question of this study: How hands-on experience shifts the roles of users with limited/no clothing-making skills from passive consumers to active users? Using focus groups, the researcher will answer the question regarding the design part of this study: which technical solutions and guidelines will potentially assist a user with limited/no sewing and patternmaking skills to assemble a 2D to 3D garment? Also, this stage will be an attempt to evaluate and respond to the second research question: How are design challenges alleviated during the transformable garment design process?

A minimum of 8 skilled participants (Young & Casey, 2019) will join a semi-structured focus group to share their points of view regarding this design strategy. The data obtained from stage two affects the next steps of the study. A participatory approach to design research particularly leads throughout this section. Generative tools such as simple low fidelity prototypes will be designed for this section for participants to use during the design activity. These include fabrics with available roadmaps printed on the surface to follow different fabric folding's and to close the shapes with diverse types of closures. At the end of this stage, two garment prototypes designed by the researcher as a part of a pilot study, will be presented to the focus group to evaluate. The qualitative basic interpretative analysis will be used for analyzing the data obtained in this stage. The result of the analysis will help the researcher in generating the 2D to the 3D transformable garment in the next stage.

Third Stage. The third stage involves the development of a 2D to 3D garment design strategy. From this stage two new designs will be developed and constructed by the researcher. The data and design solutions obtained from the focus group as well as the

review of literature will assist the researcher at this stage to implement appropriate design strategies.

Fourth Stage. The fourth stage involves the final evaluation of the 2D to the 3D transformation of garment by non-skilled user group (N = 7) (Young & Casey, 2019). Participants will provide their feedback regarding garment prototypes while interacting with garments. During this stage, the researcher/moderator will perform participant observation and will record the data in the form of audio recording. Subsequently, each participant will respond to relevant questions during a semi-structured in-depth interview after they finish interacting with prototypes. The last and fifth stage regards analyzing the data obtained from the fourth stage. In this stage, observation memos and notes, audio recordings, as well as transcripts of interviews, will be coded and analyzed. A qualitative basic interpretative analysis will be used for data analysis in this stage. The result of this stage will be included in the last chapter.

Data Collection

To understand the design criteria and user/consumes' opinions regarding the 2D to 3D transformable garments, the researcher collects data through focus group and in-depth interview. For each of these parts, audio recording and participant observation will be applied to obtain rich data. The focus group will assist the researcher to collect data during the participatory design part and obtain the design criteria to design two transformable 2D to 3D garments. The in-depth interview will take place at the next stage to get the participant feedback regarding the executed designs.

Focus Group

The second part from stage two of this study belongs to gathering data from skilled participants in the focus group. This stage happens after designing and completing the generative tools for the participatory research design activity. In this study, the focus group will be a critical factor to gain an initial idea about people's opinions regarding the effective design strategy, ease of use during the 2D to 3D process, and research topic in general.

If participants are comfortable talking openly in public, this form of data collection is appropriate (Boyce & Neale, 2006). A focus group is a preferred data collection method when participants' interaction provides rich information when there is a limited time to collect data, and when people feel encouraged to share their ideas in-group rather than during an in-person interview (Creswell, 2007). Greenbaum (1993) defined three focus group types based on the number of participants and tools used to collect data: "1. Full group: discussion is 90 to 120 minutes (about 2 hours). A trained moderator leads the discussion involving eight to ten people with common demographics and attitudes per session, 2. Mini group: Like the full group, except that it consists of four to six people in a group, and 3. Telephone group: individuals participate in a telephone conference call, led by a trained moderator, for thirty minutes to two hours" (pp. 1-2).

Among these three types of focus groups there are three similarities. In all these groups there must be a trained moderator to lead the session. They must adopt a strategy such as saying as little and strategically as possible to encourage participants for maximum participation and discussion. Another similarity relates to the criteria based on which a group of participants will be selected. Based on a specific criterion a homogeneous group of participants will be gathered for their shared knowledge of the

topic to provide the highest-quality discussion about the topic. And lastly, all three types of groups are audiotaped (Creswell, 2007).

There are also some differences among these types of focus groups. The number of participants is different between the full group and mini group. As the mini group has fewer participants in comparison with the full group, some researchers prefer to choose this group to spend more time on this little group to get richer and more in-depth data. The second difference relates to the environment of research between the telephone group and the other two groups. As telephone groups are conducted in a conference call environment, participants and the moderator are all in separate locations, therefore, there is an absence of face-to-face contact and minimal interaction among group participants. However, this group offers more anonymity in comparison to the other two groups. For the same reason, telephone groups are generally conducted in a shorter period (Creswell, 2007).

In this study, the focus group type one (Full Group) will be conducted with a minimum of 8 homogeneous participants selected based on a specific criterion. In this research, samples will be selected based on specific criteria. Women with basic knowledge in garment construction will participate in this study. Therefore, two main criteria for selecting participants are: (a) having a basic knowledge of garment construction such as patternmaking and sewing; and (b) having an interest in slow fashion and long-lasting clothing items. Selecting skilled participants with garment construction knowledge is necessary to ensure users engaged with this process are qualified and able to make a significant contribution in the process (Morris & Ashdown, 2018).

At this stage of participatory design research, skilled participants have the potential to assist with technical aspects of the final prototypes by sharing their opinions about low fidelity prototypes and suggesting design strategies. To guide participants during the 3rd stage, the researcher developed two half-scale sample garments as pilot designs with 2D to 3D transformation feature. Participants may be unfamiliar with this type of transformational garments, therefore, to ensure they understand the concept the pilot study designs will provide more clarifications at this stage (Sanders & William, 2003).

Preparation of Focus Group's Generative Tools. Generative tools such as simple low fidelity prototypes will be designed for this section for participants to use during the design activity in the focus group. According to Virzi (1989), "prototype fidelity is a measure of how authentic or realistic a prototype appears to the user when it is compared to the actual service" (p. 224). He also compared the high-fidelity prototype with a low fidelity one as, "to the extent that a person using the prototype cannot distinguish it from the final system, the prototype is high fidelity. If the prototype can readily be distinguished from the service, then fidelity is low" (Virzi, 1989, p. 224).

For this reason, the low fidelity prototypes will be made in half scale and from sample muslin fabrics. These include fabrics with available guidelines (signifiers) printed on the 2D surface for participants to follow different fabric folding to form 3D shapes. At this stage, shapes created by participants do not indicate any type of garment, instead, they will be suggesting conceptual 3D forms. What will be tested at this point with skilled participants are distinct types of guidelines, closures, and discoverability of features. Participants' opinions and inputs during this stage affect the third stage of this

study and help the researcher develop meaningful 2D to 3D design strategies. The

researcher developed two half-scale sample garments as pilot designs with 2D to 3D

transformation features. These two pilot designs will be presented to participants to

evaluate as well. Having pilot designs is crucial in helping participants to have a clear

idea about the subject of study. Regarding pilot testing, Sanders and William (2003)

stated:

> while your instructions may seem obvious to you on paper, they may seem vague
> or unclear when spoken aloud to a person unfamiliar with the task. Remember,
> people aren't asked to do this kind of task every day, so it is important to make
> sure in advance that they understand it (pp. 142-143).

Participant Recruitment Method for the Focus Group. At this stage,

purposeful sampling will be conducted. The concept of purposeful sampling means "that

the inquirer selects individuals and sites for study because they can purposefully inform

an understanding of the research problem and central phenomenon in the study"

(Creswell, 2007 p. 125). Purposeful sampling is a general term that has several typologies

of sampling strategies in qualitative inquiry.

In this study, the snowball or chain sampling strategy will be used to recruit

participants. As Creswell (2007) defined "snowball sampling identifies cases of interest

from people who know people who know what cases are information-rich" (p. 127). In

this regard, participants will be recruited by informing people who can potentially help to

find participants with two main criteria: (1) having a basic knowledge of garment

construction such as patternmaking and sewing; and (2) having an interest in slow

fashion.

To augment the credibility of this study, participants will not be selected from

friends, family members, acquaintances, or colleagues. Information related to the focus

group and study comprising purpose of the study, participant's recruitment criteria, benefits of the study, and participant's compensation method will be included in a flyer to share with people who will help to recruit participants as well as on social media. In this research the location for the focus group where participants and researcher/designer meet will be a reserved meeting room or a fashion studio to plan one-hour private discussion and design activities with 8 participants.

Applying Sanders and William (2003) Framework to Harness the Creativity of Focus Group. According to Sanders and William (2003), to provoke the creative thinking of participants in the initial phase of the product development process, researchers must value what the participant says, does, and make. The "say" methods belong to verbal communication of participants such as talking about their ideas during a focus group meeting. The "do" methods "as applied ethnography focus on what people do" and capture it with observation (p. 139). The "make" methods relate to implementing strategies that provoke participant's creative expression. Sanders and William (2003) explained that the traditional ways of market research and designing for people put them into the positions of passive consumers. As they stated, based on market research methods at the time, consumers were never invited into the early stage of the design process. At most, they were invited to share their ideas "at the concept evaluation phase or in usability testing" (Sanders & William, 2003, p. 136). They also confirmed that "participation in the middle or end of the design development process is not enough to drive truly human-centered product and service development" (Sanders & William, 2003, p. 136). Therefore, they suggested adopting strategies "to harness the creativity of

ordinary people early in the design development process" (Sanders & William, 2003, p.

136).

Ideation which refers to "the preverbal idea stage" and expression which refers to

"the translation of those ideas into formal systems of communication" are two main

stages that researchers must support to harness people's creativity (Sanders & William,

2003, p. 137). Sanders and William (2003) proposed a four-step framework for this

reason. They provided a description and guideline for each step to follow. These steps are

including "1) Immersion, 2) Activation of feelings and memories, 3) Dreaming, 4)

Bisociation and expression" (Sanders & William, 2003, p. 137).

In this research, the third step (dreaming) will not be required because the fourth

step (bisociation and expression) follows similar procedures as the third step.   The

first step occurs in the actual context of the experience under investigation such as the

participant's home or office, the other two steps will take place during the in-person

meetings with the researcher in the focus group. In this research, the three steps of this

framework will be followed to stimulate participant's creativity. The data collected from

this stage will be analyzed and the outcome results will be implemented in the next stage

which is designing the 2D to 3D garments. These three steps are explained in the

following paragraphs.

Immersion. According to this framework, the immersion timeframe varies from

one week to seven weeks, and it will be conducted in "the natural context of the

experience being studied, usually the participant's home or place of work" (p. 139). As

Sanders and William (2003) mentioned, "we guide the participants in daily self-

documentation of their thoughts, feelings, and ideas about the experience being

investigated" (p. 139). At this stage, the participants are required to observe and record their current experiences or think about their past experiences related to this study. According to this framework, this stage could be regarded as a time-saving stage as participants complete some tasks ahead of time and bring them to the meeting or email back before the meeting. For this research, participants will receive different types of questions about their demographic information and opinions related to this topic. As well as demographic questions, they will receive the following four questions via email to respond one week before the focus group:

- Look around in your home or office and notice which task requires a completion guideline and hands-on practice.

- If your answer to the previous question was yes, what did you feel after making it?

Activation related feelings and memories. This stage and the following ones will be organized as an in-person meeting and in the form of a focus group. According to this framework, the researcher must "open the group meeting with a discussion of things they noticed" while answering the questions from the immersion stage. To complete this task, the following questions will be asked:

- Have you ever made something following guidelines? If yes, what did you do?

- Do you like resolving puzzles? If yes, please explain if you like the puzzle with more pieces or less?

- How do your feelings differ between something that you make and something that you shop?

After participants answered the questions, they will be engaged with exercises using toolkits "that have been designed to evoke and activate related memories and feelings" (p. 139). The low fidelity prototypes which have been described in section 3.5.1 of this chapter will be used for this part. Participants after completion of the guidelines on 2D surfaces will reach the conceptual 3D form. Participants will give feedback regarding different types of guidelines and closures used on kits as well as their feeling regarding this experience. The following two questions will be asked to determine their opinions regarding the technical parts and the level of complexity of the kits.

- Please assemble these kits following guidelines and share your opinion at the end of the process regarding the closures and guidelines provided on each of them. Explain what you think, like, or dislike about them.

- Please define the level of complexity and pleasure of each one from 0 to 10.

Bisociation and expression. This is the last step where participants are invited to "bring expression to the ideas they are having" (p. 139). As the framework suggests, "the exercises/toolkits that we use for this step are deliberately abstract and ambiguous" (p. 139). To ask participants to express their ideas they will be given drawing paper with pencil, and croquis figures to use as a base to draw their ideas using these tool kits. They can refer to their preferred type of closure and guideline which they used in the previous step during their creative expression. If the closure and guideline they want to use for each design did not exist among the toolkits of the previous step, they will be asked to express and add what they think would work better for their designs. At this stage they will be asked two more questions:

- What do you think about constructing your garment based on the guidelines without technical requirements of garment construction?

- What do you think about the idea of a transformable garment which provides a variety of styles in one garment?

The following table summarizes the three steps of the Sanders and William (2003) framework with the relevant questions designed for each step of this focus group:

Table 3.1.

Research Questions related to Sanders and William (2003) Framework and for Focus Group

Applying Sanders and William (2003) Framework to Harness the Creativity of Focus Group	Research Questions
Immersion	- Look around in your home or office and notice which task requires a completion guideline and hands-on practice. - If your answer to the previous question was yes, what did you feel after making it?
Activation of feelings and memories	- Have you ever made something following guidelines? If yes, what did you do? - Do you like resolving puzzles? If yes, please explain if you like the puzzle with more pieces or less? - How do your feelings differ between something that you make and something that you shop? - Please assemble these kits following guidelines and share your opinion at the end of the process regarding the closures and guidelines provided on each of them. Explain what you think, like, or dislike about them. - Please define the level of complexity and pleasure of each one from 0 to 10.
Bisociation and expression	- What do you think about constructing your garment based on the guidelines without technical requirements of garment construction? - What do you think about the idea of a transformable garment which provides a variety of styles in one garment?

Audio Recording. Audio recording is another data collection tool that will be used widely throughout this research as a form of documentation. Qualitative research as an interpretative, naturalistic approach to the context requires a group of various interpretative material practices such as field notes, interviews, conversations, photographs, and recordings to make the context visible (Denzin & Lincoln, 2005). In this research, during the participant interview and focus group, the audio recording will help to capture and later analyze the data, with the consent/approval from participants (Merriam, 2009; Yin, 2009). Audio recordings will be used during the participants' interaction with toolkits and design activities in the focus group. The audio recording will be used in the focus group when participants answer the questions during immersion and activation related feelings and memories.

Participant Observation. In this study, during the participatory design research activity, the participant observation will be used as a tool for collecting data as participants interact with low fidelity prototypes. Also, the video recording from this session helps the researcher to verify and confirm her observations later during the data analysis. As Meriam (2009) suggested, "Observations are also conducted to triangulate emerging findings; that is, they are used in conjunction with interviewing and document analysis to substantiate the findings" (p. 119). To gain trustworthy results with observation, Merriam (2009) suggests including three crucial factors: (a) to observe systematically; (b) to address a particular research question; and (c) constantly to check and balance observations. The first and second research questions guided the observation protocol: (1) How does a hands-on experience shift the roles of users with limited/no clothing making skills from passive consumers to active users? and (2) How are design

challenges alleviated during the transformable garment design process? Therefore, the participant observation protocol has … main criteria: (a) how participants interact with the instructions provided on the surface design; (b) the participants' comments during the interaction with the low fidelity sample; and (c) based on provided instructions, how many different 3D shapes they will find from the 2D surface design.

Observation is an ideal method of data collection in qualitative research when an activity can be observed firsthand, when a new perception is desired, and when the participant cannot or does not want to discuss a topic (Merriam, 2009). As Merriam (2009) suggested, like conducting an interview in which the researcher must prepare a range of structures ahead of time, in participant observation as well, he/she must decide to look after certain events and specified behaviors before starting the observation. During the focus group the way participants interact with low fidelity prototypes, different types of closures, and guidelines are crucial to be observed are recorded immediately in a written format.

Focus Group Process. Following approval from the Institutional Review Board, the study began by collecting data through a focus group consisting of eight individuals (seven women and one man) with previous knowledge in pattern making and sewing. The focus group data were gathered on 14th April 2022 at 3:00 pm. The location of this session was in Costume Shop at the University of Missouri. Participants received gift cards as incentives right before the focus group. They also read and signed the focus group consent letters before starting the session. The focus group data was audio recorded. Moreover, the researcher captured the visual data during the participants' hands-on activity with photography.

In-depth Interview

Final Evaluation of Garment Design Strategies with user group. The fourth

stage involves the evaluation of garment design strategies by non-skilled participants (N

= 7). They will provide their feedback regarding garment prototypes while interacting

with garments. During this stage, the researcher/moderator will perform participant

observation and will record the data in the form of audio recording. Subsequently, each

participant will respond to relevant questions during a semi-structured in-depth interview

after they finish interacting with prototypes. Final evaluation of 2D to 3D garments is

crucial to determine if the design strategies adopted to create garments truly meet the

participants' expectations and could be proposed as a potential strategy for the user

involvement method.

Participant Recruitment Method. Participants for this stage will be recruited

from non-skilled users who do not have garment construction knowledge such as

patternmaking and sewing. Additionally, end-users who participate at this stage must

have an interest in craft and hands-on practice anything other than sewing and

patternmaking. As an example, they could be interested in knitting, crochet, embroidery,

or fabric dying. Purposive sampling with a snowball approach also will be conducted in

this step. Information regarding the scope of the study, participant's criteria, and

participant's compensation method will be indicated in a flyer to share with individuals

who assist with snowball sampling as well as on social media.

Participants' interaction with Garments. At this stage, 8 participants will be

interacting with the final garments in separate sessions. The goal of this stage is to give

participants some directions regarding the ways to shape the 2D surface to the 3D

garment and then let them interact with prototypes. The main goal of this section is to test if the affordances and guidelines included on the 2D surface are easy for participants to follow or are challenging. At this point, the guidelines included on the 2D surface must be self-explanatory and sufficient to help the participants to follow and shape the 3D garment. They will be informed about the garments' guidelines and how they work before start interacting with garments, but they will not be assisted in the assemblage part. Each user will interact with 5 prototypes in an individual session. During the assemblage session, the researcher will stay in the room to collect data by observing the user and taking notes. For data collection purposes, they will be also audio recorded during the interaction with garments. Right after this session, they will answer the follow-up questions about prototypes and research concepts.

Audio Recording. As the focus group in stage two, in this phase, the audio recording as a form of data collection will be used throughout the user interaction with prototypes as well as in-depth interviews after obtaining the consent/approval from participants. Users will be interviewed after they finish interacting with prototypes answering questions that address their experience during the interaction with final prototypes as well as their general opinion regarding the concept of this study.

Participant Observation. As with the focus group in stage two, at this stage, the participant observation will be used to collect data during the users' interaction with final prototypes. Also, the video recording from this session helps the researcher to verify and confirm her observations later during the data analysis. Three crucial factors suggested by Merriam (2009) including observing systematically, addressing a particular research question, and constantly checking and balance observations will be followed at this stage

as well. "The theoretical framework, the problem, and the question of interest determine what is to be observed" (Merriam, 2009, p. 119). Therefore, in this study, the goal of observing participants during their interactions with prototypes is to gain insight on subjects related to the third research question: What values can be generated by garment changing activities without using professional garment construction techniques? In this study, the way participants approach the newly designed garment is crucial to be observed and recorded. Therefore, for the participant observation protocol there are three main criteria to be observed: (a) participants' feelings during the interaction with the garment; (b) participants' comments throughout this interaction process; and (c) their hand movement to identify the level of difficulty in working with the closures.

      In-depth Interview. In-depth interviewing is one of the widely used and popular forms of data collection in qualitative research. In this study, in-depth interviews will be conducted to get an insight into participants' points of view after finalizing the garment design prototypes by the main investigator/researcher. Therefore, an in-depth interview will take place during the last stage of this study. Research questions will be asked after user's finish interacting with prototypes. An in-depth interview helps the qualitative researcher to explore a new issue in-depth or getting an insight into participants' points of view and actions (Boyce & Neale, 2006). "In-depth interviewing is a qualitative research technique that involves conducting intensive individual interviews with a small number of respondents to explore their perspectives on a particular idea, program, or situation. (Boyce & Neale, 2006, p. 3). The main advantage of in-depth interviews over surveys and other types of data collection is that this tool provides much more detailed

information for researchers as well as a relaxed atmosphere for the participant (Boyce & Neale, 2006).

This study like most qualitative research applies semi-structured interviews. Merriam (2009) described a semi-structured interview by providing five main characteristics: "(1) Interview guide includes a mix of more and less structured interview questions; (2) All questions are used flexibly; (3) Usually, specific data required from all respondents; (4) A large part of the interview is guided by a list of questions or issues to be explored; and (5) No predetermined wording or order" (p. 89). As Merriam (2009) stated, "Interviewing is necessary when we cannot observe behavior, feelings, or how people interpret the world around them" (p. 88). The five main characteristics mentioned by Merriam (2009) will guide the design and use of interview research questions. The focus of the study was to gain insight on subjects related to the first research question. Consequently, this part (In-dept interview) will address the two last research questions of this study. Therefore, interview questions will be created to reach that goal. As Merriam (2009) indicated "no predetermined wording" must be included in questions. Subsequently, to determine the type of values which can be generated by garment changing activities, any type of values such as enjoyment, creativity, versatility, or ease of use will not be included in questions. Instead, participants will answer less direct questions regarding their experience with garment prototypes. Also, the fourth research question will be addressed in this during this interview session: "How does transformable garment design impacts users/consumers' perception/attitudes towards sustainable fashion?". Following is a list of interview questions which will address the third and fourth research questions:

Table 3.2.

Research Questions Related to Interview Process

Research Question	Interview Question
RQ3: What values can be generated by garment changing activities without using professional garment construction techniques?	How was your experience during the 2D to 3D garment assemblage? Think about this experience and try to find a similar experience you had before. How you feel during these types of activities?
RQ4: How does transformable garment design impacts users/consumers' perception/attitudes towards sustainable fashion?	Think about a product that you've made. It shouldn't necessarily be from fashion products. Tell me how long you kept and used it? Do you think you keep a transformable garment for a longer time or not? Please justify you answer.

Interview Process. Seven participants with limited or no sewing and patternmaking skills took part in this stage. The initial goal for the interview process was to recruit eight participants, however, after interviewing seven participants and analyzing the data, it reached saturation. The demographic information of participants in this stage is provided in Table 1. Most of them had handcraft skills such as drawing, cross-stitching, embroidery, calligraphy, knitting, crochet, tatting, and quilting. However, no one among the participants in this stage had advanced skills in patternmaking and sewing. Six participants were interviewed in the researcher's studio. The other two interviews took place in the University of Missouri's apparel lab. All the participants asked for the dress form to envision better the 3D shape of the 2D surface as they were completing and assembling the 2D shape. All the participants read and signed the study's consent letter.

Moreover, before starting the interview process, they received incentives in form of gift cards as an appreciation of their contribution to this study and their time.

Demographic information of participants in both Focus Group and Interview Process. The demographic information of participants in both focus group and interview is provided in Table 3.3.

Table 3.3.

Demographic information of participants

Participant	Age	Gender identity	Racial identity	Type of craft knowledge	Participate in Second Stage: Focus Group	Participate in Forth Stage: Interview
1	18	Female	White	Professional sewing (9 years of sewing)	X	-
2	18	Female	Mixed (white, black, pacific islander)	Professional sewing (3 years of sewing)	X	-
3	22	Female	Caucasian	Professional sewing (3 years of sewing)	X	-
4	20	Female	white	Professional sewing (5 years of sewing)	X	-
5	38	Female	white	Professional sewing and patternmaking (16 years)	X	-
6	32	Female	white	Professional sewing (20 years of sewing) Patternmaking (1 year)	X	-
7	23	Female	White	Professional sewing and patternmaking (10 years)	X	-
8	31	Male	Black (African American)	Professional sewing and patternmaking (7 years)	X	-
9	42	Female	White	Painting, knitting	-	X
10	42	Female	Latino	Limited sewing	-	X
11	56	Female	White	Limited sewing, cross-stitch, embroidery, tatting (lacemaking)	-	X
12	57	Female	White	Knitting, basic crochet	-	X
13	57	Female	White	Limited sewing, embroidery, crochet, knitting, drawing, painting, quilling, calligraphy	-	X
14	26	Female	Middle east	Limited sewing, embroidery, painting, needle work	-	X
15	26	Female	White	Limited sewing, painting	-	X

X = participation in the stage; - = no participation in that stage.

Development of 2D to 3D garment design strategy based on stage 1 & 2

The third stage involves the development of a 2D to 3D garment design strategy. This stage will be an attempt to evaluate and respond to the second research question: How are design challenges alleviated during the transformable garment design process? The results of the focus group affect the design choices at this stage. Participants' feedback on the level of complexity of guidelines as well as closure types will help the researcher to make the design choices. The researcher/designer will follow design strategies that have less complexity according to the participants' feedback. The number of two total new designs will be developed and constructed by the researcher.

Ethical Considerations

Regardless of which qualitative approach is followed by the researcher, in every stage of the study from data collection to analysis of the data, researchers encounter ethical issues. To conduct research ethically first and foremost, the researcher must be able to convince participants that the research has some level of probable success (Merriam, 2009). As matter Creswell (2007) mentioned, "to gain support from participants, a qualitative researcher conveys to participants that they are participating in a study, explains the purpose of the study, and doesn't engage in deception about the nature of the study" (pp. 141-142).

However, no one at the beginning or throughout the research process could know the research results are trustworthy. For that reason, Merriam (2009) suggests showing the trustworthiness of the study "there has been some rigor in carrying out the study" (p. 209). But what makes an investigation rigorous or trustworthy? Two factors suggested by Merriam can show the trustworthiness of a study: "the researcher's careful design of the study, and applying standards well developed and accepted by the scientific community"

(p. 210). Furthermore, explaining the purpose of the study to participants and gain their

trust has two results: first, participants do not think that they were deceived about the

nature of the study. second, they will support the study (Creswell, 2007).

Another ethical consideration in qualitative research is to keep all the research

participants' identities and information confidential, in other words, keep the informant

anonymous (Creswell, 2007). Therefore, in this study, the identity of participants in every

stage of the study will remain anonymous by adopting strategies such as assigning

numbers or other names to individuals. All the ethical considerations in this study will be

reported to the Institutional Review Board (IRB) before initiating the focus group. As

both the focus group and interviews require interaction with human subjects, IRB

permission will be required before embarking on the data collection. However, the lack

of human subjects in the second phase of the data collection due to being focused on the

researcher's creative practice solely eliminates the need for IRB approval. Lida Aflatoony

is the principal investigator, and the IRB project number is xxx (TBD). Another ethical

consideration is to appropriately cite and give credit to any outside source used in this

study such as photography, design, and research. Also, there are no conflicts of interest in

conducting this research.

Triangulation

Triangulation is one of the many forms of validation strategy and involves using a

variety of sources to provide supportive evidence for findings (Creswell, 2013; *Lincoln &*

Guba, 1982; Merriam, 2009). Triangulation is a common strategy to confirm that

research is trustworthy (Merriam, 2009). Or as Stake (2010) affirmed triangulation is

about being more confident that the evidence is good and having the meaning right. In

this qualitative research, two triangulation strategies will be used: Member checking and participants' feedback.

Member Checking

According to Stake (2010), member checking is "presenting a recording or draft copy of an observation or interview to the persons providing the information and asking for correction and comment" (p. 126). This is a common strategy for ensuring the internal validity and credibility of the researcher's emerging findings (Merriam, 2009). One important consideration during the member checking is to make sure the material presented for member checking do not include people's quotation or personal description to be confidential (Stake, 2010). Also, another consideration is to allocate enough time to this process as it is a slow process (Stake, 2010). In this study, after data collection and before writing the final draft, all collected materials will be given to one or two colleagues in this field or to participants to ask for corrections and additional comments.

Participants Feedback

Participants' feedback is another form of member checking but this time only participants of the study must provide feedback on emergent findings. In this study, participants will provide feedback and share their points of view about the garment prototypes made by the principal investigator/researcher. Their comment and suggested corrections will be analyzed and reported at the end of this study alongside other general findings.

Theoretical Triangulation

According to Jensen and Jankowski (1991). theoretical triangulation "suggests application of concepts and perspectives from diverse theories and disciplines" (Jensen &

Jankowski, 1991, p. 63). This form of triangulation occurs throughout this study, as in this research design democratization as a theory applies in different stages. The result of the theoretical application was stated in chapter five in *theoretical contribution* section.

Analyze the Data

In this study, the data analysis will occur twice: once after the focus group, and one time after the interview section. The data obtained from the skilled participants during the focus group helps the researcher to determine the design criteria to generate 2D to 3D transformable garments. The data received from the in-depth interview, instead, reveals the end users' opinions and attitudes regarding the 2D to 3D transformable garments and their feedback towards the designed samples for this study.

Analyze the Data After Focus Group

At this stage, the data obtained from the focus group including audio recordings will be transcribed and analyzed. Also notes taken from the participant observation will be analyzed. Two primary areas will be observed during the data analysis: the first one is to identify the design criteria to use during the design process in the third stage of the study, and the second one is the general opinion of the participants regarding this research topic. Participants' input in this section is not limited to the design details and garment features, but also their responses to the questions during the immersion and Activation related feelings and memories will be transcribed and analyzed. Transcripts will be coded, and the final themes and results will be reported in a written format.

At this stage, the qualitative basic interpretative analysis designed by Tony Castro (2021) will be used to analyze the data. These steps include: (a) Identify constructs in the research questions; (b) Create a list of initial codes to begin review of the data; (c) Tag

and label the data; (d) Organize labels into categories; (e) Make-sense of categories; (f)

Generate themes; (g) Confirm/Disconfirm themes across data; and (h) Generate

Conclusions (Castro, 2021).

Analyze the Data After In-depth Interview

In this stage, the data obtained from stage fourth will be analyzed and reported in

the last chapter of this study. Observation memos and notes, audio recordings, as well as

transcripts of interviews, will be coded and analyzed. A qualitative basic interpretative

analysis will be used in data analysis for this stage. The steps of analysis process are the

same as the method used in basic interpretative analysis during the focus group data

analysis.

Positionality Statement

As a female researcher in the field of apparel design and with my lived experience

in the Middle East, I believe knowledge is socially constructed and participants and I

create knowledge in interaction (Savin-Baden & Major, 2012). I believe that knowledge

is being socially constructed from people's social practices and comes from people's

minds (Yazan & De Vasconcelos, 2016). According to Savin-Baden and Major (2012),

"constructivism is the notion that knowledge lies in the minds of individuals, who

construct what they know on the basis of their own experience" (p. 29). As a researcher

who adopts the constructivism approach, I believe that research involves an attempt to

understand individual construction of knowledge as well as to "understand the ways in

which individuals construct meaning" (Savin-Baden & Major, 2012, p. 29). Moreover, a

major part of this research is conducted with participatory design research method which

beliefs in the contribution of users in the design process. This interaction between participants and I, will contribute to knowledge construction.

Summary

In this chapter, an overview of methodologies applicable to this research has been presented and discussed. Steps presented in this research, research model, methods of data collection and data analysis, participants' recruitment strategies, triangulation methods, and ethical consideration were discussed. The first stage relates to identifying the practical problem, reviewing the literature to determine the significance of the problem, identifying research questions, and iterating this process to make sure about the uniqueness and need of this study. In the second stage, this research follows the participatory design research methods. At this stage, the data from skilled participants will be gathered in the focus group. To harness the creativity of participants this stage will follow the three steps out of four steps of Sanders and William (2003) framework. The number of 8 skilled participants will be engaged in participatory activities and answer the following questions. In the third stage, the 2D to 3D transformable garments will be designed based on data obtained from the participatory research and literature review. The stage fourth and fifth of this study relate to the data analysis, report, conclusion, and implication of this study.

Chapter 4: Findings

This chapter details the data gathered from the focus group and the data analysis from (a) the design solutions shared by participants; (b) the transformable garment design; (c) the focus group; and (d)the in-depth interviews. These stages are presented based on their order presented in the research framework in chapter three.

As presented in chapter 3, this study is based on the participatory design research method. This involves users as "co-designers" and empowers them to generate and develop ideas themselves (Constantine, 2004). Consequently, this study is not only nurtured by the researcher's design development ideas but is also fed by focus group input (participatory design research) conducted before the final design product development stage. The information received from the participatory design stage is combined with the researcher's tacit knowledge as well as the information found in literature about specific design strategies for a 2D to a 3D process to reach the final designs.

Findings from the Second Stage: Focus Group

The focus group helped to collect first-hand data in response to the first research question of this study: How hands-on experience shifts the roles of users with limited/no clothing-making skills from passive consumers to active users? In order to obtain information regarding the hands-on experience, the researcher asked a few questions regarding self-made garments. Also, she asked participants to compare their experience with hand-made garments with the purchased garments. Also, using focus groups, the participants answered the question regarding the design stage of this study: Which technical solutions and instructions will potentially assist a user with limited/no sewing

and patternmaking skills to assemble a 2D to 3D garment? The focus group's duration

was 1 hour and 3 minutes. During this session, participants answered questions and

participated in a hands-on activity, received information regarding the 2D to 3D

transformable garments in a pilot study, and at the end, drew their ideas with a pencil on

paper.

Hands-on-Activity Phase of the Focus Group

The purpose of this section of the focus group was to basically introduce the

transition of the 2D surface to the 3D shape. It was essential for participants to be

engaged with this simple activity to have a better idea about the 2D to 3D transitioning

phase for the next phase and to be introduced to the surface instructions. As stated in

chapter 3, the participatory approach to design research particularly led throughout this

section. Generative tools such as simple low fidelity prototypes designed by the

researcher for this section for participants have been used during this hands-on activity.

These include fabrics with available roadmaps printed on the surface to follow different

fabric folding and to close the shapes with diverse types of closures. Consequently, a

circle-shaped muslin fabric was presented to participants. Arrows were used as an

instruction on the surface of the muslin fabric to help participants follow directions and

fasten the closures to find the ultimate origami shape. Using the final shape of the fabric,

participants discussed and explored the 2D surface design to various 3D shape

possibilities. This discussion allowed the participants to better utilize the fabric structure

to support their origami shape. Figure 1 shows the 2D form of this design sample and the

3D forms that participants explored and shaped. Participants, by following the

instructions could find two different 3D shapes.

Figure 4.1.

2D to 3D sample with instructions and how participants engaged with the fabric
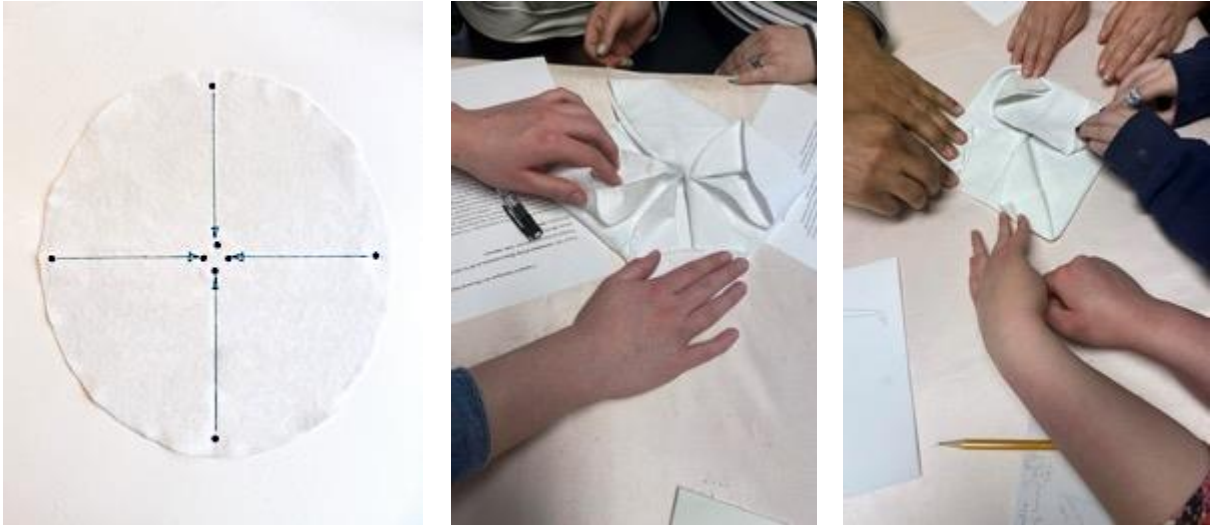
Participant 3 regarding this activity said, "It was simple, it made sense, and I enjoyed it."

On the contrary, participant 1 stated that they needed more direct instructions. Participant

1 commented, "I like having a defined answer on how it's supposed to go and how you

fold it. There were so many options here, and I was not sure which one was the right

one." Participant 6 added,

> As other people have said it was interesting to see all of the different things that
>
> we could do with this limited set of instructions. But if a goal was like participant
>
> 1 said to find the correct answer, if it's like to follow the instructions and create
>
> the thing that the creator wanted us to make, I would put the score a little bit low
>
> around three out of ten.

> To clarify their statement, participant 6 mentioned, "if a goal was to play around

with different ideas, um, I think the level of enjoyment was like middle I'd say like five

out of ten." In this regard, participant 8 answering the question about the level of their

enjoyment of this activity mentioned that their level of enjoyment was six out of ten

however, it will be higher if, "my enjoyment will reset 10/10 with the possibility of what

this could have been if there had been maybe more arrows, if there had been more points

of connection, and if certain arrows have been color-coded" Also, participant 4 added,

"people might get frustrated if the directions aren't subjective" finally, participant 6

pointed out the relation between the goal of a design and the type of instructions a

designer use for it, "it really depends on the intention, um, because if the intention is like

the play, I think this works for a while." However, they added that for an apparel design,

the instructions must be more subjective, "If the intention is to produce something such

as you know something wearable, I think that as they were saying, it needs more

instruction to get from point A to Point B."

In this hands-on activity, participants were able to transform a 2D surface into two

3D shapes. According to their statements, the type of instructions used on the surface for

this activity was suitable to find various folding styles and provided a sense of play.

However, for a wearable product, such as a transformable garment, instructions need to

be more subjective and intentional in order to find specific styles otherwise users might

get frustrated. Some of their suggestions include: (a) using more arrows; (b) having more

points of connection; (c) color coding; (d) moving from point A to point B.

2D to 3D Design Phase of the Focus Group

After participants completed the hands-on activity, the researcher presented two

half-scale 2D to 3D sample garments to the participants. The sample garments serve as a

pilot study to provide the participants with a starting point for their design of

transformable garments (Figure 2). This is necessary so that participants can have "an in-

depth understanding of one design process case" ((Lee & Jirousek, 2015, P. 160)…). The

primary value of a pilot study in a design process is that "it establishes a protocol for the

study of the subject and defines a set of issues to be explored during further research"

((Lee & Jirousek, 2015, P. 160). Samples provided to the participants consisted of two to

three 2D flat pieces which could be joined and shape a 3D garment with transformable

features. The researcher demonstrated the sample garments to the participants on half-

scale Alvanon dress form and explained to the participants how the garment changes

from 2D to 3D shape. At this point, the researcher provided no instructions to the

participants when working with the 2D surface so as not to suggest a specific approach.

Further, not providing instructions to the participants allowed the participants to use their

imagination and envision any instruction they find appropriate.

Figure 4.2.

Half-scale 2D to 3D designs for the pilot study

Ultimately, 6 out of 8 participants drew their transformable garment ideas with a

pencil on paper (Figure 3). Two out of eight participants left the focus group before this

stage as they could not stay more than one hour. Each participant took approximately five minutes to complete this task. According to their shared ideas, transformable garments changed their aspects from one style to another. In other words, based on their designs, not more than two styles were included in one garment.

Figure 4.3.

Participants' transformable design ideas during the focus group from 6 participants
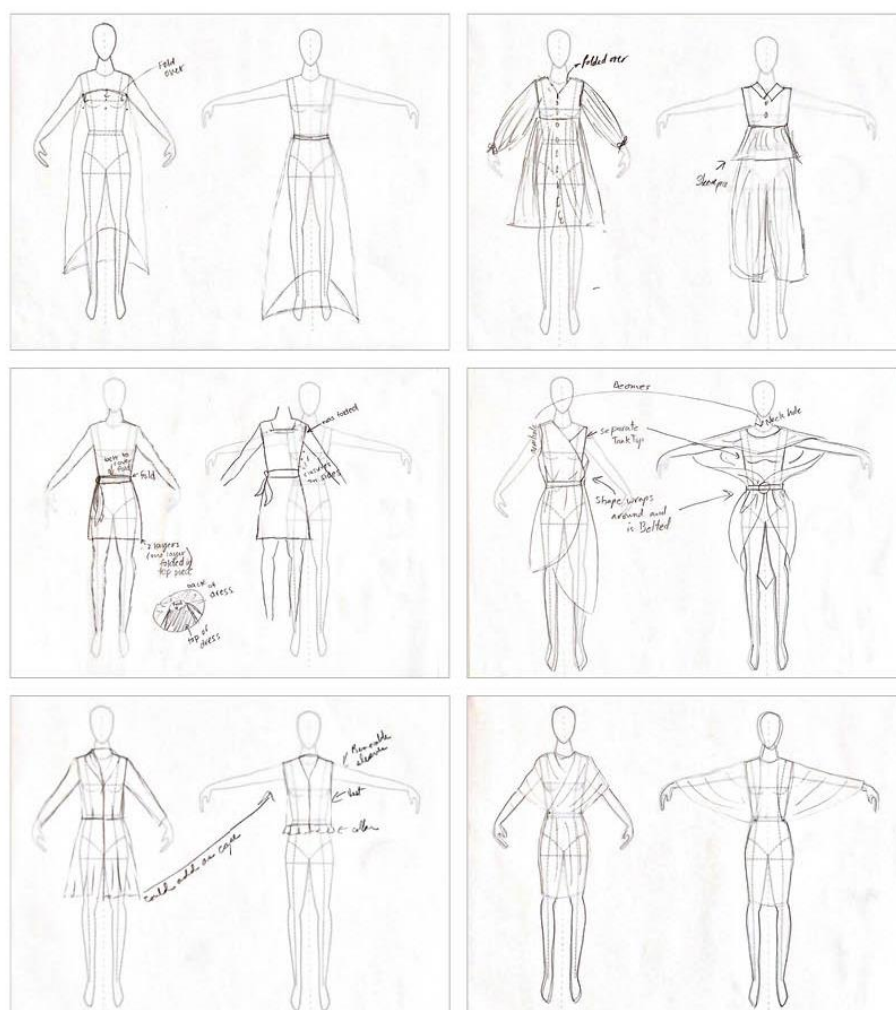
Participants shared their ideas about designing transformable garments during the drawing phase of the focus group. Specifically, the ideas shared included (a) folding over

the top part of a dress to convert it into a skirt; (b) folding over the collar to hide it inside and appear as a V-neck collar and converting the sleeves to pants; (c) folding over the top part of the dress to convert to a multiple-layer skirt; (d) converting the armhole to the neck hole in a wrap-around dress; (e) converting a sleeved dress to a sleeveless vest by detaching the skirt and using it as an add-on cape, as well as detaching the sleeves and collar from the dress and attaching the collar to the bottom of the vest as a ruffle decoration; and (f) converting the sleeve type in the dress from a wrap-around style to a cape sleeve. Based on participants' designs, there are three main suggestions for transformable garments (1) fold-overs; (2) detaching and attaching; (3) changing the direction.

Design Solutions Shared by Participants During the Focus Group

Analysis of data received from the focus group stage revealed three major themes regarding the design of a transformable garment (a) more options; (b) intuitiveness for the maker; and (c) transformation. The first theme *more options* has two subthemes including (a) clear instructions; and (b) users' creativity. Also, the third theme *transformation* has two subthemes including (a) reduce intimidation; and (b) functional diversity. In the following paragraphs, each theme will be elaborated on in detail.

More Options

The researcher explored features for user-friendly instructions to be then included on the 2D surface. The result of the data analysis revealed the first theme of *more options*. All the participants mentioned that by having more options, the transformable

garment allows the user to be more creative if the instructions and assembling instructions are well-defined and clear.

Clear Instructions. In terms of clear instructions, participant number 6 said, "If it's something like I'm following a certain set of instructions or as you know we move from A to B to C like sudoku I love it." The same participant also mentioned, "If the intention is to produce something such as you know something wearable, …, It needs more instruction to get from point A to Point B." Likewise, participant number 1 mentioned, "I like having a defined answer on how it's supposed to go". Similarly, participant 8, commented, "my enjoyment level increases with the possibility of having maybe more arrows, and if there had been more points of connection and if certain arrows have been color-coded." Participant 4, mentioned, "I think within one piece there's a lot of different things that you can do with it as long as the instructions are subjective." The same participant also affirmed, "people might get frustrated if the directions aren't subjective...like you had something that could be a skirt and you wanted to make it sure."

Participants 6 and 8 both mentioned instructions based on pictures and using pictographic to give clear instructions. To this extent, they also suggested combining the instructions and decorations. Participant 8 said, "Oh well, if there were just more of these arrows or even as little arrowheads started about that is the decoration, but it is also the instruction in a pictographic sense and it transcends language." Likewise, participant 6 affirmed, "I think there's something really special about using pictographic to give instructions." Moreover, participant 8 mentioned decoration can act as instructions, "Like

even within the design of the textile itself, or like the colors and the shapes that you use to decorate the thing that can act as your instructions."

User's Creativity. Participants also mentioned that instructions must foster a sense of creativity. They pointed out that having more possibilities to transform the garment was positive, if the instructions raised the level of enjoyment as well. Participant 5, commented, "a little bit more of the flexibility of how to modify and manipulate your changes [having diverse functional choices] …and maybe it [instructions] requires a little bit more playing." Similarly, participant 6 said, "I like long multi-step puzzles, as long as I know I can get through every step, but if I can't I'll get frustrated." Also, participant 8, mentioned, "The idea of more possibilities got me to attend." The same participant also mentioned, "Okay, for example, there are three specific things we can create, but we can also mix and match and create our formula."

As a summary of this theme, participants suggested two main features for instructions (a) instructions must be purposeful and subjective. This characteristic would be achieved by providing clear instructions, moving from A to B to C, and using pictographic as a language, and (b) instructions must allow for creativity. They suggested having more flexibility in how to modify as well as having options to achieve this goal. As mentioned in chapter 2 of this study in the theoretical framework, fostering the users' creativity and enjoyment shared by lead users during the focus group contributes to the hedonic design features. Attributes that make an experience enjoyable raises the hedonic feature of a product. Moreover, the clear instructions mentioned by lead users augment the discoverability feature of a product mentioned in the current practice module in

chapter 2. Having well-defined instructions, assist users to discover the instructions to follow to assemble the transformable garment.

Intuitiveness for the Maker

The second theme from the data reviled that a transformable garment must be intuitive for the participants. Most of the participants mentioned their preference to have fewer changing pieces to be able to accomplish the garment assembling task like a puzzle in one sitting. Participant 5 explained that a high quantity of changeable pieces requires time. She preferred designs that are less complicated and more intuitive, "I tend to like things that are going to be less complicated and they're gonna be more intuitive." Also, participant 1, regarding the time required for accomplishing this task said, "I prefer to do fewer pieces just because I like being able to finish everything in one sitting. And if I must get up and go do something else [and leave the project for a while], as I've never finished it." Similarly, participant 2 pointed out that more pieces require a communal activity, otherwise it might not be finished in one sitting, "I really do enjoy doing puzzles, especially if it's with my sister. So, I would say more pieces. But like what participant 1 said, if I have to get up, I may not finish it."

Moreover, participant 3 said, "if it's like just being with a puzzle by myself, I would like fewer pieces just because I don't have a lot of patience." She also underlined the requirement of the team working if the design is more complicated with more pieces, "if I resolve it with other people, I don't mind more pieces because it's like communal activities like I'm not getting frustrated. It is kind of like somebody else doing more work for a while." Participant 8 would rather have fewer pieces as well and justified it as, "Because I've had projects where it's like it's a bunch of pieces and I get kind of tired and

bored after a while even if I know the final product will be amazing because of all the pieces."

This theme, intuitiveness for the maker, details the importance of making multi-piece designs intuitive. More pieces might be more engaging and create a sense of accomplishment as participant 7 mentioned, "I would probably say I want more pieces, I don't know, because I guess I feel more accomplished at the end that I know I'm going to dedicate like a long period to it." However, as the rest of the participants affirmed, it requires many breaks and resumes the process as well as more time to spend. Therefore, more pieces become a suitable case for communal activities and not individual tasks.

Transformation

The third theme of design solution from the focus group revealed a transformable garment with instructions must be constructed in a way that encourages a sense of willingness in users to transform things.

Reduce Intimidation. The first trait for a transformable garment in this regard is to be less intimidating, less overwhelming, and without any constraints based on users' skill level. Participant 5, regarding the concept of a transformable garment with instructions mentioned, "I think it's a fun way to play, it is very playful without overstressing, you know, and it seems doable." She also commented, "regardless of constraints or limitations, I would say, we can change and play and swap or mix out or modify how that's going to look." Similarly, participant 6 said, "I feel this as like kind of apparel making but make it Ikea. I like the idea of being able to follow a pattern and not necessarily to understand all the technical jargon."

Further, participant 8 mentioned that this concept appears less intimidating than actual sewing and garment making if the instructions are clear, "I love the concept, I think giving this to people who don't know how to sew or feel intimidated about being like a fashion designer like this is very approachable with clear instructions." Participant 3 regarded this concept as an approachable method for users and being less intimidating, "something like this feels approachable to me because it's like there's no wrong way to do it type of thing. It is like if I do something that I don't like, I'll just unsnap a button, hahaha." Moreover, she pointed out the lack of permanence and said, "The lack of permanence is something that I find appealing and the ability to like endlessly try new things, figure something out, without consequence." Participant 5 stated this concept encourages playing, "I think it leaves the opportunity to be playful and not be too overwhelmed with any constraints that you may have." She also said, "you're making it more accessible to different skill levels … this provides an outlet to be creative and not have that intimidation level."

Functional Diversity. Having a variety of closures is the second important aspect of transformable garments which fosters users' willingness to transform. As previously mentioned by participants, closures provide a lack of permanence and change without consequence. These closures must be strong enough to hold fabrics and be used based on the purpose of each closing function. For example, participant 5 stated, regarding the type of closures to connect two pieces of a transformable garment, "obviously snaps! I'm not a Velcro girl, let me tell you that much, haha" She was also concerned about using magnet buttons to hold garment pieces together,

my only concern about the magnets was, when I think about that, the functionality of it. Are they going to hold strong enough for it not to fall apart and especially through folding in unique ways where there needs to be added tension?

Moreover, participant 6 stated, regarding getting more space between fabric pieces, "I also like the possibility of a hook and eye. With a hook and eye, you can get a little bit of space, so if the goal was to put something inside of it, I would probably use a hook and eye." The rest of the participants also were in favor of snaps or hook and eyes. Consequently, participants suggested using a variety of closures to provide the function-changing aspect in a transformable garment if they are strong enough to hold fabric pieces and based on the purpose of each changing function.

In addition, participants also shared their ideas regarding the self-made products as well as following instructions in transformable garments which resulted in the other two themes. These two themes did not relate to design but were helpful in terms of understanding the users' feelings regarding the self-made products and transformable garments (a) The sense of accomplishment increases attachment; and (b) User's feelings on following instructions depend on the quality of the instructions. In the following paragraphs, each theme will be detailed with the support of participants' comments. Figure 4.4 demonstrates all themes including the design themes and general themes resulted from the focus group data analysis.

Figure 4.4.

Design themes and general themes resulted from the focus group data analysis
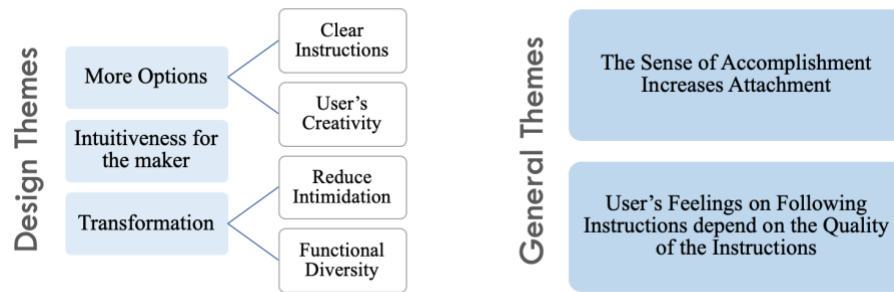
The sense of accomplishment increases attachment

Based on participants' suggestions, the sense of accomplishment they sometimes mentioned as satisfaction or pride, increases the sense of attachment in users in relation to a self-made product. Participant 5 said,

I really like [to be] emotionally attached to things I make, because I take great pride in the work in the craftsmanship I put into things, and I think that has also, a contribution to why I'm so attached to it as well.

Participant 5 also compared it with purchased products, "So, there's a high level of attachment to things I make versus things I buy." Participant 7 also mentioned, "I feel more attached to things that I make than those that I buy. And even things I buy that I alter or change I feel some more attached to them." For participant 7, who said she is a perfectionist, the sense of attachment happens when the product is perfected. She said,

I'm also definitely more attached to things that I make. But I am kind of a bit of a perfectionist, so like I picture something exactly if I had and make it and if it's not right, I'm like it's not good enough.

So, participant 7 will be attached to a self-made product if the perfection aspect of it is reached. In the same way, participant 8 mentioned that she will be attached to a self-made product if it is reached the perfect standards,

> I am much more critical of the things that I make. And sometimes it can be
> critical in a way of hoping that you know so that I can improve down the line…
> It's like I am a lot prouder of the things that I make but also it hurts if it's not
> perfect because I am looking much harsher." Moreover, participant 8 said, "I am
> very attached to things I make.

User's feelings on following instructions depend on the quality of the instructions

Participants mentioned that being able to complete instructions and build a transformable garment also creates a feeling of accomplishment. However, it depends on the quality of instructions provided for the garment. In other words, as they said, good gameplay directions depend on how easily a user could move through instruction steps. On the contrary, convoluted and messy instructions create feelings of frustration. Participant 6 said, "how I feel afterward always depends on the quality of the interactions a lot, because I have a lot of feelings about what makes for good gameplay directions and so depending on, you know how easily I move through those steps." They also mentioned, "I feel really good and accomplish that I have a great time playing the game when the instructions are clear." Participant 6 also mentioned how convoluted the instructions are could change her feeling about the whole process. They said, "And then, when the instructions are like convoluted or messy or you know have too many extra steps, I get frustrated and it can sometimes change how I feel about the actual game itself, even if the game could be fun the instructions are bad, I don't want to play."

Third Stage: Transformable Garment Design Resulting from the Focus Group's Data

The information received from the eight participants in the focus group was combined with the researcher's tacit knowledge and literature to determine the final design for this study. The information received from the literature helped the researcher to explore and design a one-piece pattern for the 2D surface. The 2D to 3D apparel design in this research relates to the transition of the 2D flat textile into a 3D garment. This falls under the category of transformable clothing design as this dimensional transformation changes the capacity of the textile from a 2D form to a 3D garment by user input. Additionally, transformability in this garment occurs by providing two different sleeve styles. Having options limited to two styles was determined by the outcomes of the focus group under the category of intuitiveness for the maker. Because most of the participants mentioned their preference to have fewer changing pieces to be able to accomplish the garment assembling task like a puzzle in one sitting. Therefore, the transformability in this design occurs in three stages: (a) from a 2D surface to a 3D garment; (b) from a poncho cape to a kimono-sleeved jacket; and (c) from a kimono-sleeved jacket to a poncho cape.

According to the focus group data, clear instructions in 2D instructions are necessary to reduce users' frustration and provide a defined answer. Therefore, by following specific instructions such as matching the same floral motifs and following the direction of arrows provided on the flat textile users can successfully make the 3D garment and explore the two sleeve styles. The matching floral motives on the 2D surface were according to the participants' suggestions about creating instructions based on

pictures and using pictographic to give clear instructions. Following the participants'
suggestions, decoration in this garment act as instructions and provide instructions for
them to follow and transform the garment both from 2D (Figure 4.5) to 3D as well as
from one sleeve type to another.

Figure 4.5.

2D flat textile with the surface design used as instruction*s*

The researcher started the design ideation by sketching with a pencil on paper. When the ultimate result was achieved, the prototyping process started with the draping method on a physical half-scale Alvanon dress form. According to the statements of participants as well as their design suggestions, too many transformable options in garments or unclear instructions provide a sense of frustration and can be overwhelming instead of enjoyable. Keeping this in mind, the researcher limited the transformability options to two functions and explored two options for the garment sleeves: one as a poncho cape, and another as a kimono-sleeved jacket (Figures 4.6 and 4.7). Organic shapes and scallops in the pattern are used to match the floral motifs of appliqués applied on the surface. After obtaining the ideal pattern, the half-scaled patterns were transformed into full scale using a GTCO Calcomp digitizer.

Figures 4.6 and 4.7.

The transformable garment is in two styles

The pattern was cut from Italian creped wool in lilac-blue for the outer layer, and from floral patterned polyester satin in white for the lining. A variety of couture techniques were executed in both sewing the garment and applying embellishments to the surface. The appliqués used for the surface embellishment have been selected and cut

from a floral sequin lace in white and stitched down using invisible slip stitches. A series of embroidered arrows with hook and eyes (Figure 4.8) at each endpoint show the direction of closing darts. Moreover, on each side of the dart legs, a couple of matched motifs were located to create a mirrored image when the dart is closed as well as providing an additional instruction for users. Also, on each shoulder, a small dart is located to follow the body shape. Users can close these darts by following the matched motifs and closing the loops and buttons located on each dart leg. Finally, eight matched motifs around the sleeves' vertical cuts with loops and buttons located on each side, provide an interchangeable possibility for two sleeve styles.

Figure 4.8.

the detail of the arrow with hook and eyes used as a closure

Findings from the Fourth stage: Participants' feedback and Interview Process

At the beginning of the interview process, participants interacted with the transformable garment designed for this study for approximately 10 minutes. Before starting to assemble the garment, the researcher gave participants minimum instructions

about how to follow the guidelines. Finding matched patterns and following the direction of arrows were two main instructions the researcher provided.

Following these instructions, participants were able to assemble the 2D surface to the 3D garment as well as to find the two different sleeve styles without the help of the researcher (Figure 4.9). Six out of seven participants were able to find the poncho cape style first, and another as a kimono-sleeved jacket style in the second attempt. They mentioned that the poncho cape style was less challenging and more straightforward to find. All participants started to follow the arrows and close the hook and eyes to close the garments darts, then followed by closing the shoulder darts. By doing so, they were able to figure out the center front closures (buttons and loops) and follow the side closures to shape the sleeves.

After interacting with the 2D to 3D transformable garment, participants answered questions regarding their experience and interaction with the garment. They also provided their general idea regarding a transformable garment as well as the relation between handmade design and sustainability. The result of the data analysis revealed three major findings. A transformable garment such as this one has two attributes including (a) hedonic attributes; (b) clear instructions; and (c) sustainable features. The clear instruction theme also had two other subthemes (a) less frustrating; and (b) feeling satisfied and accomplished. Figure 4.10 indicated all the themes generated from the interview process.
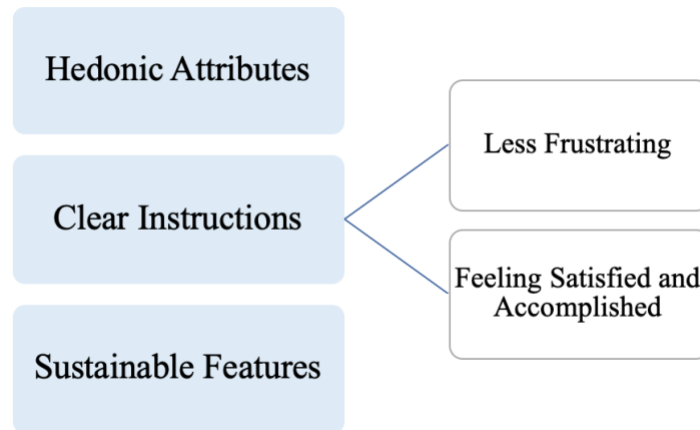
Figure 4.9.

participants' interaction with the garment. They followed the matched patterns and

arrows to assemble the 2D surface and change it to the 3D garment

Figure 4.10.

Themes resulted from the interview data analysis

Hedonic Attributes

Users' feedback revealed this 2D to 3D transformable garment has hedonic attributes. All participants mentioned that interacting with this transformable garment was an enjoyable experience. Participant 9 said, "It was fun to see how it all fits together… it's a new experience for me to put a pattern like this together." Similarly, participant 10 commented, "It was a great experience... in this activity, I felt good." Participant 12 also commented, "It was fun… it's also relaxing, and kind of meditative thing that you do when you dress up." Furthermore, participant 13 mentioned, "It was enjoyable because it made sense. It was easy to figure out how to put the things together."

Participant 14 regarded her experience as, "it's amazing, so wonderful experiencing this." Finally, participant 15 mentioned, "It was kind of like, enjoyable to a degree, you know, the experience of it, watching it when it comes together was cool and enjoyable." According to the literature in chapter 2, a product that fosters a sense of enjoyment in users has hedonic design attributes. Many factors might cause the

enjoyment sense. According to participants' feedback, some of those factors here include easiness in following instructions, being meditative and relaxing, and as they said being fun.

Clear Instructions

Another finding from the interview data was this transformable garment design had clear instructions. The clear instructions designed on the 2D surface assist the users in easily assembling the 3D garment. As participant 11 mentioned, "It was pretty easy" she also compared it with another transformable garment she had experienced before and added, "this was much more obvious because you knew like, there's the little arrow. And you knew that this lines up with that. And so, there are not so many ways that this can line up with that." Similarly, participant 15 said having clear instructions makes the assembling process easy, "I found it to be quite easy based on your instruction to match arrows arrow-like piece to like the piece."

Less frustrating. Also, clear instructions help users to be less confused and frustrated. Participant 9 compared her experience in assembling sewing patterns with the experience she had with this garment. They mentioned that unlike the experience they had with this transformable garment, figuring out the actual patterns is stressful and frustrating,

> And I just remember feeling kind of confused because everything had to be backward… I was having to flip my brain around to conceptualize how the garment went together and a lot of times I had to redo it. And so, it was kind of stressful and frustrating.

They mentioned that they had less frustration in figuring out the 2D to the 3D transformable garment. Participant 10 compared this design with other transformable designs she experienced in the past and mentioned that the lack of clear instructions made her frustrated, "In the past when I tried other dresses that they told me could become like a lot of different things, I got frustrated. So, I stopped." She also pointed out that having too many changing possibilities in some other transformable garments caused that feeling, "It was too many different possibilities! I could figure out one or two, but I could not figure out more than that unless I followed specific instructions." Finally, participant 11 contrasted this design with a transformable wraparound skirt from Urban Outfitters and she mentioned how the lack of clear instructions for that skirt made her frustrated, "they have a video that tells you all these different ways to put it together. And frankly, it's just too fast and confusing." She added, "They're like, oh, you stick this into here, and you do this and do that. And you do it, but it was just too much work and too much thought."

Feeling Satisfied and Accomplished. Well-defined instructions which assist users in easily assembling the garment with no obstacles also create a sense of satisfaction and accomplishment in users. Participant 12 mentioned, "I felt accomplished". Also, participant 10 expressed her satisfaction feeling as,

> It was a great experience. I just had to connect some things. And so, I found it at first, I was like, I'm gonna be bad, but I was actually good. It was, it was nice. I figured out soon what I had to do.

Participant 13 compared this garment with furniture products from IKEA and said, "I suppose you could relate it to putting together furniture or that, you know, if you

get packages of furniture, like IKEA!" she added, "when they fit, it's satisfying. And when you don't understand or you can't figure it out, it's frustrating." She pointed out the clear instructions in this garment and said, "when it's like, this (indicating the garment) was easy… It made sense how to do it, and it was very satisfying." Participant 15 compared her experience with putting together a puzzle and mentioned, "I could compare it to like doing like puzzles or something where something's not together, and then it comes together, and you get to like, see the final piece. So, it's definitely like a satisfying experience."

Sustainable Features

Participants stated that A transformable garment is a sustainable product. Participants gave two reasons for that (a) quality; (b) versatility.

Quality. Participants pointed out that the quality is first then the versatility comes second. They mentioned that they do not sacrifice the quality just because the garment is versatile. participant 9, answering the question *if she keeps a transformable garment for a long time,* mentioned,

> It would all depend on the quality and the material it was made from so if the material held up well, and it was well made with good seams and great craftsmanship, then I will keep it around until it absolutely is falling apart.

On the contrary, she said if the garment is not well executed, she will not keep it "if it's not made well if it doesn't wash or sit very well on my body. Regardless of whether it's versatile or not, I won't keep it around as long."

Similarly, participant 10 regarding the quality of the transformable garment commented "I would keep it provided the fabric stays good. I don't like when the color

fades or the fabric gets, like looks clearly old." They mentioned under this circumstance, they will keep the garment for a long time "if I see that, you know, the fabric stays good, then yeah, I like to keep it because I can use, I guess different styles and so that makes it kind of like different." Participant 11, also, mentioned the quality as a major reason for keeping a transformable garment for a long time "I think this is such a beautiful garment. I wouldn't want to ever get rid of it. I don't know if that is typical of transformable garments. But this is really nice quality and it's it seems very lush."

Versatility. Participant 11 then mentioned the flexibility of use as a second reason for its longevity,

> I think I would wear this every time. Oh, we're going to a party. Let me put on this over my shoulder! Yeah, in one way or another either. I also think as a jacket, it could be a really nice formal presentation jacket. So, I think that gives me a little more flexibility with it.

Similarly, participant 12 mentioned the exact same reason "If I would keep it for a longer time? Absolutely! I mean, if it is something like this, well-made and beautiful" She elaborated on her reason and said "It's not you know, commercially made and disposable. So, because there is I think a value in the handmade…it's something you want to keep in your closet like you keep the art." Participant 13 mentioned both the beauty and versatility of this transformable garment as two reasons she would keep it for a longer time "I think if I had this garment, I would keep it forever. Because it's beautiful. And it's, you could wear it in different ways". Participant 14 regarded mentioned the versatility as the reason and as a substitute for buying more clothes "I keep a very, you know, a limited number of items in my closet, something like that; Absolutely! I would

get to redesign and design all over again, you know." Finally, participant 15 said, "100% you would keep a transformable garment longer. Because you have multiple ways of wearing it." She added, "Being able to have versatile looks with one garment is preferred. And it does make the longevity of the garment longer."

Similarities between the Focus Group and Interview Themes

Comparing the results of data analysis from the focus group process with the interview process revealed some similarities between their themes. However, we consider that participants during the interview process engaged with the final transformable garment, and participants in the focus group had the chance to see a low fidelity prototype for 2D to 3D garments as a pilot study. Clear instructions, intuitiveness for the maker, and hedonic attributes are three similar themes found in both focus group and interview processes.

Clear instructions for guidelines on the 2D surface, was the first overlapping theme. According to participants in the focus group, instructions must lead the user from point A to point B to point C if the purpose of the guideline is to produce something wearable. They mentioned that having defined answers, subjective guidelines, and more points of connections on the 2D surface is advantageous. Similarly, participants in the interview process mentioned that in comparison with other transformable garments they had in the past, the example presented to them in this study was easier to assemble. They emphasized that the clear instructions designed on the 2D surface assisted them in easily assembling the 3D garment.

Intuitiveness for the maker was the second common theme between the focus group and interview processes. According to the result from the focus group, a

transformable garment must be intuitive for a user. Most of the participants in the focus group mentioned their preference to have fewer changing pieces to be able to accomplish the garment assembling task like a puzzle in one sitting. They also mentioned that having a high quantity of changeable pieces makes the assembling task a communal activity rather than an individually doable task. Similarly, participants in the interview process compared the transformable garment design in this study with other transformable garments they experienced in the past. They affirmed that having too many different possibilities in other transformable garments made them frustrated. They mentioned that the transformable design in this study was less frustrating due to having fewer options and clear assembling instructions.

Finally, hedonic attributes are the third similar theme found in both focus group and interview processes. Participants in the focus group process mentioned that guidelines must foster a sense of creativity. They pointed out that having more possibilities to transform the garment was positive, if the guidelines raised the level of enjoyment as well. Likewise, participants in the interview process said that interacting with the transformable garment in this study was an enjoyable experience. According to the definition of hedonic design in chapter 2 of this study, attributes that make an experience enjoyable and foster the user's creativity raise the hedonic feature of a product.

Chapter 5: Conclusion

Chapter 5 contains the following sections: (a) research goals, objectives, and gaps; (b) discussion of findings; (c) contributions and implications; and (d) limitations and future research.

Research Goals, Objectives, and Gaps

This research study aimed to explore strategies for transformable clothing design to engage consumers in the design process, in turn, establish an awareness of sustainable fashion. The first goal of this design research was to create a 2D to 3D apparel design process that places agency in the hands of the user. The 2D to 3D apparel design in this research study was related to the transition of a 2D flat textile into a 3D garment. A crucial goal of the design process was to create a series of transformable garments with embedded instructions, like a map, integrated into the surface design. To that end, a 2D form of the garment as a flat textile supplied a suitable stage for including these instructions. These instructions are intended to aid users in constructing their garment shape variations and deciding to use different and connected parts in choosing multiple ways to wear the garment (Aflatoony, 2019).

Therefore, the second goal of this research study was to evaluate the sense of control and connection between a user and a transformable garment. The primary purpose of this process was to investigate whether this involvement was tied to prolonged clothing lifespan. To achieve this goal, this study used the participatory design research method. Consequently, this study was not only nurtured by the researcher's design development ideas but was also fed by focus group input (participatory design research) conducted before the final design product development phase. The information received

from the participatory design stage was combined with the researcher's tacit knowledge and the information found in literature about specific design strategies for a 2D to a 3D process to develop the final designs. Although the main design choices and creative process in this research were conducted by the researcher/designer, democratization, the theory that guides this project, occurred by giving the user the ability to manipulate the final garment in various forms from a flat shape to a 3D style.

Studying the previous literature, which considered user involvement in the apparel design and construction process, revealed the gap between users' skills and the task in a do-it-yourself task designed for them. As an example, McQuillan et.al. (2018) used digital textile printing to create what they defined as a "way-showing system," for assembling garments but found in initial testing that extensive instructions were needed for inexperienced users. Certainly, including assembly instructions into a 3D design requires an effective communication structure with meaningful information for the user. Further, studies have shown that women attract a source of happiness and a positive sense of well-being by sewing their clothing (Martindale and McKinney, 2020). However, the reality is that most apparel consumers do not have the skills or knowledge to make garments. While including users with no construction knowledge may be challenging due to the lack of willingness to learn the new task, and frustration surrounding technical issues such as fit and lack of ability to troubleshoot these technical issues, the benefit of including neophyte designers in this study had the potential to create a stronger connection with the garment.

Discussion of Findings

To fill the preceding gap in the literature, this study explored techniques to ease user involvement in the construction of a transformable garment without the need for advanced garment construction skills. The data revealed several major themes and sub-themes that explain user-friendly features/instructions to include in 2D to 3D transformable garments for non-skilled users and assessed the users' feelings and feedback on this concept. The features/instructions suggested by this study's themes aided non-skilled users in assembling their transformable garments.

The data collected in this study resulted in six major themes about the design of a transformable garment: (a) more options; (b) intuitiveness for the maker; (c) transformation; (d) hedonic attributes; (e) clear instructions; and (f) sustainable features. Moreover, the findings revealed two more findings on users' feelings in relation with transformable garments with guidelines: (a) the sense of accomplishment increases attachment; and (b) user's feelings on following guidelines depend on the quality of the instructions. Some of the themes, resulting from various stages of this study, overlap in terms of general meaning. In the following paragraphs, each of the themes will be elaborated on in more detail.

More Options

The first theme, *more options*, had two subthemes: (a) clear instructions, and (b) users' creativity. This theme revealed that having more options in transformable garments allows the user to be more creative if the instructions and assembling guidelines are well-defined and clear. This theme emphasized the subject of discoverability introduced in chapter 2 of this study. This finding reveals that the subject of discoverability introduced

by Donald Norman (2013), which is mostly used in the domain of industrial and interaction design, is also applicable in fashion design.

Further, this finding underlines the importance of proper use of signifiers, which is one of the fourth features of discoverability. Signifiers as communication means to show where the action should take place (Norman, 2013) makes it possible for a user to figure out what actions are possible. Under these circumstances, transformational options can be provided in garments. Having more options with well-defined instructions on how to assemble each garment fosters a sense of creativity in users. Therefore, subjective instructions and more options play a crucial role in raising the level of enjoyment and creativity in garment assembly tasks.

Intuitiveness for the Maker

The second main theme, *intuitiveness for the maker*, appeared from the focus group and revealed that a transformable garment must be intuitive for the user. According to this finding, transformable garment designs must be less complicated and more intuitive. Also, being able to carry out the assembling task in a reasonable time was preferred. The use of more pieces might be more engaging and create a sense of accomplishment, however, if the process takes too long, it requires many breaks throughout the process. Therefore, it cannot be done in a time-effective fashion. Consequently, the entire process will be tedious for users. The easiness of assembling in transformable garments were emphasized by scholars previously and found in literature in this study as well. According to Koo et al. (2014) transformable garments that are fun, easy to experiment with, and supply a satisfactory process for the consumer offer hedonic expectations. Also, according to the literature and findings in this study, when designing

a transformable garment, designers must pay attention to simplifying the process of transformation for consumers and provide enough easy-to-follow guidelines or affordances because having too many changeable features can easily overwhelm and confuse the consumer (Koo et al., 2014). Therefore, more pieces in transformable garments become a suitable case for communal activities and not individual tasks.

Transformation

The third main theme, *transformation*, had two subthemes: (a) reduce intimidation; and (b) functional diversity. The third theme for transformable design solution revealed that a transformable garment with instructions should be constructed in a way that encourages a sense of willingness in users to transform garments. The first trait for a transformable garment in this regard is to be less intimidating, less overwhelming, and without any constraints based on users' skill level. Paying attention to users' skill level is fundamental and previously emphasized in literature in chapter 2. When designing a transformable garment, it is crucial to focus on the users' expectations. Designers who follow the strategy of shape-changing designs, as well as knowledge of radical clothing construction, must consider and recognize the physical and psychological abilities of the end wearer (Morais & Montagna, 2015).

Moreover, Cramer (2011) said "to be successful in this model of producing fashion, the designer must (or should) consider the capabilities of the user, as they are likely to have limited skills and to be easily put off by even a reasonable degree of complexity" (p. 442). Therefore, the data from this study revealed that for successful involvement of users in the design or construction process the complexity of this process should be considered. Further, having a variety of closures fosters users' willingness to

transform. Closures can serve as an alternative to permanent stitching, provide a lack of permanence, and change without consequence. Therefore, applying suitable closures on transformable garments, which assure a strong connection between fabric pieces, provides the user the willingness to transform.

Hedonic Attributes

The fourth theme, *hedonic attributes*, emerged from the data. The concept of hedonic design is used to attract consumers to a product with aesthetic features which is understandable and enjoyable for a group of people with a common sense of reference (Vallgårda et al., 2017). Users' feedback revealed that the 2D to the 3D transformable garment designed for this study had hedonic attributes. When interacting with a product is an enjoyable experience, such as the experience participants had with the transformable garment in this study, the product has hedonic attributes. This finding aligns with the previous literature as well. According to the literature in chapter 2, a product that fosters a sense of enjoyment in users has hedonic design attributes. Many factors might cause a sense of enjoyment. According to participants' feedback in this study, some factors that contribute to the sense of enjoyment include ease in following instructions, being meditative and relaxing, and as they said being fun.

Moreover, there is a close relation between hedonic attributes and product longevity and consumer loyalty previously introduced in chapter 2 of this study. Scholars suggest that by offering higher levels of hedonic benefits, designers and marketers enhance a greater level of excitement, delight, and cheerfulness in consumers. Chitturi et al. found increased customer delight resulted from improved hedonics and positively affected the customers' loyalty (Chitturi et al., 2008). Including hedonic attributes in

apparel products such as the example executed in this study, increases the product longevity as well.

Clear Instructions

The fifth main theme, *clear instructions*, emerged from the data. This theme had two subthemes: (a) less frustrating; and (b) feeling satisfied and accomplished. The findings from this research study suggested that the transformable garment designed for this study had clear instructions and the instructions assisted the users in easily assembling the 3D garment. Further, clear instructions, like those provided in this study helped ensure less confusion and frustration among the participants. Similarly, well-defined instructions, which aid users in easily assembling the garment with no obstacles, also create a sense of satisfaction and accomplishment in users. This finding, also, underlines the importance of including discoverability attributes in transformable garments previously mentioned in the first theme. Clear instructions emerged twice from the data, once during the focus group data collection and again as result of the interview data.

Sustainable Features

The sixth main theme, *sustainable features*, emerged from the interview data. Participants stated that a transformable garment can serve as a sustainable product. Participants gave two reasons for that: (a) quality; and (b) versatility. These two design aspects are part of four fundamental design practices by the apparel industry to increase clothing lifecycle: (1) technical quality such as selection of material and finishing to provide durability; and (2) improved clothing features such as fit, versatility of use and appearance to augment the use satisfaction (Laitala, Boks, and Klepp, 2015). In terms of

quality, participants in this study stated that the quality of the garment is one of their first considerations, followed by versatility. Meaning, if the design instructions are clear and all other assembly obstacles were removed, but the quality of the product is poor, the user may discard the garment regardless of versatility.

Participants also stated that the overall versatility of the garment provided a sense of sustainability. This finding was supported by the literature. Understanding the consumer's essential needs of appearance change or emotional experience, also, can lead to products that incorporate those values in new sustainable fashion practices (Niinimäki, 2015). The result of this study also emphasized the ability to change a transformable garment for various occasions. Indicating that the transformation of the garment provides the user with flexibility of use. As a result, users will keep a transformable garment longer because they have multiple ways of wearing it, thus leading to a sustainability factor for the garment. As a general result of this theme, the longevity of a transformable garment is not only contingent upon its transformational features, but the quality of the products in terms of materials, aesthetics and instructions play a crucial role in the user keeping a transformable garment for longer. The finding of this study shows that garment quality is the first crucial factor in users' view and versatility is the second.

Similarities between Themes

Due to the nature of this study, using both focus group and interview methods, the researcher compared the data from both methods and discovered similarities between the two stages of data. The researcher discovered that the themes (a) *clear instructions*, (b) *intuitiveness for the maker*, and (c) *hedonic attributes* were found in both focus group and interview data.

In both the focus group and interview process, participants emphasized that *clear instructions* lead to an easy assembling experience. Subjective instructions, having defined answers, and more points of connection help lead consumers in the assembly process. *Intuitiveness for the maker* was the second common theme discovered between the focus group and interview processes. In both groups, participants stated that transformable garments must be intuitive for the user. Reducing the number of variations available and applying clear assembly instructions are two ways participants suggested for removing frustration and inserting intuitiveness for the users. Finally, *hedonic attributes* are the third common theme between focus group and interview data. According to the definition of hedonic design in chapter 2 of this study, attributes that make an experience enjoyable and foster the user's creativity raise the hedonic feature of a product. Findings from both the focus group and interview revealed that a 2D to a 3D transformable garment with well-defined assembly instructions fosters creativity and raises the level of enjoyment in users.

Contributions and Implications

The study's findings contribute to the existing apparel research literature by providing support for the theoretical framework, *design democratization*, behind this study. According to the theoretical framework, designers, as well as lead-users, are responsible for providing democratization, implementing hedonic design, and creating a sustainable design. Also, the study's findings provide implications for apparel brands, designers, and product development scholars wishing to pursue transformable garment techniques to involve non-skilled users in the construction process. Specific contributions and implications are discussed in the next section per the theory that informed this study.

Theoretical contribution

This study's findings support the underlying argument of democratization, which suggests that design democratization is achieved when designers involve consumers in the final stages of the garment-making process. Democratization can provide the users with a simple hands-on activity and a sense of satisfaction. Based on participants' suggestions in this study, the sense of satisfaction and pride they felt increased their sense of attachment to a self-made product. Their satisfaction and pride, also contributed to the participant's perception of the transformable garment as having increased longevity and sustainability.

Further, according to the data, a 2D to a 3D transformable garment assembly is a relaxing, meditating, and fun process. Therefore, democratization in design will be achieved by providing the participants with a sense of satisfaction in transformable garment assembly. Moreover, the data supported an argument that the *user's feelings on following guidelines depend on the quality of the instructions*. According to this finding, the sense of satisfaction resulting from the democratization of design will depend on the quality of instructions provided for the garment. In other words, as participants said, good gameplay directions depend on how easily a user could move through instruction steps. On the contrary, convoluted, and messy instructions create feelings of frustration.

This study's findings also support the underlying argument for implementing a hedonic design to raise the level of enjoyment in consumers. According to the literature, the concept of hedonic design is used to attract consumers to a product with aesthetic features which is understandable and enjoyable for a group of people with a common sense of reference (Vallgårda et al., 2017). According to the results of this study, a 2D to

3D transformable garment with well-defined instructions for assembly raises the level of enjoyment and creativity. Likewise, participants in the interview process said that interacting with the transformable garment was an enjoyable experience. According to this result, such a design could contribute to a sense of enjoyment and creativity in users, and therefore, contain hedonic design features.

This study's findings also support the underlying argument for creating a sustainable design with the 2D to the 3D transformable garment. According to the literature, to increase the lifespan of a product, designers must adopt strategies to make them both "enjoyable" and "useful" to increase the level of attachment (Laitala et al., 2015, p. 103). Also, researchers found that handcrafted items have a longer period of use in comparison with purchased items, therefore, they are considered more sustainable (Lee, & DeLong, 2017). Although not all apparel consumers can make, repair, or handcraft fashion products, creating a design system, such as the one designed for this study, _ for empowering consumers to have a greater contribution to apparel construction would augment their sense of involvement and emotional bond with their product. Further, the study's findings suggest that the users' ability to redesign a transformable garment and providing multiple ways to wear the garment are positive attributes that encourage the consumer to own the transformable garment longer, thus leading to a sustainable approach. Figure 5.1 includes the conceptual model of the theoretical framework with related themes connected to each section.

Figure 5.1.

Theoretical framework with related themes
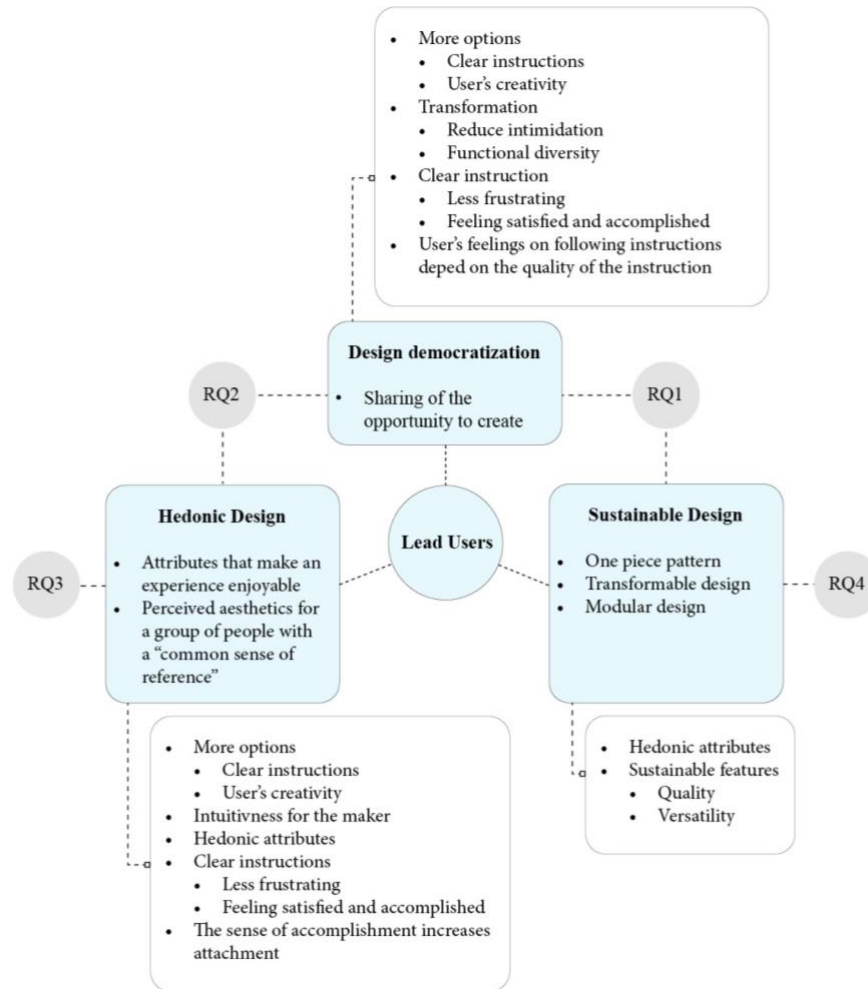
According to the results regarding the theoretical contributions, this study

provides adequate responses to the four research questions. The first research question

investigates how does a hands-on experience shift the roles of users with limited/no

clothing making skills from passive consumers to active users? The data analysis

revealed that the 2D to the 3D transformable garment assembly can change the role of a

passive consumer to an active user if the assembly process is easy to follow providing

clear instructions on 2D surface. The second research question asked how are design challenges alleviated during the transformable garment design process? The result from the data analysis revealed that by creating intuitiveness for the maker, reducing intimidation, providing functional diversity, and implementing clear instructions in transformable garment, the garment assembly task for end users will be a pleasant experience.

In response to the third research question about what values can be generated by garment changing activities without using professional garment construction techniques? The data analysis result suggested that users by assembling this type of garment will experience variety of feelings including satisfaction, accomplishment, pride, enjoyment, being creative, and attachment. Finally, the last research question asked how does transformable garment design impacts users/consumers' perception/attitudes towards sustainable fashion? This study's findings also support the underlying argument for creating a sustainable design with the 2D to the 3D transformable garment. Empowering consumers to have a greater contribution to apparel construction would augment their sense of involvement and emotional bond with their product. Increasing the emotional bond and sense of attachment resulted from the transformable garment assembly encourage the consumer to own the transformable garment longer, thus leading to a sustainable approach.

Practical Implication

Democratization of design provides implications for apparel brands, designers, and product development researchers. By involving consumers in the final part of the garment-making process and providing consumers with a simple hands-on activity, a

more inclusive product offering can be supported. As mentioned previously in this study, most apparel consumers do not have the skills or knowledge to make garments that follow a do-it-yourself garment-making process. Consequently, adopting a strategy that supports hands-on engagement in a transformable garment could be beneficial for both skilled and non-skilled consumers. Thus, providing a more inclusive and creative process without the need for garment-making knowledge.

The study's findings related to the implementation of hedonic design in transformable garments have implications for apparel brands and designers that may be considering ways to raise the level of enjoyment in their products. When apparel brands and designers consider implementing hedonic design features in transformable garments, the findings suggest that providing subjective instructions on the 2D surface could raise a sense of creativity and enjoyment. Participants in this study stated that having more possibilities to transform the garment was positive if the instructions also increased the level of happiness.

For apparel brands and designers, the ability to provide the consumer with a 2D to 3D transformable garment, with appropriate and intuitive instructions, will support a sustainable strategy for the apparel brand. According to the data from this study, being able to have versatile looks with one garment is preferred by users, and it makes the longevity of a garment longer. For apparel brands and designers, who are exploring options for sustainability in their product offering, using transformable garment design could contribute to increased sustainability efforts among their consumers, thus leading to increased sustainability achievements by the apparel brand.

Limitations and Future Research

As is the case with most research, this research has areas that could be improved. First, this study did not use a specific age range classification for participants. The participant recruitment criteria for both the focus group and interview were mainly based on an individual's gender and skill level in garment making. For future studies, focusing on a specific age range could provide new insight into differences between results from each age range.

Second, due to time limitations, this study examined one single 2D to 3D transformable garment design. For future studies, more variations of transformable garment styles and transformational options could be provided for participants' evaluation. With the inclusion of more transformable designs, the research could have provided a more in-depth perspective into all areas of the theoretical framework for this study. Therefore, future researchers could expand the study by including more examples of 2D to 3D transformable garments and examine how unique styles and options affect the result.

In this study, the combination of single/minimal pattern piece design and transformable design were used to introduce garment assembling process with instruction for non-skilled users. Other than these two apparel design methods, the concept of garment assembling process with well-defined instructions for non-skilled users could be expanded to other apparel design methods such as variety of modular designs explored in chapter 2 including component modular design, geometric modular design, and compounded modular design. All these three main modular design groups could be a suitable stage for the garment assembling concept introduced in this study. Not only apparel items, but also, using pictography and combining the surface decoration with

instructions for non-skilled users to assemble a product could be a suitable method to use in other fashion products including accessories such as shoes and bags.

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Appendix A

IRB Approval Letter

Institutional Review Board
University of Missouri-Columbia
FWA Number: 00002876
IRB Registration Numbers: 00000731, 00009014

310 Jesse Hall
Columbia, MO 65211
573-882-3181
irb@missouri.edu

March 24, 2022

Principal Investigator: Lida Aflatoony
Department: Textile and Apparel Mgmt

Your IRB Application to project entitled Assessment of User Democratization in 2D to 3D Garment Assemblage was reviewed and approved by the MU Institutional Review Board according to the terms and conditions described below:

IRB Project Number	2090409
IRB Review Number	374587
Initial Application Approval Date	March 23, 2022
IRB Expiration Date	March 23, 2023
Level of Review	Exempt
Project Status	Active - Exempt
Exempt Categories (Revised Common Rule)	45 CFR 46.104d(2)(ii)
Risk Level	Minimal Risk
HIPAA Category	No HIPAA
Approved Documents	Informed Consent & Assent - Consent (Exempt Studies Only): #588172 Informed Consent & Assent - Consent (Exempt Studies Only): #588173 Other Study Documents - Focus Group Protocol: #585374 Other Study Documents - Interview Questions: #585373 Recruitment Materials - Recruitment Flyer: #588170 Recruitment Materials - Recruitment Flyer: #588171

The principal investigator (PI) is responsible for all aspects and conduct of this study. The PI must comply with the following conditions of the approval:
- No subjects may be involved in any study procedure prior to the IRB approval date or after the expiration date.
- All changes must be IRB approved prior to implementation utilizing the Exempt Amendment Form.
- Major noncompliance deviations must be reported to the MU IRB on the Event Report within 5 business days of the research team becoming aware of the deviation. Major deviations result when research activities may affected the research subject's rights, safety, and/or welfare, or may have had the potential to impact even if no actual harm occurred. Please refer to the MU IRB Noncompliance policy for additional details.
- The Annual Exempt Form must be submitted to the IRB for review and approval at least 30 days prior to the project expiration date to keep the study active or to close it.

- Maintain all research records for a period of seven years from the project completion date.
  If you are offering subject payments and would like more information about research participant payments, please click here to view the MU Business Policy and Procedure: http://bppm.missouri.edu/chapter2/2_250.html

If you have any questions or concerns, please contact the MU IRB Office at 573-882-3181 or email to muresearchirb@missouri.edu.

Thank you,
MU Institutional Review Board

Appendix B

Oral Concept Script for the Focus Group

Project Title: Assessment of User Democratization in 2D To 3D Garment Assemblage

Principal investigator/Researcher: Lida Aflatoony

Advisor: Dr. Li Zhao

Script

You are being invited to take part in a research project. You must be 18 years of age or older. Your participation is voluntary, and you may stop being in this study at any time. The purpose of this research project is to explore strategies for transformable clothing design to engage consumers in the design process, in turn, establish an emotional bond to build the awareness of sustainable fashion. The purpose of the research is to generate new and innovative garments which could provide the transition of the 2-dimensional flat textile into a 3-dimensional shape. You are being asked to answer some basic questions regarding transformable garments, share your ideas about the transformable garment, your experience regarding making products following guidelines, and help the researcher during the focus group to identify user-friendly closures and design features for generating 2 dimensional to 3 dimensional garments. Your participation should last up to 60 minutes. For your time and effort, we will be offering compensation in the amount of $10 gift card. The information you provide will be kept confidential and only the research team will have access.

If you have questions about this study, you can contact the University of Missouri researchers, Lida Aflatoony, at (573) 476-2442 or lidaaflatoony@mail.missouri.edu, and Dr. Li Zhao at (573) 882-9638 or zhaol1@missouri.edu. If you have questions about your rights as a research participant, please contact the University of Missouri Institutional Review Board (IRB) at 573-882-3181 or muresearchirb@missouri.edu. The IRB is a group of people who review research studies to make sure the rights and welfare of participants are protected. If you want to talk privately about any concerns or issues related to your participation, you may contact the Research Participant Advocacy at 888-280-5002 (a free call) or email muresearchrpa@missouri.edu.

You can ask the researcher to provide you with a copy of this consent for your records, or you can save a copy of this consent if it has already been provided to you. We appreciate your consideration to participate in this study.

Appendix C

Oral Concept Script for the Interview

Project Title: Assessment of User Democratization in 2D To 3D Garment Assemblage

Principal investigator/Researcher: Lida Aflatoony

Advisor: Dr. Li Zhao

Script. You are being invited to take part in a research project. You must be 18 years of age or older. Your participation is voluntary, and you may stop being in this study at any time. The purpose of this research project is to explore strategies for transformable clothing design to engage consumers in the design process, in turn, establish an emotional bond to build the awareness of sustainable fashion. The purpose of the research is to generate new and innovative garments which could provide the transition of the 2-dimensional flat textile into a 3-dimensional shape. You are being asked to interact with a sample garment generated in this study. Additionally, you will be asked to answer some basic questions regarding transformable garments and your experience from interaction with sample garments. Your participation should last up to 60 minutes. For your time and effort, we will be offering compensation in the amount of $10 gift card. The information you provide will be kept confidential and only the research team will have access.

If you have questions about this study, you can contact the University of Missouri researchers, Lida Aflatoony, at (573) 476-2442 or lidaaflatoony@mail.missouri.edu, and Dr. Li Zhao at (573) 882-9638 or zhaol1@missouri.edu. If you have questions about your rights as a research participant, please contact the University of Missouri Institutional Review Board (IRB) at 573-882-3181 or muresearchirb@missouri.edu. The IRB is a

group of people who review research studies to make sure the rights and welfare of participants are protected. If you want to talk privately about any concerns or issues related to your participation, you may contact the Research Participant Advocacy at 888-280-5002 (a free call) or email muresearchrpa@missouri.edu.

You can ask the researcher to provide you with a copy of this consent for your records, or you can save a copy of this consent if it has already been provided to you. We appreciate your consideration to participate in this study.

Appendix D

Focus Group Questions

Title: Assessment of User Democratization in 2D to 3D Garment Assemblage
Principal Investigator: Lida Aflatoony
Advisor: Dr. Li Zhao
Demographic Information
1. Current geographic location (city, state):
2. Age:
3. Gender:
4. Race or ethnicity:
5. How many years you know patternmaking and sewing?

RQ1. How hands-on experience shifts the roles of users with limited/no clothing-making skills from passive consumers to active users?

- Look around in your home or office and notice which task requires a completion guideline and hands-on practice.
- If your answer to the previous question was yes, what did you feel after making it?
- Have you ever made something following guidelines? If yes, what did you do?
- Do you like resolving puzzles? If yes, please explain if you like the puzzle with more pieces or less?
- How do your feelings differ between something that you make and something that you shop?

RQ2. How are design challenges alleviated during the transformable garment design process?

- Please assemble these kits following guidelines and share your opinion at the end of the process regarding the closures and guidelines provided on each of them. Explain what you think, like, or dislike about them.
- Please define the level of complexity and pleasure of each one from 0 to 10.
- What do you think about constructing your garment based on the guidelines without technical requirements of garment construction?
- What do you think about the idea of a transformable garment which provides a variety of styles in one garment?

Appendix E

Interview Questions

Title: Assessment of User Democratization in 2D to 3D Garment Assemblage

Principal Investigator: Lida Aflatoony

Advisor: Dr. Li Zhao

Demographic Information

6. Current geographic location (city, state):

7. Age:

8. Gender:

9. Race or ethnicity:

10. What type of hand craft techniques you know?

RQ3. What values can be generated by garment changing activities without using professional garment construction techniques?

- How was your experience during the 2D to 3D garment assemblage?

- Think about this experience and try to find a similar experience you had before. How you feel during these types of activities?

RQ4. How does transformable garment design impacts users/consumers' perception/attitudes towards sustainable fashion?

- Think about a product that you've made. It shouldn't necessarily be from fashion products. Tell me how long you kept and used it?

- Do you think you keep a transformable garment for a longer time or not? Please justify you answer.

Vita

Lida received her undergraduate degree from the *University of Science and Culture* of *Tehran/Iran* in *Clothing and Textile Design* (Honors: Cum Laude), followed by her master's degree from *The Polytechnic University of Milan, Italy* in *Design for Fashion Systems.* Upon completion, she spent five years working in high-end apparel design companies in Milan. Throughout her nine years of studying and working in Milan, her knowledge of apparel production, technology, and design concept expanded considerably. She had the good fortune to work in both ready-to-wear and high-fashion production contexts and learn both industrial and bespoke production techniques. During her industry experience in Milan, she identified several real-world issues in apparel and textile design. In today's world, the scope, implications, and rates of change of these critical problems are unlike anything the research community has faced before. Therefore, solutions to these problems have the potential to change the way all of us live. With that in mind, she left Milan to pursue her Ph.D. in *Textile and Apparel Management* from the *University of Missouri* in Columbia. her goal in attaining her Doctoral degree has been to develop the research and technological skills to understand and address some of those core issues as well as explore possible apparel design solutions for under-served market needs through qualitative and quantitative research. Also, pursuing her education at a higher level at Mizzou has given her the opportunity to share her previous expertise in apparel production with other scholars in this field through different research studies. Lida's research interests include design innovation, user participatory design solutions, sustainable product development, sizing, digital apparel design and fashion technology in apparel production.