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**Using Origami for Creative Design and Pattern Development in Fashion Education**

**Moda Tasarımı Eğitiminde Yaratıcı Tasarım ve Kalıp Geliştirme için Origami Kullanımı**

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***Arastırma Makalesi / Research Article***

## USING ORIGAMI FOR CREATIVE DESIGN AND PATTERN DEVELOPMENT IN FASHION EDUCATION

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**ABSTRACT:** Situation based design-thinking challenges the designer to innovate while applying knowledge and skills in search of design solutions. This research explores design thinking and investigates a methodology for fashion design education, which assists students with 3-dimensional creative thinking. The project was implemented with a group of 2nd year students from the Department of Fashion and Textile Design as a controlled exercise. With a focus on the transitional process from 2-dimensional ideas to 3-dimensional products, origami was selected as an inspiration point to explore complex structures, firstly in paper before reinterpretation in fabric as a skirt design. Overall results indicated that this project proposes a successful methodology for fashion design education in order to develop creative thinking. This approach to fashion design and pattern making education offers a more contemporary experiential path for design students in order to develop innovative structures by unifying making with design process.

**Keywords:** Fashion design education, pattern making, garment structure, origami, creativity

### MODA TASARIMI EĞİTİMİNDE YARATICI TASARIM VE KALIP GELİŞTİRME İÇİN ORİGAMI KULLANIMI

**ÖZET:** Duruma yönelik tasarım odaklı düşünce yaklaşımı (Situation based design-thinking), tasarımcıları, bilgi ve yeteneklerini kullanarak tasarım çözümleri bulmak üzere, yenilikler aramaya yönlendirir. Bu çalışmada, tasarım odaklı düşünce yaklaşımı ile, moda tasarımı eğitiminde üç boyutlu yaratıcı düşünceyi teşvik etmek üzere geliştirilen bir süreç incelenmektedir. Araştırma için, Moda ve Tekstil Tasarımı Bölümü 2. sınıf öğrencileri ile bir uygulama gerçekleştirilmiştir. İki boyutlu fikirlerin üç boyutlu giysilere dönüştürülmesi sürecine odaklanarak yürütülen uygulamanın esin kaynağı olarak origami seçilmiş; böylece, öncelikle kâğıt üzerinde tasarlanan ve daha sonra kumaş ile yeniden yorumlanıp etek tasarımına dönüştürülen yaratıcı giysi yapılarının geliştirilmesi amaçlanmıştır. Çalışma sonuçları, projede uygulanan yöntemin, moda tasarımı eğitiminde yaratıcı düşünmeyi geliştirmek üzere başarılı bir yöntem olduğunu göstermektedir. Moda tasarımı ve kalıp hazırlama eğitimi için önerilen bu süreçte, giysi yapımı ve tasarım aşamaları birleştirilerek, tasarım öğrencilerinin deneysel bakış açılarını geliştirecek ve yenilikçi giysi yapılarına ulaşmalarına yardımcı olacak güncel bir yaklaşım sunulmaktadır.

**Anahtar Sözcükler:** Moda tasarımı eğitimi, kalıp hazırlama, giysi yapısı, origami, yaratıcılık

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## 1. INTRODUCTION

In order to develop more innovative structures and silhouettes in fashion, most of the recent approaches and discussions in this field focus on creative pattern cutting techniques and unifying making with design process.

Pattern making, through the technique of draping on the mannequin or flat pattern making, is the craft of modelling shapes around the body. Within this process, Aldrich (1997) underlines the importance of thinking 3-dimensionally (3D) by “designing round the figure”, and highlights the challenges involved, “when one has to relate flat pieces of paper to a design which is basically sculptural when completed.” [1, p4]

With an increase in the body of research in design disciplines, methods of design education and design pedagogy have been a major topic for discussion over the last decade. Although inextricably linked, fashion design and pattern making are frequently separate within the fashion design curriculum. With fashion design, a focus on nurturing creativity and originality is at the fore, whereas pattern making is frequently approached from a purely technical standpoint. However, contemporary fashion design education moves towards the idea of the designer as pattern-maker and vice versa, bringing these two disciplines closer together into one interconnected body. In her discussion about fashion design pedagogy, Gully (2010) suggests that teaching pattern making and construction in fashion design was previously grounded on a craft based model, where students copied samples. However, she believes that making should be combined with an understanding of design process in order to open up new perspectives for design students, adding that, “Fashion design must move between 2-dimension (2D) and 3-dimension (3D), in order to establish what the speculative garment actually is. Design doesn’t suddenly stop, and making begin.” [2, p44].

Numerous experimental models exist for creative pattern making, and we believe that educational models should be developed for fashion design students, where students can be supported to generate a creative approach to 3D garment structure. Designers often focus primarily on the design outcome, driven in search of a design solution to meet the demands of the problem, in fashion the finished garment. Any reflection on the design process is frequently overlooked; in this context, as Cross (2011) suggests, “enthusiasm lies in what they produce, and not how they produce it.” [3, p6] Within the field of fashion design development, this approach can prove problematic, as the process, in particular the pattern making process, is fundamental to creating a successful design outcome.

Lawson & Dorst (2009) offer three types of design thinking, which can be considered in the context of developing a fashion design educational model. “Convention-based design thinking” where-in a set of rules determine modus operandi within a field. Within the realm of fashion design, the idea of strict rules and parameters correlate most succinctly with conventional pattern making techniques. As Lawson & Dorst (2009) point out, “an over-reliance on these conventions can lead to standard, run-of-

the-mill solutions”, [4, p68] which in terms of fashion design and pattern making means reversion to basic products shapes. A second approach “Strategy based design thinking” sees the designer consciously develop an original process and develop a design situation for themselves, which on an undergraduate student level would prove much too challenging [4].

“Situation-based design thinking” offers the most viable model for this study, in that the designer develops a tailored response suited to a particular design challenge. The designer innovates while applying knowledge and skills to generate a fitting design solution [4]. Ironically, this approach to design development is not far removed from how traditionally garments were created in the past by a tailor or couturier, when design and production were one and the same thing, as mentioned by Cross (2011, p4):

“In traditional, craft based societies the conception, or ‘designing’ of artefacts is not really separate from making them; that is to say, there is usually no prior activity of drawing or modelling before the activity of making the artefact. ... The process of making somethings does not normally start before the process of the designing is complete” [3].

Within the context of design thinking, this research takes origami as inspiration and investigates a method that can be used as a driver for developing creativity in relation to structural design and product development together in fashion design education. This “situation-based design thinking” approach enables students to apply existing pattern making knowledge and sewing skills, but at the same time encourages a more individualistic innovative approach to reinterpret the origami structures as design solutions.

Origami as an inspiration point is frequently used in fashion design. As claimed by Choi (2016, p213) “Origami provides a toolkit for transformation through its various structural qualities. The diagrammatic relations of origami can help fashion designers explore new forms while expanding the present framework for garment construction” [5]. Derived from *ori* meaning folding and *kami* meaning paper, origami is a traditional Japanese folding art used to create both two-dimensional (2D) and three-dimensional (3D) subjects such as figures, animals, and flowers. Most origami is folded from square paper and from a single sheet [6].

Niedderer and Roworth-Stokes (2007) discuss how creative practice can be used in research in valid and rigorous ways, and develop a generic framework for the contribution of practice-led design to the body of knowledge [7]. Origami was used by Choi (2016) to generate creative patterns in fashion design, where this practice-led design framework was applied. As highlighted in this article “origami paper planes demonstrate the infinite potential to be developed into creative patterns for fashion design, due to their structural similarities, through the manipulation of even the smallest details when folding and refolding” [5, p210].

Taking origami as an inspiration, this research investigates a new design process developed to help students generate structurally creative designs. By analysing the line, shape, and structure in a

chosen origami model, students are challenged to use this as the inspiration point to develop more structurally interesting garments, removed from basic pattern blocks. The objectives of the research can be itemized as follows:

- Objective 1. To explore the creative potential of origami as an integral element in a fashion design process
- Objective 2. To evaluate a methodology for a fashion design process which aims to assist students with creative thinking
- Objective 3. To investigate the design education process of generating 3D experimental structural garments, probing the transition from 2D plane to 3D structure
- Objective 4. To utilize origami to develop knowledge and understanding of complex structure translated through pattern making for fashion design students
- Objective 5. To investigate the benefit of working with small-scale collaged paper designs for fashion design students during the design development process

This project differs from similar approaches in origami as a fashion inspiration as it focuses on design development and pattern making together. For many students, pattern making can be a challenging part of their studies. This reinforces ideas explored by Almond (2010) that due to the technical nature of pattern making, students are often put off which has a knock-on effect on their creative process [8]. This project, therefore, strives to develop a system wherein pattern making and design become interdependent on each other. A contemporary approach to fashion design studio places as emphasis on process and conveying the idea of “design thinking” to students [2]. This project offers a comprehensive step-by-step design process from craft to design, which also integrate design thinking and making.

## 2. ORIGAMI AND FASHION

### 2.1. Origami in Contemporary Fashion Design

An examination of origami influences in the practice of contemporary fashion designers enables us to establish a context for this project in relation to contemporary fashion design. Choi (2016) identifies two approaches to origami inspired fashion design categorized as the deconstructive Japanese style and the constructive design approach that “fuses decorative origami detailing with the Western couture tradition” [5, p214].

The deconstructive approach to origami-inspired design has evolved from the Japanese school led by the likes of Issey Miyake, Rei Kawakubo, Yohji Yamaoto and their prodigy’s Junya Watanabe, and Dai Fujiwara. Japanese rituals, traditions, cultural heritage, rich textiles and advanced technology have played an integral part in their practice, with key cultural references such as origami frequently referenced. Their work is often “imbued with the history of the past, yet looks dynamically toward the future” [9, p6].

Issey Miyake has regularly drawn on this cultural heritage. The Pleats Please collections evolved from his experiments with traditional Japanese pleating and folding techniques wherein

fabrics sandwiched between two layers of washi paper were permanently pleated. The 2011 Fall Issey Miyake collection by designer Dai Fujiwara (Figure 1) presents an “inventive insight into the process of design” wherein “black-clad assistants folded and stapled paper tape, origami like, into five items of clothing: a tailcoat, a dress, a skirt, a peplum jacket, a collar. Models wearing these paper garments were followed by other girls wearing fabric versions of the same look.” [10].



Figure 1. Issey Miyake Fall 2011 Ready to Wear by Dai Fujiwara

The brand “132.5” was developed through a project, which began in 2007 as a collaboration between Miyake and Reality Lab. By exploring new production methods, they created a series of garments made from single pieces of flat cloth folded in an origami form with permanently heat-set folds (Figure 2). The website explains, “The brand name refers to the way a piece of cloth (“1D”) takes on a three-dimensional shape (“3D”) and is then folded into a flat surface (“2D”), and the way that wearing it transforms it into a presence that transcends time and dimensions (“5D”).” [11].



Figure 2. 132.5 Issey Miyake brand

Miyake’s research in this field has paved the way for a new generation of designers to explore the idea of folding to create folded malleable surface texture. One designer working in a similar manner is German Julie Waibel who explores “pleated

patterns and transforming structures” similar to origami which are used in transformable garments such as dresses and also designs objects and accessories [12].

The constructive approach to drawing inspiration from origami is more apparent through Western designers practice. John Galliano’s critically acclaimed Spring Summer 2007 show for Dior couture inspired by "Pinkerton's affair with Cio-Cio San, Madame Butterfly" is a strong example of this approach. In this collection, Galliano fused the classic Dior silhouette with structural origami elements, “Each look sprouted yet more miraculous planes of origami folding, their stiff geometries creating necklines like flowers or hovering birds.” [13].

Other designers who have explored this route include Viktor & Rolf, whose Fall 2011 collection offers “ultramodern version of the origami-inspired jackets has structured folds and pleats starting at the collar and traveling the length of the arms to the wrists” [14].

The Marchesa Spring Summer 2010 collection features origami elements while the Spring 2009 collection by André Lima at the Sao Paulo Fashion Week is inspired by geometrical shapes and origami animals [15].

## 2.2 Origami in Contemporary Fashion Design Education

Traditionally in fashion design education, pattern making is approached from two perspectives, flat pattern making, and draping. However, currently new methods are being developed and explored in order to create new structures, but also to entice students to the field of pattern making. Shingo Sato’s Transformational Reconstruction (TR) method is one example of this trend [16]. His method is comprised of many facets including new directions for the body, 3D textile effects from origami manipulations, complex concepts in folding, forming, and layering, and precision pattern cutting. Another contemporary approach by fashion designer and academic Julian Roberts is called 'Subtraction Cutting', which refers to an experimental method of hollow construction [17]. Another useful and popular resource for fashion design students is the “Pattern Magic” series. Tomoko Nakamichici, former professor of Bunka Fashion College in Tokyo and author of this series, presents a systematic guide to creating sculptural clothing using intricate pattern making techniques. Her books are comprised of research into garment patterns which are used as a basis to instruct her students. She explores the process of developing structural garments and explains, “Making a pattern is as fascinating as trying to solve a puzzle” [18, p26].

As another interesting source in this field, in her book entitled “Fashion Pattern Cutting: Line, Shape and Volume” Zaman (2014) explores the fashion process from research to garment production by proposing a simplified step-by-step introduction to creative and complex pattern making. She takes architecture, natural forms and origami as three key sources of inspiration [19].

As a successfully applied teaching and learning project in this field, Almond’s (2010) analysis of the final year fashion design students’ works at the University of Huddersfield explores how

the boundaries of fashion design can be extended with creative pattern cutting [7]. Within the context of creative pattern cutting, origami shapes offer new forms for fashion design with their hand-crafted and transformable features. In Choi’s 2016 practice-led research, he methodically explores the application of a variety of folds into the various pieces in his collection, experimenting with the triangle fold, squash fold, and reverse fold [5]. Such techniques can be easily applied as student projects to develop creativity. Wu (2003) applied origami techniques to develop his master thesis collection by experimenting with different fabrics, and a variety of folding patterns for innovative wearable garments [20]. Origami is frequently used as an inspiration point in fashion design education, and many cases of such projects can be exemplified.

## 3. PROJECT PROCESS

### 3.1 Background

Within the context of situation-based design thinking, this research study analyses a design methodology which aims to generate creative 3D thinking and to encourage a more innovative approach for pattern making.

Through the aim of this project, a student project was selected for analysis. The project was conducted on a cohort of 15 students in the second year of study on a degree course in fashion and textile design. In the first year of their studies, students undertake a general interdisciplinary design education, whereas in the second year, they begin to specialize in the fashion design field. In the first semester of second year, the students undertake a fashion design studio course and an introductory pattern-making course.

This origami skirt project is scheduled as the first project in the second semester of the second year of study. It aims to amalgamate and reinforce skills acquired in the first semester fashion design studio and pattern-making courses. It aims to use origami as a catalyst to explore structure and develop on pattern making knowledge, in order to generate more structurally interesting design outcomes by moving away from basic block shapes and simple silhouettes. Figure 3 illustrates the connection between 2D and 3D elements of design process.

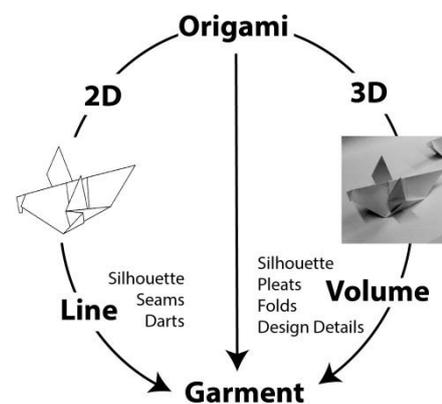


Figure 3. The design process from origami to garment design

## 3.2 Project Realisation

### 3.2.1. Class Supervision

The project is conducted over five classes, four hours in duration each. All aspects of the design development, pattern, and sewing process are executed during class hours only. Students submit all project work at the end of each class, which are returned to them at the beginning of each session. This controlled environment facilitates the assessment of student levels and skills, and aids with monitoring the process. The strict schedule also focuses students on the task at hand, encouraging them to maximize their time wisely.

Students are required to source all necessary project materials prior to beginning the project including white paper, sticky tape, calico fabric, fusible, zipper, scissors, and pattern rulers. This facilitates the smooth running of the project and avoids wasting time.

The project brief focuses specifically on a skirt design. In the first semester of second year, students acquire basic design and pattern knowledge for this specific product family. In addition, the relatively simple character of a basic skirt allows for the application of more complex structures.

### 3.2.2. Origami Paper Shapes

As the starting point for the design process, students select one of six basic origami shapes. Simple animal and bird shapes are intentionally chosen including the crane, crab, bird, butterfly, pelican and owl. Pre-cut paper squares, 30x30 centimetres in size, are provided. An instructional A4 worksheet offers clear directives on how to fold each shape in a series of steps. While referencing the instructional worksheets, students are asked to use the paper square to create their chosen shape.

On completion of the exercise, students are instructed to make a photographic record of their origami shape from different perspectives, as an additional visual source and for inclusion on the presentation board later.

### 3.2.3. Collaged Design Development

For the design development process, students are instructed to work on small-scale paper collaged skirt designs as opposed to sketching their ideas.

Working with small-scale basic skirt silhouettes, students are encouraged to carefully examine the structure of their origami shape and consider how it might be reinterpreted and reintegrated into the skirt. Using scissors, they are advised to dissect the origami shapes and small-scale paper skirts while contemplating how they might be reassembled as a skirt design. Students are asked to explore the scale of the origami shapes in relation to the scale of the skirt. Using this cut and collage method, they develop three design variations.

Students are offered some general indicators on how they might transform the standard skirt silhouette:

- Change the position and angle of seam lines and darts
- Divide the skirt panels into different sections

- Make inserts such as pleats into the seams
- Change the waist position or add a waistband
- Raise, lower or angle the hemline
- Add layers, pleats, or volume
- Create functioning design details such as pockets or fastenings

On completion of the exercise, students are instructed to make a photographic record of their collaged skirt designs from a front and back view.

### 3.2.4. 3-dimensional Skirt Development

Students are informed that they may work with draping, flat pattern making, or a combination of both techniques for the production of their skirt. Tailor's dummies and a basic straight skirt block are provided.

After selecting one design from the design development stage, students are asked to make a final prototype using calico fabric. By limiting fabric choice to calico, students could focus on garment structure and recreating the origami structure using a basic woven fabric.

While developing the pattern, students are advised to correctly mark pattern pieces with seam allowance, straight of grain, darts and notches. Due to the complexity of the origami structures students are also recommended to devise a system to correctly name the various pattern pieces. Even with an experimental design, students must ensure that garments are correctly finished by adding fusible to waist bands or facings, and by adding a fastening such as a zipper.

Similar to the previous steps, students photographed their final products on a mannequin. As a final step, presentation boards were prepared to include a visual record of their project process.

## 3.3 Evaluation of Student Work

The students' process, including the evolution of the design development, creative pattern development and final product realisation were closely monitored by the instructors throughout the duration of the project. This close supervision enabled instructors to observe and assess the design and production process, as well as the final product. This offered a comprehensive overview of the entire process, which facilitates a more informed debate on the process as an educational project at third level education.

In addition to this, final products were evaluated by 10 jury members from the Department of Fashion and Textile Design over a two-day period. Projects were presented on tailors dummies with presentation boards positioned next to each design. Jury members completed an evaluation sheet comprised of 30 questions. Segmented into five parts, the order of the questions follow the project process steps. 5 point Likert scale from strongly agree to strongly disagree was used to rate each response. The questions being organized into five segments in the evaluation sheet provided a base for further discussion and personal communication regarding the project development process and the final design outcomes.

A revised version of the questionnaire was applied to the students. Some questions related to process and methodologies were eliminated, and students were redirected to focus on questions related to the product results and creativity.

## 4. RESULTS

### 4.1. Instructor evaluation

#### 4.1.1. Origami paper shapes

The process of folding paper to create the origami shape, as opposed to working from a photograph is critical. The hands-on experience of creating a 3D form from a simple flat plane in paper is crucial to focus the student on 3D thinking, which can later be translated into skirt designs. Similar to the process of origami, the flat pattern making process also transforms a flat plane, albeit fabric, into the 3D structure of a garment. By following a simple systematic process to make the origami shape, it emphasizes the multi-layered, overlapped, 3D aspects of the origami shape. It enables students to understand the possibilities, function, and limitations of each fold as they advance through the exercise of developing the origami shape as illustrated in Figure 4. Some details in several final products show evidence that students have translated origami folds into creative structures in the skirt as shown in Figure 5.

#### 4.1.2. Collaged Design Development

This is the first point at which students are challenged to consider how the origami can be utilised as the inspiration for a skirt design. The process of cutting, collaging, and combining the origami shape with a basic skirt silhouette enables students to experiment with a small scale experimental model of their design. Working with the folded origami, cutting and positioning it with the paper skirt model, helps students consider scale, position and function of the 3D elements of the folds. Being able to physically touch, flip, turn and reposition the folded paper in relation to the skirt shape helps students envisage how such elements could be integrated into a full-scale skirt.

In addition to the speed and ease of working small scale, using a cheap accessible material such as paper reduces any anxiety about making mistakes. This initial design development step helped to bridge the gulf between inspiration source and skirt design. Working with collage also eliminates the need for sketching design ideas. The process of sketching design ideas can be daunting for some students who do not like drawing, and poor drawing skills can create a poor or inaccurate representation of the origami linear elements. More importantly drawing a 2D representation of a 3D element regresses and reduces the understanding of the 3D elements design process. Figure 6 illustrates how a student has successfully integrated the origami structure into the design.



Figure 4. Making the origami shape and applying it to a skirt design using collage

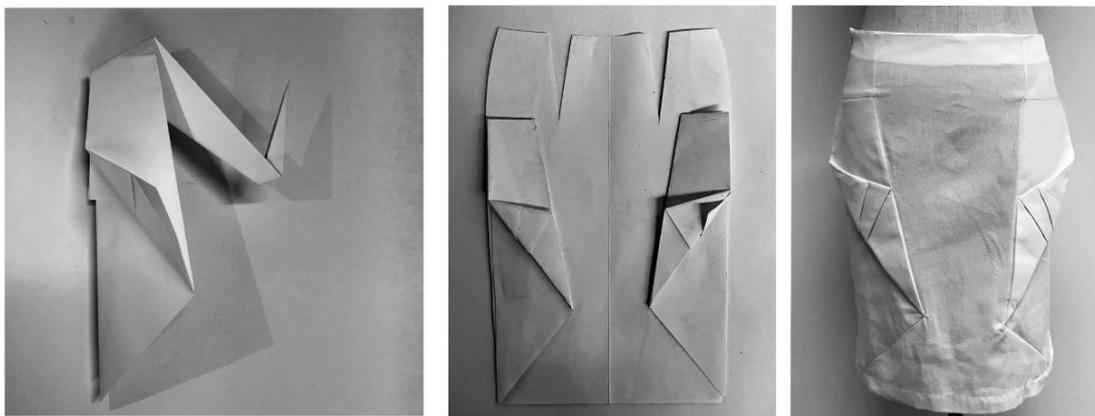
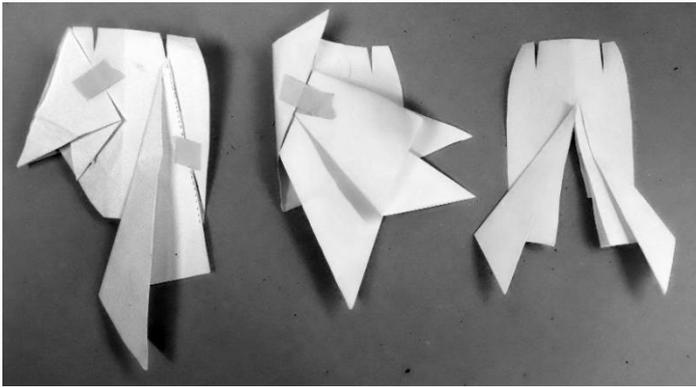


Figure 5. Step by step application of origami to a final skirt (First two images are in small scale, whereas the rightmost image is in real scale of a skirt)



**Figure 6.** Three design development experiments

#### 4.1.3. 3-dimensional Skirt Development

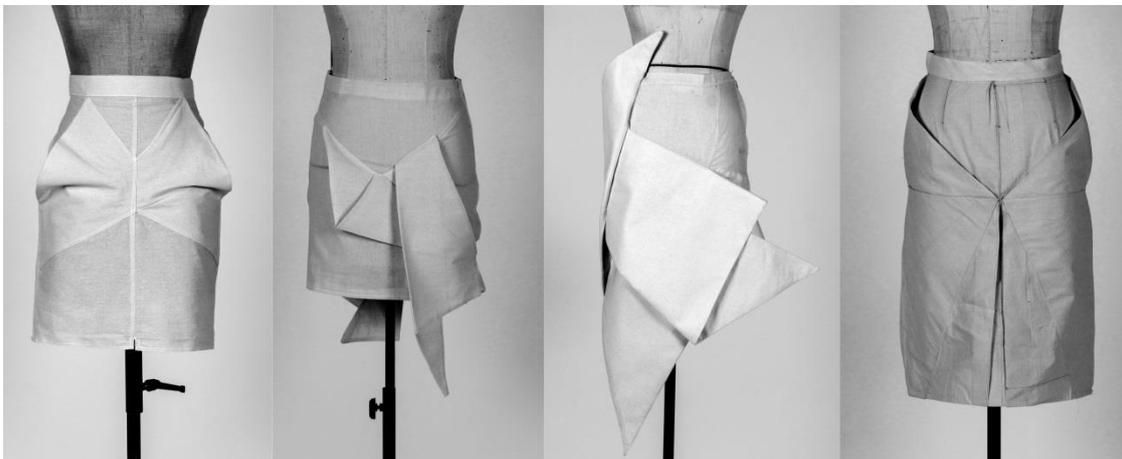
Amongst 15 students, one student preferred to use draping only, 11 used flat pattern making while 4 students used a combination of both methods together. The student who use draping only to develop the prototype worked solely by cutting and folding fabric, which was applied directly to the mannequin. The students who opted for flat pattern making carefully analysed their small-scale paper skirt models, dissecting them to carefully understand where the origami inserts and applications were

positioned, and used flat pattern making to recreate their idea as a full-scale paper pattern, which they then used to create the final prototype. Another small group used both of the methods described above, developing their own unique approach to arriving at the final prototype.

All approaches enabled students to move from the initial origami structure into a full-scale skirt design drawing inspiration for either silhouette, cut, or structure, or a combination of these. Figure 7 illustrates four examples from final skirt designs.

#### 4.2 Expert Evaluation

Before evaluating the design outcomes jury members (experts) were informed to disregard any quality issues related to the sewing on the products. As well as completing the evaluation sheet, they were asked to comment on their favourite and least preferred part of the project, and were asked for feedback on how, in their opinion, the project might be improved. The most significant results of the survey are given in Table 1 and Table 2. Table 1 includes the highest scores, where most jury members agreed strongly, whereas Table 2 includes the lowest scores with the lowest grades from the jury members and with a higher standard deviation amongst the results.



**Figure 7.** A selection of finished skirt samples

**Table 1.** Highest scores from experts (starting from the highest)

	median	max	min	std dev	total value
This project proposes a methodology for a fashion design process which aims to assist students with creative thinking	5	5	4	0,40	48
Making small scale collaged design development (combining the origami with the basic skirt) helps to recognize how origami can be integrated or developed into the structure (cut) of a skirt design	5	5	4	0,40	48
Making origami paper shapes helps students to understand the transition from a 2-dimensional (2D) plane to a 3-dimensional (3D) structure by folding paper	5	5	3	0,60	48
This project allows students to see the potential in origami as an inspiration for garment construction which can be eventually interpreted as a skirt design	5	5	3	0,60	48

**Table 2.** Lowest scores from experts (starting from the lowest)

	median	max	min	std dev	total value
Students have a tendency to revert back to basic block shapes	3,5	5	2	1,19	37
Students have a tendency to revert back to standard dart placement	3,5	5	3	0,78	37
Making small scale collaged design development (combining the origami with the basic skirt) helps to move away from basic skirt design structures	4	5	2	0,94	41
This project generated structurally interesting outcomes	4	5	3	0,70	41
Students have a tendency to applique shapes to mimic the origami shapes	4,5	5	2	0,98	42

According to the survey results, most jury members evaluated the project successfully. The most appealing outcome was given in the uppermost row of Table 1 with the highest score, claiming that this project proposes a methodology for a fashion design process, which aims to assist students with creative thinking. This was one of the main aims of the project and was claimed to be successfully achieved (Objective 2 in Section 1). A highly successful phase of the project was designated by jury members as the small scale collaged design development (combining the origami with the basic skirt) helping to recognize how origami can be integrated or developed into the structure (cut) of a skirt design. This was calculated as the second highest ranking given in Table 1, which refers closely to Objective 5 of this research. However, one jury member disagreed stating that this step did not help to move away from basic skirt design structures (Table 2-row 3). Another objective of this project was to help students understand the transition from 2D plane to 3D structures (Objective 3 in Section 1), and this is linked with the third highest score in Table 1. When investigated in this project, the creative potential of origami as an inspiration for garment construction was favourably mentioned by the experts (Objective 1 in Section 1).

The most noticeable results from Table 2, the lowest scores, indicated that students have a tendency to revert to basic block shapes and standard dart placement, and appliqué shapes to mimic the origami shapes. Even though some jury members strongly agreed or agreed with the structurally interesting outcomes of this project, two jury members neither agreed nor disagreed with this. Since design ideas strongly depend on personal taste and the success of final products are also dependent of student capabilities, these results are taken as further discussion issues.

Even though highest and lowest scores are highlighted as the main outcomes of the questionnaire in Table 1 and Table 2, it was noted that the general tendency with the scores were high and close to each other. The values given in Table 1 are low in comparison to the rest of the scores, but still high with an average of 3 (neither agree nor disagree) or 4 (agree). Overall, most jury members agreed with the contribution of this project as a successful method for fashion design education.

In addition to the questionnaire results, jury comments from personal communication after the questionnaire were analysed and summarized in the categories below.

### *Applying Origami to the Skirt Structure*

Most jury members questioned whether the brief had instructed students to develop ideas through appliqué, or to work solely in 3D. One jury commented that both approaches were plausible stating, “half of the designs appear to be appliqué and half are structurally integrated, neither of these appear to be a bad process of working – both gave results.” One jury member appreciated that some students were able to apply the exact same folds to the fabric as they discovered in the paper trials. However, another jury commented that an exact replica of the origami shape could be construed as costume, and therefore commended a renewed interpretation of the origami.

One of the aspects that was pointed out was the fact that, for some students, regular straight skirt patterns were taken as a base, on which folded fabric was attached. Another related issue highlighted that since students had already learnt the basic skirt block, it was construed as limiting to their creativity as it generated hesitation to experiment and move away from the basic skirt structure.

Focusing on one side of the garment only, meaning that design ideas mostly for the back were frequently missing, was deemed problematic. A failure to consider the skirt as a 3-dimensional entity meant that the front of the skirts achieved the primary aims of the project whereas the backs were sometimes not properly considered in the design process.

For some experts, the process of transition from origami to skirt design needed to be more 3d spatially experimental, and it was suggested that the 2d to 3d development phase could be trialled with a transitional step using large scale paper experiments.

### *Design Details*

Several jury members commented that darts in standard positions were apparent on many of the designs. Another noted that the side seams and zippers appeared to be positioned ‘straight’, at 90-degree angles, arguing that it did not fit well with the irregular lines of the origami shapes.

To move away from basic shapes and lines it was suggested to integrate more structural dress making details such as pleats, and drapes into the designs. Shapes were also noted to be sometimes transferred to function such as a curved fold that functions as a pocket, and a folded strap that functioned as a belt closure.

### Scale

Working with small-scale design ideas was deemed a good idea, however it was noted that results may vary when applied to the real large-scale designs as some aspects of the design may need to change to work correctly on the body. One respondent noted that this process helps students learn the importance of scale, which is something they could apply in future projects.

### Fabric Choice

Calico was acknowledged as a good choice due to the stiff handle and characteristics that resemble paper. Some difficulties arose when sewing multiple folded layers of the calico, which was noted as one of the disadvantages of this fabric.

One jury member recommended that exploring different fabrics in this project would allow students to understand how fabric can influence the final design outcome by affecting the silhouette and fit.

### Student Level

It was noted that results are changing from one student to the other according to ability; some successful and some less successful design outcomes are presented. It was suggested that increasing the number of student participants could help to give a more comprehensive analysis of the success of such a project.

### Timing

No clear consensus about the timing of the project could be reached. Several respondents recommended moving the project

to an earlier point in the curriculum suggesting it could be approached in a more experimental way before students begin to worry about wearability. One suggested moving it to the 1<sup>st</sup> semester of the 2<sup>nd</sup> year. On the contrary others stated that the 2<sup>nd</sup> year was too early, instead suggesting it could be part of a 3<sup>rd</sup> year deconstruction project where they felt it would achieve better results as students would have more experience pattern making. If applied to more advanced levels, it was proposed that colour could be integrated as another parameter to highlight the structure.

### Comparisons

One jury member referred to a previous student exhibition they had visited in Antwerp where students had presented full-scale paper origami dresses with no neckline or sleeves. While comparing these projects, it was commented that, in their opinion, this project was more successful and valuable as it helped students to transfer from paper to fabric and working in calico helped to improve their construction and sewing skills.

### 4.3 Student Evaluation

Survey results from 15 students were evaluated through similar criteria as academics so that a comparison could be conducted. The most significant results of the survey are included in Table 3 and Table 4. Table 3 includes the highest scores, where most students agreed strongly, whereas Table 4 includes the lowest scores with the lowest grades from students and with a higher standard deviation amongst the results.

**Table 3.** Highest scores from students (starting from the highest)

	median	max	min	std dev	total value
This project proposes a methodology for a fashion design process which aims to assist students with creative thinking	5	5	4	0,46	75
This project encourages an independent experimental approach to pattern making in order to translate their design ideas	5	5	3	0,61	73
This project allows students to see the potential in origami as an inspiration for garment construction which can be eventually interpreted as a skirt design	5	5	3	0,61	73
This project helps students to consider proportion and scale when integrating origami ideas into the skirt design	5	5	3	0,61	72
This project focuses students on complex structure which is translated through pattern making	5	5	2	0,79	72

**Table 4.** Lowest scores from students (starting from the lowest)

	median	max	min	std dev	total value
Students have a tendency to revert back to standard dart placement	4	5	1	1,22	62
Students have a tendency to revert back to basic block shapes	4	5	3	0,72	62
This project generated structurally interesting outcomes	4	5	3	0,70	65
This project demonstrates that basic origami structures translate well into experimental skirt structures	4	5	3	0,53	67

According to the results obtained from academics and students, the majority of students and academics agreed that this project proposes a methodology for a fashion design process, which aims to assist students with creative thinking. This item from the survey was listed on the top of Table 1 and Table 3 by acquiring the highest scores. Another highest score from students was about the encouragement of this project as an independent experimental approach to pattern making in order to translate their design ideas, which suggests that students enjoyed the process. This result shows similarity to the statements in the literature review, where it was claimed that traditional pattern making can be challenging for students, and might have a knock-on effect on their creative process [7]. Therefore, such projects, where pattern making and design are interdependent, and 2D pattern and 3D garment construction are integrated for design development, add value for contemporary fashion design education.

Lowest scores from students and from academics aligned with the suggestions of reverting back to standard dart placement and basic block shapes. As another significant result of the questionnaire, it was noted that students were not confident about generating structurally interesting outcomes. This was a similar outcome to the academics. Even though, the project process is definitely seen as a supportive approach for creative design, outcomes of the project were not satisfactory for both the academics and the students. This might be dependent on the student capabilities; therefore, in order to verify the results, a similar project process will be applied to another group of students, and will be evaluated in a similar methodology as further work.

## 5. CONCLUSIONS AND FUTURE WORK

Origami is often used in fashion design as a conceptual starting point for contemporary collections as well as educational projects. This project introduces origami as a catalyst for combining fashion design, pattern making and the garment construction process. Situation-based design thinking enables students to apply existing knowledge and skills while searching for innovative design solutions inspired by the origami structure. The structural nature of origami provides a useful creative reference point to enable students to understand the transition from a 2D plane to a 3D structure. This concept can be applicable in paper for an origami model, in small scale collaged paper designs, and also in fabric for a garment prototype inspired by origami. Although 1/5<sup>th</sup> and half-scale methods are common within the field of pattern making, working with small scale collaged paper designs as part of the design process is relatively unusual. The questionnaire results suggest that a majority of students and academics agreed that making small scale collaged design development develops creativity as a design development process, and enables students to quickly envisage the application of 3D structural design elements. The introduction of origami as the foundation for garment construction, integrated as a part of design development, connects the pattern making to the design process as they become interdependent on each other. This offers

students an alternative to the technical aspects of pattern making, and instead presents garment construction as a more experimental process, like an art form. This approach to fashion design and pattern making education, moves away from the traditional ‘teach and tell’ methods, derived from “Home Economics” curriculums and offers a more contemporary experiential path for the current generation of design students [21].

An analysis of the process, final prototypes, expert and student evaluations shows a consensus with regards to the success of the suggested methodology. Details of a student project are introduced within this paper, offering a comprehensive educational source for fashion design teaching including project outline, results and evaluations.

As future work, this project will be improved and repeated with another group of students wherein different fabric qualities and structural design details will be given as parameters at the beginning of the process. A variety of fabric qualities will be explored to ascertain their affect on the silhouette and structure of origami-inspired designs and to familiarise students with the properties and characteristics of different fabrics. A stronger focus on applying the 3D aspects of origami to the human body will be considered, incorporating a step in the process to allow the students to experience large-scale paper structures directly on the mannequin. It was seen that students often reverted back to a standard skirt block, this seemed to inhibit a truly experimental approach to 3D pattern development, this aspect of the project will be revised.

An analysis of the results confirms that origami can be used to develop the creative potential within the fashion design process. It was noted that building the origami shape helps students understand the possibilities, function, and limitations of each fold, which consequently assists in translating such structures in to a skirt design.

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