A Study on the Production Methods of Upcycling Tweed Fabric Using Clothing Waste Based on Chanel's Tweed Design

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Abstract: This study aimed to produce upcycled tweed fabric using clothing waste, and to this end, weaving methods for tweed were designed, and the creative upcycling of tweeds was produced. For the improvement in the quality of recycled fabrics and to produce creative, upcycled tweed designs, four weaving methods were designed based on Chanel's tweed design. Various types of discarded clothing waste were collected and used as materials. The upcycling tweeds produced were evaluated by experts based on the factors of novelty and appropriateness. As a result of the evaluation, all of the upcycled tweed fabrics presented excellent creativity scores. The creativity score was high when different materials, such as yarn and fabric tape and yarn and bead, were used. Tweed weaving is not difficult to perform, and our interest increased during the weaving process. The creativity of upcycling tweed fabric was discussed in depth, centered on experts who evaluated upcycling tweeds. Through this study, the possibility of popularizing the upcycling of tweed fabric using clothing waste is expected. This study is meaningful in that it presents aesthetic and functional utilization methods for decreasing clothing waste and shows the possibility of creative changes made to clothing waste.

Keywords: upcycling tweed; Chanel's tweed; recycling of clothing waste; weaving methods

1. Introduction

1.1. Concerns about the Sustainability of Clothing Waste

Cloth, one of the causes of environmental pollution, is made of synthetic fibers, making it difficult to biodegrade; hence, it is mostly incinerated. A small number of old clothes in different forms and conditions are packaged and exported and are eventually thrown away [1,2]. It is beneficial to the environment to purchase only as many clothes as are necessary, or to wear existing clothes for a long period of time; however, the number of clothing items, increasing with rapidly changing fashion trends, is roughly equivalent to the amount thrown away.

Most clothing waste comes from fabric products that have undergone various processing processes that help human life. The most common way to dispose of clothing waste is by incineration and landfill, but clothing is difficult to dispose of easily due to already-applied clothing finishing processing such as flame-retardant treatment [3–5]. In addition to topics related to solving the problem of the incineration of flame-retardant fibers, extending the lifespan of fibers, and environmentally friendly decomposition of technical fibers, the process of thoroughly limiting and managing textile consumption and disposal is being studied. These previous studies considered a plan to change the entire process from fiber creation to incineration in an eco-friendly manner with the theme of 'cradle to cradle' and 'end-of-life' strategies [6–9].

Upcycling designs have been consistently attempted over the past decade in the fashion design field. Upcycling, the opposite concept of downcycling, is a recycling method approach that uses waste to make products of higher retail value than conventional recycled goods. Various upcycling methods have been considered for the eco-friendly recycling of clothing waste generated in daily life. In the field of fashion, methods using waste

or surplus resources [10–12] and circular fashion designs by developing fabric-cutting techniques [13–16] have been studied as promising upcycling methods. In addition to the environmental and economic implications of saving resources and minimizing waste, upcycling fashion designs means that the product availability before upcycling is extended, and the good properties of variable raw materials are maximized [17].

Fashion materials used for upcycling are mainly discarded yarn and fabric or clothing products that have already been used [10–18]. The fabric and clothing products are dismantled for upcycling production; subsequently, they become thread-like or small pieces of fabric before being sewn. Small pieces of fabric are re-cut into new forms through several steps or necessary additional processes [14–17]; however, relatively long threads decomposed from large pieces of fabric or knitwear can be used as they are. If the yarn is dismantled from discarded or unworn knit clothing and upcycled, the new item can be made of cloth with a different composition from the original material while retaining the advantages of yarn [10]. Weaving cloth by hand, instead of using a machine, has the disadvantage of taking a lot of time and effort, but it has the advantage of displaying artistry and uniqueness [11]. Handcrafted fabrics represent respect for the environment, and at the same time, the creativity and uniqueness of the producer appear, and the items are treated as artworks [18,19].

1.2. Research Objectives and Research Process

This study focused on the expansion of the recycling of various random post-consumer clothing waste generated in daily life with the end consumer of textile products in mind. The purpose of this study is to present an upcycling tweed production method for producing a new fabric using post-consumer cloth waste, thereby increasing the utilization of various randomly discarded materials. To achieve this goal, this study designed methods of producing creative, upcycled fabrics using yarn discarded from old clothes and an analysis of the weaving methods of Chanel's tweed design, one of the most high-end fabrics in the industry, for designing weaving methods. The reason tweed was selected is that it is a plain weaving fabric that is simply constructed by a crossing warp and weft design, and it can be easily and simply manufactured without using a machine [20]. In addition, various colors and types of threads can be used for weaving tweed. The texture of the threads used to create tweed is well known, and it can seem soft, but it is actually rough, open but warm, and has an artistic appearance [21]. Chanel's tweeds are made of many threads of various colors and appear in various fashion items in recognition of its artistry and luxury [22–25]. Thus, we produced creative tweeds using discarded clothing and threads and artistically transformed low-quality products that were almost discarded.

The purpose of this study is to design a weaving method for tweed production with the aim of producing upcycling tweeds using clothing waste as materials, and to produce creative tweeds based on this. This study aims to achieve the purpose of sustainability and upcycling, and at the same time, to produce improved creative and aesthetically pleasing fabrics using randomly generated clothing waste. The procedure of this study is as follows.

In the first section, Chanel's tweed fabric, a reference brand for weaving design, was examined, and based on this, four tweed fabric manufacturing methods were designed. To examine the weaving design of tweed, images of clothes and accessories using tweed fabrics are collected from products sold on Chanel's official site (www.chanel.com, accessed on 12 April 2022.) [26]. The products that appeared on the Chanel site were products released for the S/S Collection in 2022, the Cruise Collection in 2021/22, and the S/S Free Collection in 2022.

In the second section, clothing waste was collected, and weaving was performed based on the designed weaving methods. In this part, the process of dismantling clothes into a thread for tweed upcycling was first performed. The thread was discharged from the collected waste sweater, and long cloth tape was cut from fabric and woven clothing. The dismantling process was conducted by students who participated in this project. After that, recyclable yarn was selected, and upcycled tweeds were produced.

The last section is the evaluation phase. An evaluation was conducted on whether the fabric of the upcycle tweed was creative, whether the sustainability goal was successfully achieved, and whether the designed weaving method helped create the creative fabric. The evaluation was carried out by experts and creators. Tweeds were evaluated for their creativity by experts. The students who produced the tweed evaluated the difficulty of the weaving design method, their understanding of the weaving process, and their interest in the weaving process. After the objective evaluation was completed, the experts who participated in the evaluation participated in the focus group interview under the theme of the design method designed in this study and the creativity of the calculated results.

2. Literature Review

2.1. Upcycling as a Principle of Creative Design

Upcycling is a recycling method approach that differs from downcycling, which uses waste to make products with a lower retail value than conventional recyclable materials. Discarded textile products are easy to obtain in daily life, and can be recycled for other purposes if the physical properties and functions of the raw materials have not completely disappeared during the use process. However, many users who are likely to generate clothing waste in real life do not know how to recycle and find it difficult. This is because upcycling, which is a widely known method, has always been an industry-level practice method [27–31].

Fashion brands have publicly revealed at the industrial level how systematic and professional the use of materials, pattern making, and processes are and how they are eco-friendly and applied as products. However, this is achieved only from an industry-level expert point of view, and when considered from the end user's point of view of generating more end waste, it is contrary to expectations that it will be cheaper than new products, and that it will be more design-friendly because it is re-produced.

Small fashion companies and individual designers are attempting to produce artistic upcycling products with craftsmanship to bridge the gap in the degree of achieving sustainability goals at the industrial and consumer level and establish the same direction of sustainability goals. They use a variety of small amounts of random materials to differentiate product design and apply customized craftsmanship [32–34]. This method is also used in education to train fashion design experts, and the connection to sustainability, creativity, and artistry is widely used as a topic for thinking of design method strategies [35,36]. Clothing waste is suitable for fashion students who need to practice design to become experts, and students can learn the concept and practice of sustainability to become ethical industry workers while developing creativity and artistry using random materials. This is why the goals of upcycling and sustainability can be linked to creativity. Creativity has various definitions in the fields of politics, psychology, education, and art, but what these definitions have in common is that it converges into something new and valuable based on creative thinking [35–43]. Newness is the concept of novelty, originality, and making something that has never existed before, and valuable means that it is useful, applicable, and appropriate [37,43]. In any field, it is not sufficient to judge the creativity of the creator (producer) only by the result of creation. The integrated judgment of the results and thinking process accompanying creation results in a correct 'creation' evaluation [37].

2.2. Chanel's Tweed Design

Tweed is a thick, coarse, woolen fabric made using a plain or twill weaving method, mainly those used in traditional Scottish and British clothing [20,21]. Tweed is soft, open, and flexible, and has a visually rough and bumpy feeling [22]. Tweed is usually made of 100% wool that has excellent elasticity and durability properties. The weight of the fabric and its heavy feeling make it appear warm and luxurious. Recently, as a representative fabric of Chanel, tweed has been used as a fabric with a classic atmosphere of high-end clothing.

"Chanel's tweed" refers to the fabric Chanel prefers to use for suit items at the Haute Couture House in Paris [15]. Chanel's tweed was developed in the 1920s by Coco Chanel as a practical material and began to serve as a fabric for comfortable and stylish outfits for women. Since then, in Chanel's fashion collection, tweeds have been used every season as fabrics for various fashion items, and tweed items have been treated as high-end products [24,25].

To analyze Chanel's tweed design pattern, tweed fabric products sold on Chanel's official site were collected and classified. As of April 2022, the products uploaded to the site for sale were products from the 2022 S/S Collection, 2021/22 Cruise Collection, and 2022 S/S Free Collection seasons. A total of 120 products were obtained from Chanel's official site. The number of ready-to-wear products was the highest, followed by shoes, bags, and goods. Colors were categorized into black, white, red, blue, and other colors. Other colors appeared in a mixture of pink, purple, yellow, and multiple colors. Table 1 classifies the types and colors of Chanel's tweed products. Chanel's tweed fabric is made of various colors and types of yarn. In particular, for a unique feeling of tweed, it is woven using a more coarse-textured fancy yarn than smooth, normal yarn. The type and color analysis used in Chanel's tweed products shows that threads with various random colors and textures can be used to produce upcycled tweed using clothing waste and to develop products.

Table 1. The types and colors of Chanel's products using tweed.

Type of Fashion	Color				
	Black	White	Red	Blue	Etc.
Ready to wear	42	11	4	5	30
Shoes	2	4	0	0	9
Handbags	3	2	0	0	7
Goods	1	0	0	0	0
Total	48	17	4	5	46

Chanel's tweed was classified according to the yarn's type, texture, and color. The type of yarn used in the tweed was a general, normal yarn of uniform thickness and a complex yarn with a special appearance for a fancy effect. The texture of the tweed, smooth or rough, depended on the type of yarn, and unique patterns were revealed depending on the type and color of the yarn. Chanel's tweed types could be divided into four categories (Table 2). Type 1 comprises tweeds with the classiest appearance, which use one color and a fancy type of yarn. This type is characterized by the rough feeling of thread appearing on the fabric's surface and is mainly characterized by simple 1 × 1 plain weaving. This type mainly incorporates one solid color and has been found in products with restrained decorations and trimming and a luxurious appearance. Type 2 comprises tweeds in which two or more colors of a similar or different feeling of yarns were used simultaneously. This type is categorized further into three factors: tweeds using two colors of similarly textured fancy yarn (Type 2-1), two differently textured yarns (Type 2-2), and three or more colors of yarn (Type 2-3). By observing the woven pattern, it can be seen that Types 2-1 and 2-2 mainly present check patterns. To emphasize the check pattern, two contrasting colors or coarse-feeling contrasting threads were used with smooth threads. For Type 2-3, the overall tweed color varied between black, blue, and purple. Type 3 comprises tweeds made of thin and long fabric tape with colorful, fancy yarns. In this type of tweed, the pattern, color, and width of the tape yielded the tweed's overall appearance. Type 4 comprises tweeds used with beads. The tweeds decoratively expressed the luxury of the Chanel brand using beads. Table 2 classifies the types and colors of Chanel's tweed products.

Table 2. Four types of Chanel's tweed reference pictures, classified according to the yarn's type, texture, and color.

Type of Tweed	Chanel's Tweed References	
Type 1	Type 1. https://www.chanel.com (accessed on 12 April 2022) [18])	Tweeds using one color, one-type textured fancy yarns.
Type 2	Type 2-1. https://www.chanel.com (accessed on 12 April 2022) [18])	Tweeds using two colors and similarly textured fancy yarns.
	Type 2-2. https://www.chanel.com (accessed on 12 April 2022) [18])	Tweeds using two colors and differently textured fancy yarns.
	Type 2-3. https://www.chanel.com (accessed on 12 April 2022) [18])	Tweeds using various colors of similarly textured fancy yarns.
Type 3	Type 3. https://www.chanel.com (accessed on 12 April 2022) [18])	Tweeds using fabric tapes with fancy yarns.
Type 4	Type 4. https://www.chanel.com (accessed on 12 April 2022) [18])	Tweeds with beads.

2.3. Tweed Pattern Design

The purpose of this study is to manufacture fabrics that create a feeling similar to the high-quality Chanel tweed fabric using low-grade clothing waste as materials. It is important to mention that Chanel's weaving method is Chanel's own technology developed before the author's research, and it will be different from the weaving method proposed by the author.

Based on Chanel's tweed design discussed in Section 2.1, four types of tweed-weaving methods were designed by the author. Figures 1–9 are diagrams of the weaving method

created by the author, referring to Chanel's tweed design. For each type of tweed, the types of threads that should be used for warp and weft were classified into thread numbers. The types of threads were expressed with color in the diagrams. Type 1 tweed was woven into a (1 × 1) (X × Y: $X_{the\ number\ of\ warp\ yarn}$ × $Y_{the\ number\ of\ weft\ yarn}$) [44–47] basic, plain weave (Figure 1). Type 1 is the most basic weaving method, but when using threads from post-consumer clothing waste, a fancy effect can be expected in textile design due to artificial fabric crimps, color change, and deformation. Types 2, 3, and 4 are advanced versions based on Type 1. Type 2-1 tweed was designed so that two-color, textured fancy yarns were arranged and woven with regularity via warp and weft, and a check pattern appeared after the weaving was completed. This type can be categorized into tweeds with 2 × 2 (Figure 2) and 4 × 4 (Figure 3) repeat-weaving patterns. Type 2-2 tweed comprised two types of threads with contrasting textured fancy types, and the color and texture of the number 2 thread for the check pattern stood out more than that of the number 1 thread used for the base. Figure 4 depicts a tweed pattern with an 8 × 8 repeat-weaving pattern using two colors, and Figure 5 depicts a tweed with a 6 × 4 repeat-weaving pattern using the same color but with different textures. Type 2-2 tweed was designed in a repeat pattern similar to the Chanel tweed reference. Type 2-3 tweed comprised threads of various colors woven together. Figures 6 and 7 depict tweeds using three and four colors of threads, respectively. Type 3 tweed was composed of fabric tape with threads; in Type 3, four different-colored threads were placed on the warp line, and three types of tapes and number 1 thread were placed in an alternating pattern for the weft line (Figure 8). Type 4 tweed was a mixture of beads in the Type 1 tweed-weaving method, and various designs were possible based on the bead arrangement (Figure 9).

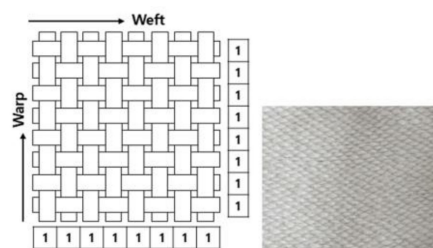



Figure 1. Weaving design for Type-1 tweed, and reference tweed.

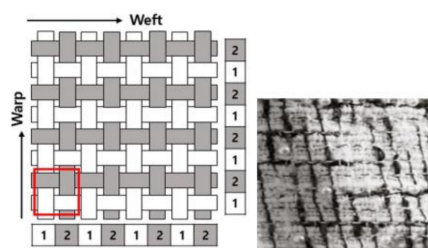



Figure 2. Weaving design for Type-2-1 tweed with 2 × 2 repeat, and reference tweed.

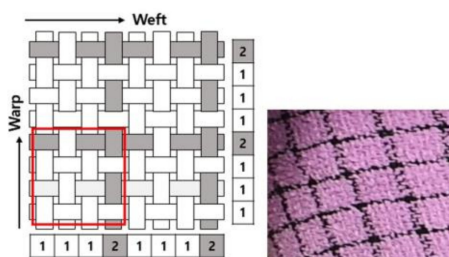



Figure 3. Weaving design for Type-2-1 tweed with 4 × 4 repeat, and reference tweed.

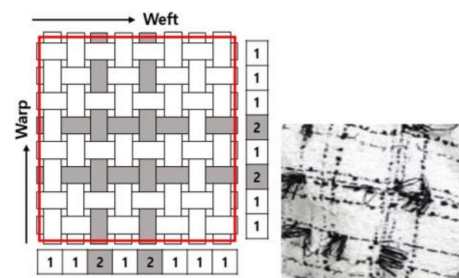



Figure 4. Weaving design for Type-2-2 tweed with 8 × 8 repeat, and reference tweed.

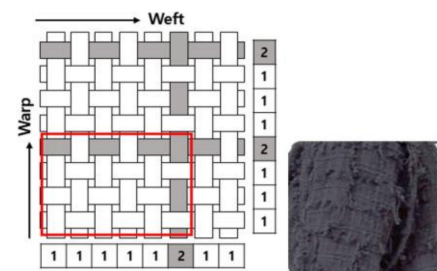



Figure 5. Weaving design for Type-2-2 tweed with 6 × 4 repeat, and reference tweed.

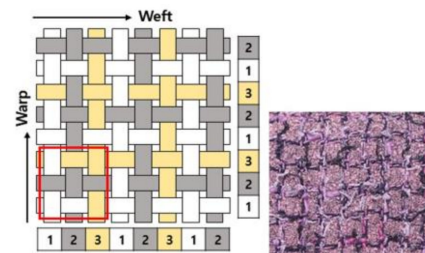



Figure 6. Weaving design for Type-2-3 tweed with three-colored yarn, and reference tweed.

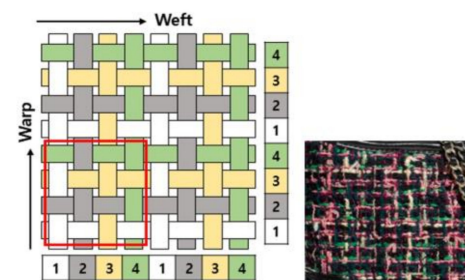



Figure 7. Weaving design for Type-2-3 tweed with four-colored yarn, and reference tweed.

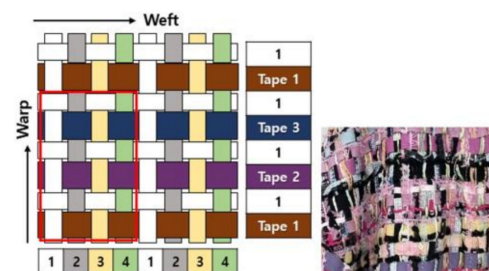



Figure 8. Weaving design for Type-3 tweed with four-colored fancy yarn, including tape, and reference tweed.

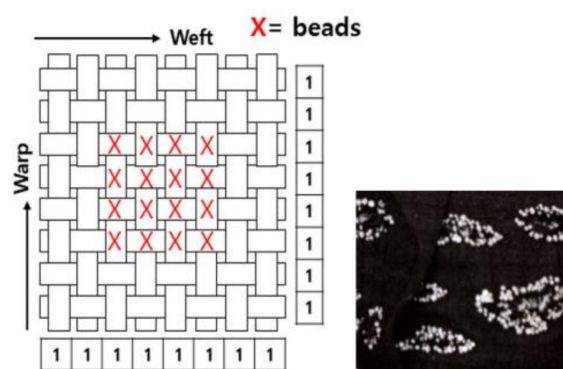



Figure 9. Weaving design for Type-4 tweed and reference tweed.

3. Methods

3.1. Preparation of Materials

Tweed weaving mainly uses various yarns and tapes, and the texture varies depending on the material used. Tweed has no restrictions on flexible materials, patterns, or colors, so it is predicted that various aesthetic effects are created when using various cloth wastes as materials. In general, new tweed fabrics are expected to be durable and present strong appearance retention characteristics. However, since the material used for upcycled tweed weaving has already been used more than once, the tension and durability levels are relatively lower than when the material was first produced, and the clarity of the material's color is also less than new one. However, upcycled tweed is likely to develop into a new design using various randomly discarded fabric materials, and workers can have the pleasure and enjoyment of creating an unexpected design using old-fashioned materials.

For the preparation of upcycling tweeds, discarded knitted sweaters and woven fabrics were collected for approximately two months in 2022 and converted into upcycled tweed fabrics. A total of 21 types of materials were collected for tweed production. Fourteen types of knitted sweaters were dismantled into thread shapes, and four types of woven fabrics were prepared for tape threads. Among the dismantled yarns, those that could not be used due to severe contamination were excluded from the process. The yarns were classified into plain and fancy types. The effects of fancy yarn were gimp, tape, slub, loop, and boucle. The plain yarns were also prepared in four colors: brown, gray, blue, and pink. Finally, the yarns prepared as materials for upcycled tweed fabric were twelve fancy yarns, four plain yarns, and four tape types made by cutting the fabrics. The tape types were prepared by cutting them to a width of 1 cm. The beads that should be used for Type 4 were included as decorations in one sweater. Figure 10 presents the fabrics and bundles of yarns collected to upcycle the tweed, and Figure 11 presents a neat arrangement of yarns, fabric tapes, and beads prepared for weaving.

Figure 10. Materials collected for upcycling tweeds. Photo edited: first author.

Figure 11. Yarn, fabric tapes, and beads for upcycling tweed: ⓐ–ⓛ fancy yarns, ⓜ–ⓟ plain yarns (brown, gray, and light pink), ⓠ–ⓣ fabric tapes, and ⓤ beads. Photo edited: first author.

3.2. Production of Upcycling Tweeds

The threads prepared for producing upcycled tweed were collected from random fabrics and clothes discarded to suit the purpose of upcycling, so the colors and textures of the threads varied. Depending on the weaving design plan, the type and color of yarns that should be in the warp and weft lines for each tweed type should be distinguished. Therefore, as presented in Table 3, a selection guide for yarns to be used for each tweed type was prepared. For producing the upcycled tweed, weaving frames (wood, width: 165 mm, height: 210 mm, and interval between wrap: 8 mm) were used (Figure 12). The reason for using small weaving frames is that the purpose of this study was not only to confirm the possibility of weaving upcycled tweed from clothing waste, but also to assume the shortest length of horizontal and vertical frames because the length of clothing waste collected in real life cannot be predictable. Thus, rather than weaving the upcycled tweed into a large area, it was essential to ensure that the design and texture of the tweed were well represented, even if a small area was woven. Based on the weaving frame, the length of the weft yarn was required to be cut by more than 165mm and the warp yarn by more than 210 mm.

Table 3. Selection guide for yarn to be used by tweed type.

Tweed Type	Selected Yarns for Upcycling Tweed
Type 1	(1) Use fancy yarn for the number 1 thread. (2) Do not use rough yarn.
Type 2-1 Type 2-2	(1) The yarns can be mixed. (2) Use different types of number 1 and 2 threads. (3) Differential in terms of color or texture between number 1 and 2 threads.
Type 2-3	(1) The yarns can be mixed. (2) Three (number 1–3 threads) or four (number 1–4 threads) yarns should be distinguished.
Type 3	(1) Use four yarn colors in the warp line, as shown in Type 2-3, and place tape yarns only in the weft line. (2) The types of tapes woven on the weft line can be the same or different.
Type 4	(1) Weave, as shown in Type 1, and repeatedly insert beads in the middle. (2) Decorate the shape freely in an 8 × 8 repeat.

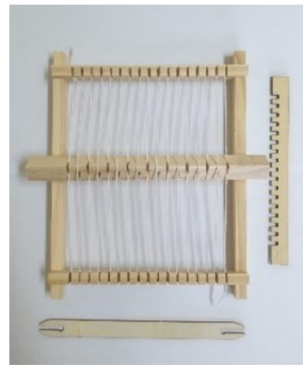



Figure 12. Weaving frame (photographed by the author).

3.3. Evaluation

The purpose of this study is to present an upcycling tweed production method for new fabric production using post-consumer clothing waste and to increase the utilization of various random wastes and the public practicality of recycling methods by fabric production accordingly. Previous studies were investigated to extract evaluation factors for evaluating the design method developed in this study and the produced results [39–42]. Creativity factors such as 'novelty' and 'appropriateness' summarized in previous studies referred to are factors commonly organized and extracted from previous studies, which make it easy to objectively evaluate universal product design. According to previous studies, evaluation elements suitable for this study were modified and prepared (Table 4). Novelty is divided into 'unexpected and originality' and 'differentiation and aesthetics'. The meaning of surprise and originality is unique because it has never existed before, and differentiation and aesthetics are about whether they have differentiated and artistic characteristics compared to existing fabrics. In this study, the novelty of the tweed for evaluation was determined based on the following ideas: (1) whether the produced tweed was an unexpected design and had originality, and (2) whether it was based on Chanel's reference sample but differed from the existing tweed fabrics and has aesthetic character. Similarly, the appropriateness factor was determined considering the following ideas: (1) whether the tweed produced was suitable for products and had a commodity, and (2) whether the produced tweed successfully achieved sustainability and upcycling objectives. The evaluation score for upcycling the tweed was rated on a scale of 1 to 5, with 1 being "very bad" and 5 being "excellent". The evaluation team comprised five experts with more than ten years of practical experience in textiles and design (Table 5). The expert evaluations were conducted independently, so the evaluation contents were not mutually influenced. The experts participated in a focus group interview right after the tweed fabric evaluation. The subject of the focus group interview is the creativity of upcycling tweed. Experts gave in-depth answers to their reasons for evaluating the novelty and appropriateness of the upcycling tweed evaluated.

Table 4. Evaluation factors for upcycling tweed.

Factors of Creativity	Novelty	Appropriateness
Detailed Elements	① Unexpected and originality ② Differentiation and aesthetic	① Practicality and commodity ② The degree of achievement of sustainability and upcycling goals

Table 5. The list of experts' information who evaluated upcycling tweeds.

Expert	Education	Occupation	Work Experience	Nationality
A	Bachelor's degree	Fashion designer (industry)	10 years	South Korea
B	Master's degree	Fashion designer (industry)	12.5 years	South Korea
C	Doctor's degree	Professor (academy)	10 years	South Korea
D	Doctor's degree	Professor (academy)	15 years	South Korea
E	Doctor's degree	Professor (academy)	13.5 years	South Korea

In addition, questions for the evaluation of weaving tweed design methods were prepared. The factors of weaving tweed design methods are the difficulty of production, the degree of understanding of the weaving process, and how much enjoyment or boredom was experienced during the weaving process (Table 6). The evaluation factor of the weaving tweed design method of upcycling tweed was selected as an item suitable for this study by referring to previous studies [43,44]. These factors were intended to evaluate the possibility of whether education on the weaving method devised in this study could be extended to the general public, or whether upcycling tweed production could be practiced in daily life as a hobby.

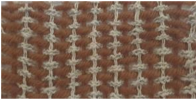
Table 6. Evaluation factors of weaving tweed design methods for upcycling tweed.

Factors of Weaving Design Methods	Questions
The difficulty of weaving design methods	- Which weaving method is the easiest? (Choose one) - Which weaving method is the most difficult? (Choose one) - How difficult are the weaving methods overall? (Very difficult, difficult, normal, easy, very easy)
The degree of understanding of the weaving process	- What is the percentage of understanding about the weaving process? (0%, 25%, 50%, 75%, 100%)
How much enjoyment or boredom was experienced in the weaving process	- How much enjoyment or boredom is experienced in the weaving process? (Very boring, boring, normal, fun, very fun)

4. Results

4.1. Production of Upcycling Tweeds

The weaving design for upcycling tweed and the selection guide for yarns were distributed to 20 students majoring in clothing and textiles. For about a month, each student produced four tweed types; thus, 80 tweeds were ultimately produced. All the yarn prepared for weaving was exhausted through the tweed fabrication process. The students were allowed to produce tweeds according to the weaving design methods and freely chose the thread detail for each tweed type based on the selection. The reason for the students' free choice of the thread was that the upcycled tweed could be produced in a similar manner to new clothing waste. The reason why students majoring in clothing and textiles were selected is that they are interested in recycling clothing materials, have inherent artistry, and are more likely to express creativity through manual work than other people.

4.2. Evaluation of Upcycling Tweeds

The evaluation results of the produced tweed are presented in Table 7. Additionally, two tweeds with excellent evaluation results for each tweed type are presented as examples in Table 8. Overall, all tweeds produced had an above-average evaluation score for creativity. The average score for the novelty and appropriateness of the entire tweed produced was

3.6. The total average score for each type was the highest in Type 3 (3.9), followed by tweed in Type 2-3 with four-colored yarns, Type 2-3 with three-colored yarns, and Type 1. For Type 3, an average score of $\geq$3.8 was observed for all evaluation elements, particularly for the appropriateness factor. Types 2-1 (2 $\times$ 2 and 4 $\times$ 4 repeats) and 2-2 (8 $\times$ 8 repeat) scored poorly for both novelty and appropriateness. These three types should have used two colors and effects during the tweed production process; the evaluation score was low because the expected check pattern did not appear well. The description of the tweeds that achieved excellent evaluation scores according to their type is as follows. For Type 1, a tweed using yarn that did not have a rough texture and contained noil, and a tweed using yarn that had a solid color without noil but had various thicknesses, were selected. For the 2 $\times$ 2 repeat of Type 2-1, tweeds with a similar texture but different colors were selected for the number 1 and 2 threads. The selected tweed was similarly smooth or rough for the number 1 and 2 threads. For the 4 $\times$ 4 repeat of Type 2-1, tweeds with a combination of plain and fancy yarns with a great contrast in color were selected. For the 8 $\times$ 8 repeat of Type 2-2, tweeds with a great contrast between textures in the number 1 and 2 threads were selected. For Type 2-2 (6 $\times$ 4 repeat), similar to the Chanel reference, yarns of the same color and different textures should be used, but there were no such yarns available. Therefore, tweeds using yarns with different textures but similar colors were selected. For Type 3, among the yarns used, the entire color of the tweed was determined as the color of the yarn with a thick and large fancy result. Blue- and pink-toned tweeds were selected. Because they were not woven over a large area, the difference between the tweeds with three- and four-colored yarns was insignificant. Colored threads that contrasted with the fabric tape were mainly used. For Type 4, unlike Type 1, which had a rough texture, those with beads combined on tweed with relatively smooth textures were selected.

Table 7. Mean (M) and standard deviation (SD) of evaluation results or upcycling tweeds for each type.

Element of Evaluation	Novelty				Appropriateness				Total
	Unexpected and Originality		Differentiation and Aesthetic		Practicality and Commodity		The Degree of Achievement of Sustainability and Upcycling Goals		
	M	SD	M	SD	M	SD	M	SD	Mean of Each Type
Type 1	3.8	1.6	3.5	1.5	3.4	1.6	3.8	1.5	3.6
Type 2-1 (2 $\times$ 2 repeat)	3.5	1.3	3.2	1.4	3.1	1.3	3.6	1.6	3.4
Type 2-1 (4 $\times$ 4 repeat)	3.6	1.2	3.4	1.3	3.2	1.4	3.5	1.5	3.4
Type 2-2 (8 $\times$ 8 repeat)	3.4	1.3	3.2	1.3	3.4	1.5	3.4	1.6	3.4
Type 2-2 (6 $\times$ 4 repeat)	3.5	1.5	3.6	1.5	3.5	1.2	3.4	1.2	3.5
Type 2-3 (3-colored yarn)	3.6	1.6	3.6	1.5	3.4	1.3	3.8	1.3	3.6
Type 2-3 (4-colored yarn)	3.6	1.5	3.6	1.7	3.7	1.6	3.9	1.4	3.7
Type 3	3.8	1.5	3.8	1.8	3.9	1.5	3.9	1.5	3.9
Type 4	3.7	1.6	3.7	1.4	3.8	1.2	3.8	1.2	3.8

Table 8. Upcycled tweed textiles.

Weaving Type	Upcycling Tweeds (Ranks 1 and 2) (Types of Yarns Used in Tweed)	
Type 1	(1) (ⓐ)	(2) (ⓒ)
Type 2-1 with 2 × 2 repeat	(1) (ⓐ, ⓜ)	(2) (ⓖ, ⓘ)
Type 2-1 with 4 × 4 repeat	(1) (ⓐ, ⓞ)	(2) (ⓐ, ⓝ)
Type 2-2 with 8 × 8 repeat	(1) (ⓐ, ⓔ)	(2) (ⓐ + ⓙ, ⓞ)
Type 2-2 with 6 × 4 repeat	(1) (ⓗ, ⓟ)	(2) (ⓘ, ⓟ)
Type 2-3 with three-colored yarn	(1) (ⓔ, ⓖ, ⓘ)	(2) (ⓕ, ⓛ, ⓟ)
Type 2-3 with four-colored fancy yarn	(1) (ⓔ, ⓕ, ⓖ, ⓘ)	(2) (ⓕ, ⓙ, ⓛ, ⓟ,)
Type 3	(1) (ⓒ, ⓝ, ⓟ, ⓞ, ⓢ)	(2) (ⓐ, ⓔ, ⓕ, ⓟ, ⓣ)
Type 4	(1) (ⓑ, ⓤ)	(2) (ⓐ + ⓙ, ⓤ)

For the students' work on the four types of materials, the novelty score was generally higher than that of appropriateness. The reason why the novelty score was high was that each student's creativity was demonstrated in the process of freely mixing randomly collected materials and weaving tweed. The reason why the appropriateness score was relatively lower than the novelty score was that the woven size was small and, therefore, less useful for its application to the product; therefore, the possibility of scalability for a clothing design using large-sized fabrics is low.

The evaluation of the weaving tweed design methods of the upcycled tweed was conducted by 20 students who participated in the tweed-weaving activity (Table 9). As a result, the difficulty of the weaving design method was observed to have Type 1 as the easiest and Type 4 as the most difficult. As for the reason for choosing Type 4, it was suggested that it was difficult to pay attention to the arrangement of the beads while weaving. The difficulty of the overall weaving design method was easily understood by more than half of the respondents. The average understanding of the weaving process was 80%, and students generally did not feel difficulty in understanding the presented weaving method. Finally, the answer to whether the weaving process was fun or boring was that no one answered "boring", and all of them felt more than a normal level of fun.

Table 9. The result of the evaluation of weaving tweed design methods of upcycling tweed.

Factors	Questions	Answer from Weaving Participants (n = 20)
The difficulty of weaving design methods	The easiest weaving method	Type 1
	The most difficult weaving method	Type 4
	The difficulty of overall weaving design methods	Very difficult (0%), difficult (15%), normal (15%), easy (35%), very easy (35%)
The degree of understanding of the weaving process	The percentage of understanding of the weaving process	0~25% understood (0%), 50% understood (20%), 75% understood (40%), 100% understood (40%)
How much enjoyment or boredom was experienced during the weaving process	How much enjoyment or boredom was experienced during the weaving process	Very boring~boring (0%), normal (20%), fun (35%), very fun (45%)

4.3. Discussion through the Focus Group Interview

A focus group interview with a group of experts who participated in the creativity evaluation of upcycling tweed was conducted by the author. The topics of the focus group interview were novelty and appropriateness, which are evaluation factors of creativity. The summary of the results of the focus group interview is as follows. First, the novelty evaluation of the produced tweed was positive. Experts answered that a new fabric was created using a material that was not new and was ignored by people, which was differentiated from the new fabric. In particular, in the case of the "unexpected originality" part, the uniqueness stemming from the limitations of the material greatly contributed to the novelty score. In this study, 21 materials used for weaving were all provided equally to weaving participants, but none of the 80 tweeds made were the same. The weaving participants selected materials that fit their tastes and produced tweeds according to the same designated weaving method, and the results revealed that imagination and creative cognitive thinking, which are essential for creativity evaluation, occurred during the weaving process. Second, experts' evaluation of practicality in terms of appropriateness was somewhat low. Experts wondered how the small tweed produced in this study could be applied as an actual product, and pointed that the results of the subsequent process were not included in this study, so the practicality could not be accurately evaluated only with tweed evaluation. Experts expected that the actual size of the manufactured tweeds was not larger than the woven frame size and that the types that can be developed into products would be only accessories, and it was proposed to increase the likelihood of making larger-sized fabrics using larger woven frames. Experts also responded positively to "Successful sustainable and upcycling Implications". Experts said that clothing waste, which was supposed to be incinerated, was properly used as a material for creative textile production, and the materials could be woven in a unified shape in the form of long threads, which is effective in achieving sustainability and upcycling goals.

After evaluating the creativity of the upcycling tweed, experts discussed in depth the research results and the connectivity related to their current job. The group of experts

who participated in the evaluation could be divided into a fashion designers' group and a professors' group, and the fashion designer group and professor group explained different perspectives on factors that they thought were important to their job. The summary of the discussion results for each group is as follows. First, the fashion designers group said that the possibility of product production and the purchase value, practicality, and appropriateness of the product are important to workers belonging to the industry. Although the research results produced in this study are unique, the number of items that can be applied to products is limited due to the size and durability of the results, so it is expected that the appropriateness problem can be sufficiently solved if the size and durability of the new products are supplemented. Second, the professors' group answered that the process of making aesthetic fabrics using random materials helps students improve their creativity and that they can collect and use the same materials every time and train to improve their artistry without difficulty. Even if students use the same prepared materials, they can develop an original aesthetic sense by displaying different creative skills and weaving fabrics that show individuality. In addition, through this training, students were expected to be able to practice sustainability as industrial workers after graduation.

Finally, experts answered the suggestions on the limitations and improvements for this study, and the summary is as follows. The first limitation is the complexity of material preparation. It is easy to collect materials, but there is a concern that the hassle of the material preparation process for weaving may reduce interest during the weaving process. Therefore, it is necessary to simplify the material preparation method, thereby enabling the use of more kinds of materials. The second limitation is the size of the woven product. Waste from everyday life is random and unpredictable. Since these wastes were used as weaving materials, the length, thickness, and size of weaving materials were not constant, and eventually, the weaving size was limited, affecting the evaluation results of the 'practicality and community'.

5. Conclusions

In the present study, new and creative upcycled tweeds were produced using discarded clothing materials to realize the creative use of clothing waste. Chanel's tweed design, which is considered a high-end fabric, was examined to devise a design method for upcycling tweed production. Based on the analysis, four tweed-weaving methods were designed, and the upcycled tweeds were produced and evaluated accordingly. The upcycled tweed was evaluated for its creativity, which was determined based on its novelty and appropriateness. According to the creativity evaluation results of the upcycled tweeds, overall, all tweeds achieved excellent creativity evaluation scores. Upcycled tweeds differed in novelty and appropriateness evaluation depending on the material used and the weaving method.

The weaving method attempted in this study can be used as a method of educating students who want to perform creative work on the subject of recycling. The weaving method is also easy, so it is expected to be educational for the general public. In order for this weaving method to be appropriately used for educational purposes, research topics on process development can be considered for future research.

The limitations and advantages of this study are as follows. First, it is necessary to simplify the preparation of materials for weaving and to expand the size of the research results. In addition, only images, not real fabrics, were used for the analysis of Chanel's tweed, and the size of the tweeds was small, so it could not be applied as an actual product. This part was also mentioned in an expert focus group interview. In addition, the size of the expert group participating in the evaluation is small, so it is necessary to supplement the quantitative evaluation results. Furthermore, the material type was limited due to the limitation of the material collection period of the tweed produced in this study. However, if the collection deadline for clothing waste is extended, more diverse results are expected. By contrast, our methodology proved the possibility of diversifying the upcycling of tweed designs in that it allowed the students to freely select yarn for tweed production,

indicating the possibility of applying infinite upcycling materials in the future. This study realized new creative changes through the recycling of clothing waste. The newly woven, upcycled tweeds can be both used as fabrics for each suitable fashion item and recreated as high-quality fabrics for future use.

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References

1. Gupta, R.; Dave, D. Sustainable Trendsetters: Up-cycling and Rejuvenation of Textile Apparels using Computational Technology. In Proceedings of the 2021 12th International Conference on Computing Communication and Networking Technologies (ICCCNT), Kharagpur, India, 6–8 July 2021; pp. 1–6.
2. Kasavan, S.; Yusoff, S.; Guan, N.; Zaman, N.; Fakri, M. Global trends of textile waste research from 2005 to 2020 using bibliometric analysis. *Environ. Sci. Pollut. Res.* **2021**, *28*, 44780–44794. [CrossRef] [PubMed]
3. Harmsen, P.; Scheffer, M.; Bos, H. Textiles for circular fashion: The logic behind recycling options. *Sustainability* **2021**, *13*, 9714.
4. Keßler, L.; Matlin, S.; Kümmerer, K. The contribution of material circularity to sustainability—Recycling and reuse of textiles. *Curr. Opin. Green Sustain. Chem.* **2021**, *32*, 100535. [CrossRef]
5. Dissanayake DG, K.; Weerasinghe, D.U. Fabric waste recycling: A systematic review of methods, applications, and challenges. *Mater. Circ. Econ.* **2021**, *3*, 1–20. [CrossRef]
6. Yasin, S.; Behary, N.; Curti, M.; Rovero, G. Global consumption of flame retardants and related environmental concerns: A study on possible mechanical recycling of flame retardant textiles. *Fibers* **2016**, *4*, 16. [CrossRef]
7. Yasin, S.; Sun, D. Propelling textile waste to ascend the ladder of sustainability: EOL study on probing environmental parity in technical textiles. *J. Clean. Prod.* **2019**, *233*, 1451–1464. [CrossRef]
8. Yasin, S.; Behary, N.; Perwuelz, A.; Guan, J. Life cycle assessment of flame retardant cotton textiles with optimized end-of-life phase. *J. Clean. Prod.* **2018**, *172*, 1080–1088. [CrossRef]
9. Grammelis, P.; Margaritis, N.; Dallas, P.; Rakopoulos, D.; Mavrias, G. A review on management of end of life tires (ELTs) and alternative uses of textile Fibers. *Energies* **2021**, *14*, 571. [CrossRef]
10. Vadicherla, T.; Saravanan, D.; Muthu Ram, M.; Suganya, K. Fashion renovation via upcycling. In *Textiles and Clothing Sustainability*; Springer: Berlin/Heidelberg, Germany, 2017; pp. 1–54.
11. Park, J.H.; Kim, Y.H. A Study on fashion design for up-cycled waste resources. *J. Korean Soc. Costume* **2014**, *64*, 138–154. [CrossRef]
12. Kushwaha, S.; Swami, C. Upcycling of leather waste to create upcycled products and accessories. *Int. J. Home Sci.* **2016**, *2*, 187–192.
13. Jiang, N.; Park, E.K. Applications of Zero Waste Pattern Cutting Methods for Women's Shirts. *J. Korean Soc. Cloth. Text.* **2020**, *44*, 969–983.
14. Kim, J.; Kim, H. A study on zero waste fashion design that applied puzzle cutting method. *J. Fash. Des.* **2018**, *18*, 37–55.
15. Kim, I.; Cha, Y.; Lee, J. Development of recycling zero-waste fashion design. *Arch. Des. Res.* **2016**, *29*, 215–229. [CrossRef]
16. Yoon, J.; Yim, E. Design methodology for the realization of zero-waste fashion design-Focused on the typology of ZWPM. *Res. J. Costume Cult.* **2015**, *23*, 929–939. [CrossRef]
17. Aus, R.; Moora, H.; Vihma, M.; Unt, R.; Kiisa, M.; Kapur, S. Designing for circular fashion: Integrating upcycling into conventional garment manufacturing processes. *Fash. Text.* **2021**, *8*, 1–18. [CrossRef]
18. Ro, J. Characteristics of handicraft in contemporary fashion from the viewpoint of social-ecology. *J. Basic Des. Art* **2016**, *17*, 101–112.
19. Bigolin, R.; Blomgren, E.; Lidström, A.; Malmgren de Oliveira, S.; Thornquist, C. Material Inventories and Garment Ontologies: Advancing Upcycling Methods in Fashion Practice. *Sustainability* **2022**, *14*, 2906. [CrossRef]
20. McQuillan, D. *Irish Tweed: History, Tradition, Fashion*; JSTOR: New York, NY, USA, 2020.
21. Helland, J. "A Delightful Change of Fashion": Fair Trade, Cottage Craft, and Tweed in Late Nineteenth-Century Ireland. *Can. J. Ir. Stud.* **2010**, *36*, 34–55.
22. Anderson, F. This Sporting Cloth: Tweed, gender and fashion 1860–1900. *Text. Hist.* **2006**, *37*, 166–186. [CrossRef]
23. Picken, M.B. *The Language of Fashion-Dictionary and Digest of Fabric, Sewing and Dress*; Read Books Ltd: Cardiff, UK, 2013.
24. Picardie, J.; Harwood, C. *Coco Chanel: The Legend and the Life*; HarperCollins: New York, NY, USA, 2010.
25. Alston, I. *Coco Chanel*; TAJ Books International: Cleveland, OH, USA, 2014.
26. Chanel. Tweed. Available online: https://www.chanel.com/kr/fashion (accessed on 12 April 2022).

27. Aus, R. *Trash to Trend-Using Upcycling in Fashion Design*; Estonian Acadamy of Arts: Tallinn, Estonia, 2011.
28. Gardetti, M.; Torres, A. (Eds.) *Sustainability in Fashion and Textiles: Values, Design, Production and Consumption*; Routledge: New York, NY, USA, 2017; pp. 148–163.
29. Han, S.; Chan, P.; Venkatraman, P.; Apeagyei, P.; Cassidy, T.; Tyler, D. Standard vs. upcycled fashion design and production. *Fash. Pract.* **2017**, *9*, 69–94. [CrossRef]
30. Teli, M.; Valia, S.; Kadu, K.; Dahale, M. Upcycling of textile materials. In Proceedings of the Global Textile Congress (2015), Bangkok, Thailand, 13 February 2015; pp. 164–167.
31. Moorhouse, D.; Moorhouse, D. Sustainable design: Circular economy in fashion and textiles. *Des. J.* **2017**, *20*, S1948–S1959. [CrossRef]
32. Jain, M. Challenges for sustainability in textile craft and fashion design. *Int. J. Appl. Home Sci.* **2018**, *5*, 489–496.
33. Crewe, L. Tailoring and Tweed: Mapping the spaces of 'slow fashion'. In *Fashion Cultures Revisited*; Routledge: New York, NY, USA, 2013; pp. 200–214.
34. Febriani, R.; Bastaman, W.; Sutantio, M. Opportunities for the utilization of natural fiber fabrics in home living textile products with the "back to nature" lifestyle trend. In *Dynamics of Industrial Revolution 4.0: Digital Technology Transformation and Cultural Evolution*; Routledge: New York, NY, USA, 2021; pp. 133–137.
35. Shrivastava, P.; Ivanaj, V.; Ivanaj, S. Sustainable development and the arts. *Int. J. Technol. Manag.* **2012**, *60*, 23–43. [CrossRef]
36. Claxton, S.; Kent, A. The management of sustainable fashion design strategies: An analysis of the designer's role. *J. Clean. Prod.* **2020**, *268*, 122112. [CrossRef]
37. Atkinson, S. Does the need for high levels of performance curtail the development of creativity in design and technology project work? *Int. J. Technol. Des. Educ.* **2000**, *10*, 255–281. [CrossRef]
38. Choi, H.-H.; Kim, M. An Evaluation Method for Assessing Creativit in Design Education. *Korean Soc. Des. Cult.* **2014**, *20*, 649–658.
39. Howard, T.J.; Culley, S.J.; Dekoninck, E. Describing the creative design process by the integration of engineering design and cognitive psychology literature. *Des. Stud.* **2008**, *29*, 160–180. [CrossRef]
40. Kaufman, J.C.; Sternberg, R.J. *The Cambridge Handbook of Creativity*; Cambridge University Press: Cambridge, UK, 2010.
41. Fink, A. *Evaluation for Education & Psychology*; Sage Publications, Inc.: New York, NY, USA, 1995.
42. Hunt, H. The effect of extracurricular activities in the educational process: Influence on academic outcomes? *Sociol. Spectr.* **2005**, *25*, 417–445. [CrossRef]
43. Osche, R. *Before the Gates of Excellence: The Determinants of Creative Genius*; Cambridge University Press: Cambridge, UK, 1990.
44. Gandhi, K. *Woven Textiles: Principles, Technologies and Applications*; Woodhead Publishing: Sawston, UK, 2019.
45. Choe, J. A Study on Interior Jacquard Fabric Design in a CAD/CAM Jacquard System-Focused on Designs Expressing the Effects of Ikat in Jacquard Design in the U.S. *J. Integr. Des. Res.* **2015**, *14*, 45–56.
46. Mamidipudi, A. Crafting innovation, weaving sustainability: Theorizing Indian handloom weaving as sociotechnology. *Comp. Stud. South Asia Afr. Middle East* **2019**, *39*, 241–248. [CrossRef]
47. Kumar, B.; Hu, J. Woven fabric structures and properties. In *Engineering of High-Performance Textiles*; Woodhead Publishing: Sawston, UK, 2018; pp. 133–151.