TEKSTİL VE MÜHENDİS

(Journal of Textiles and Engineer)

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ATIK PLASTİK POŞETLERİN DOKUMA TASARIMINDA KULLANIMI ÜZERİNE DENEYSEL BİR ARAŞTIRMA

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Online Erişime Açıldığı Tarih (Available online):31 Mart 2023 (31 March 2023)

Bu makaleye atıf yapmak için (To cite this article):

Havva HALAÇELİ METLİOĞLU, Lale ŞANLI SÜRMELİOĞLU (2023): An Experimental Research on Upcycling of Waste Plastic Bags in Weaving Design, Tekstil ve Mühendis, 30: 129, 52-60.

For online version of the article: https://doi.org/10.7216/teksmuh.1272279

TMMOB Tekstil Mühendisleri Odası
UCTEA Chamber of Textile Engineers
Tekstil ve Mühendis
Journal of Textiles and Engineer

Yıl (Year) : 2023/1
Cilt (Vol) : 30
Sayı (No) : 129

Araştırma Makalesi / Research Article

AN EXPERIMENTAL RESEARCH ON UPCYCLING OF WASTE PLASTIC BAGS IN WEAVING DESIGN

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Gönderilme Tarihi / Received: 10.08.2022
Kabul Tarihi / Accepted: 09.12.2022

ABSTRACT: Today, humanity is faced with plastic bag wastes caused by industrial applications and unconscious use that have become widespread over the last century. These bags, which have become a global problem, negatively affect the environment and human health with the chemicals in their structure. In addition, since plastic bags do not have to be upcycled and are considered as garbage, they are mostly not upcycled. However, today's environmental conditions necessitate upcycling for sustainable life. In this context, it is aimed to use the waste plastic bags directly through woven design, and to use the resulting textural product as a textile surface and dividing element in interiors. In this respect, after the literature review, experimental surface research was carried out with plastic bags on the traditional vertical weaving loom in the weaving process and the ones with high texture effects were selected and woven in large sizes. The concept of texture, which is one of the basic elements of design, is directly related to weaving. Even if the eyes are closed, objects can be distinguished by touch and therefore affect the person sensually and emotionally. In this regard, in order for the plastic bag texture to be in the foreground, the number of warp was drawn infrequently and plastic bags cut into strips were used in the weft insertion. The plastic bag is enriched in textural terms by combining materials such as paper and copper wire from time to time to ensure aesthetic integrity. While it is thought that this experimental study for the upcycling of plastic bags can reduce the pollution caused by the bags to a certain extent, it is hoped that new ideas about upcycling will cause an environmental awareness in the society

Keywords: Waste, texture, weaving, upcycling, plastic bag

ATIK PLASTİK POŞETLERİN DOKUMA TASARIMINDA KULLANIMI ÜZERİNE DENEYSEL BİR ARAŞTIRMA

ÖZ: Bugün insanlık, geçen yüzyıl boyunca yaygınlaşan endüstriyel uygulamaların ve bilinçsizce kullanımın sebep olduğu plastik poşet atıklarıyla karşı karşıyadır. Küresel bir sorun haline gelen bu poşetler yapısındaki kimyasallarla, çevreyi ve insan sağlığını olumsuz yönde etkilemektedir. Ayrıca plastik poşetlerin geri kazanım zorunluluğu olmadığından ve çöp olarak düşünüldüğünden çoğunlukla geri kazanımı yapılmamaktadır. Oysa günümüz çevre koşulları sürdürülebilir yaşam için geri kazanımı zorunlu kılmıştır. Bu bağlamda, atık plastik poşetlerin dokuma tasarım yoluyla doğrudan kullanımı sağlanıp, elde edilen dokusal ürünün iç mekanlarda tekstil yüzeyi ve bölücü eleman olarak değerlendirilmesi hedeflenmiştir. Bu bakımdan yapılan literatür taramasından sonra uygulama sürecinde, geleneksel dikey dokuma tezgahında plastik poşetlerle deneysel yüzey araştırması yapılmış ve doku tesiri yüksek olanlar seçilip büyük boy dokunmuştur. Tasarımın temel öğelerinden biri olan doku kavramı, dokuma ile doğrudan ilişki içindedir. Doku vasıtasıyla göz kapalı dahi olsa dokunmayla nesneler ayırt edilebilmekte ve dolayısıyla kişiyi duyusal ve duygusal olarak etkilemektedir. Bu bakımdan yapılan uygulamada plastik poşet dokusunun ön planda olması için çözgü tel sayısı seyrek çekilmiş ve atkı atımında yoğun olarak şeritler halinde kesilmiş plastik poşetler kullanılmıştır. Plastik poşet, estetik bütünlüğü sağlayacak şekilde yer yer kağıt ve bakır tel gibi malzemelerle birleştirilerek dokusal yönden zenginleştirilmiştir. Plastik poşetlerin geri kazanımı için yapılan bu deneysel çalışmanın poşetlerin sebep olduğu kirliliği belirli oranda azaltabileceği düşünülürken, geri kazanıma ilişkin yeni fikirlerin ortaya çıkmasına ve toplumda farkındalık konusunda belirli bir bilinç oluşturacağı umulmaktadır.

Anahtar kelimeler: Atık, doku, dokuma, geri kazanım, plastik poşet

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DOI: *https://doi.org/10.7216/teksmuh.1272279* *www.tekstilvemuhendis.org.tr*

1. INTRODUCTION

Today, our society is face to face with plastic bag waste caused by industrial developments, technological advances, increasing population, and unconscious consumption. Introduced in the 1970s and used everywhere in the early 1980s, plastic bags are thrown into the trash or environment after use.

Swedish scientist Sten Gustaf Thulin invented the plastic bag and patented it in 1965. The use of plastic bags, which are produced and encouraged to reduce the use of paper bags, has increased in many areas soon. This situation has brought with it various environmental problems. In this context, many artists and designers have tried to create awareness by using waste plastic bags as material in their works [1]. On the other hand, the lack of recycling obligation has created negative effects in the environmental context.

Plastic bags are produced from a type of plastic called polyethylene (PE) which is a widely used plastic type [1]. It is estimated that between 500 billion and 1 trillion plastic bags are used in the world every year. Although recycling rates vary from country to country, less than 1% of these are recycled [2]. The rest is thrown into the garbage or the environment. Its use is prohibited in various countries, and in some, it is provided for a fee. Although the pricing does not completely stop the usage, it has partially reduced it. On the other hand, it is known that biodegradable plastic bags, which are called environmentally friendly, can dissolve under very special conditions and these conditions are available in only a few garbage collection units in the world [3]. Although they seem to be destroyed physically, they are not completely destroyed, they are divided into micro particles (microplastics) and continue to harm the environment for years.

For a sustainable environment and life, a total ban on plastic bags may be a permanent solution first, but this may not be possible in the long run due to its widespread use everywhere. Second, a reduction, reuse and recycling policy can be used. Reducing usage means using fewer resources. Reuse means repairing and reusing the existing ones, when necessary, without using new resources for a while. Reducing usage or reusing an existing one may be an alternative option. Paper bags, on the other hand, are environmentally friendly, but more energy is consumed in their production and are more costly than plastic bags. If they can be produced with materials that do not harm the environment and human health and at a low cost; cloth bags are a relatively better option than paper and other options. Besides these, another option is upcycling. Today's living conditions and environmental conditions have necessitated upcycling. In upcycling, the whole of the waste is used as a value. For example, when a plastic Coke bottle is upcycled, a pen holder can be made by using both the material that makes up the bottle and its shape. On the other hand, melting the coke bottle and turning it into another plastic product is considered as recycling rather than upcycling [4]. In the Cradle to Cradle book by William McDonough and Michael Braungart, the concept of "upcycle" is expressed as a high cycle and "recycle" as a low cycle [5]. In this case, the materials gained with high turnover mean a more sustainable environmental approach.

Sustainability is a concept that ensures the use of resources and the continuity of the integrity of ecosystems. Upcycling is a tool that helps to establish this continuity. Today, it has been determined that various studies and practices are carried out within the scope of sustainability and the concept of sustainable design has gained importance. For example; Textile designer Luisa Cevese transforms waste textile materials into usable accessories and interior design products. For years, designer Alabama Chanin has been reconstructing waste fabrics by hand sewing [6].

Since the existence of humanity, the act of weaving, which meets basic needs such as dressing and covering, has gone beyond meeting the need today and has become one of the powerful forms of expression. Weaving has become a product in which various creative solutions can be applied and loaded with different meanings and missions [7]. The new materials are interpreted in decorative, thought-provoking and politically oriented categories in the light of structuralist syntheses [8]. In this respect, through weving design, the designer can create environmentally friendly, aesthetic and functional surfaces according to his purpose. It can reflect the message it wants to convey, either directly or indirectly, on the weaving surface. Texture, which is one of the important design elements, is intertwined with weaving and forms the essence of weaving. Texture, which is the rhythm of life, also helps us make sense of the world. Humans living intertwined with textures are affected by the differentiations arising from their functionality as well as the aesthetic effects of the textures. The effects arising from these differentiations affect people's self-protection, sense of security and mood [9]. The texture is an effective and important element in perceiving an object, in interior designs, in clothing and in other choices of individuals.

This research is a study that upcycles waste plastic bags through weaving and approaches them in the context of texture. While evaluating waste plastic bags, textural possibilities were also investigated with experimental studies. It has been tried to underline that the waste plastic bag is not garbage nor naturel, it is a material that can be evaluated by weaving and should be used consciously.

2. MATERIALS AND METHOD

In this research, plastic bags with different qualities, copper, paper, fishing line and raw cotton yarn were used for experimental studies. As for the textural and physical properties of plastic bags, Plastic bags show good resistance to outdoor conditions and humidity. They also have flexibility and superior chemical resistance. When the surface of plastic bags is examined, the most obvious textural character is light refraction. It has a shiny

iridescent surface with the effect of light. It has a soft and translucent effect when touched.

Figure 1. Light refractions on the plastic bag surface [10]

Due to the transparency of plastic bags, the texture of the ground on which they are placed temporarily changes the surface of the bag. But in a vacuum, it has its own bright iridescent effects with the effect of light.

Copper wire is preferred for its flexibility and shapeability. Paper is used to create a contrast with the plastic bag with its textural quality and direction of origin. Fishing line is used because of its transparency. Raw cotton yarn is used to prevent the plastic bag from slipping in the texture In addition to the descriptive research method, the design-based research method was used for experimental studies. Design-based research was first introduced by Brown (1992) and Collins (1992) as design experiments. Design experiment is a research method in which scientific processes such as discovery, explanation, verification and dissemination are in question and necessitates the active participation of the researcher in teaching-learning activities [11].

In the design process, 10 experimental texture studies were carried out using Turkish knot and flat weaving techniques. Turkish knot and plain weaving techniques have been chosen because they are basic, simple, traditional weaving techniques that can be transferred from generation to generation and they are up-to-date. Since experimentation is at the forefront in the designs, techniques such as cutting, twisting, burning and twining were used for the spontaneous researches required by the creative process and forming of the material. Experimental studies are evaluated in view of aesthetical criteria such as texture, composition, balance and emphasis, and 4 weaving designs were planned referenced by them. Trial weaving studies were examined aesthetically in terms of composition, texture possibility, emphasis and balance, and weaving designs were made based on these studies. All of the designs are woven on conventional loom with vertical warp system, which is easy to transport and install. Its size is 180 cm x 138cm.

3. WEAVING AND TEXTURE CONCEPT INTERACTIONS

“Weaving is not just a production method. The language of sensing light, creating texture, using color, perceiving form is the means of transforming this perception into a tangible entity” [12]. The concept of texture, which is one of the basic elements of design, is directly related to weaving. Named with the English word "texture", "texture" comes from the Latin word "textere" and the word meaning of textere is explained by the verb "to weave" [13]. Of course, not only woven fabrics, but all fabrics and objects have a texture and surface.

In the formation of fabric texture, factors such as weave, weave density, density, fiber content, how it is made from a spun yarn, etc. are effective [13]. Weaving, which is an aesthetic whole, is a composition that combines form, color and materials [8]. In addition to the material and technique, the effect of light and shadow should also be considered in the recognition of the texture. For example; the texture of especially transparent, semi-transparent or opaque fabrics, which emerges with raw materials, yarn, knitting and weaving techniques, occurs as a result of its interaction with light. In order to understand the structural and visual effects of such fabrics, it is important to establish a relationship between texture and light [14]. The light causes the bumps and pits to be affected at different values on the rough surfaces that provide the texture. It also determines the dominance of warm and cold colors. On the other hand, while the weaving connection units repeated on the surface of the woven fabric form the texture, they also form a basic pattern with this structure [7].

Today, woven fabric design has to respond to the emotional and sensory needs of the individual, as well as fulfilling the needs of the society in a functional sense. Woven fabric design is a concept; in addition to the fashion trends, that needs new ideas and creativity with the influence of current art movements, social events, cultural variation, communication, and different motifs, patterns, textures, colors, etc. It is an area that transforms it into a product by ensuring continuity within the repetition systems in the integrity of the elements. Texture is an effective element not only on the fabric surface but also in other areas. In the decoration of a building, it is important for the interior designer to know the material the texture and the effects of the texture, in terms of the visual, tactile and functional nature of the work. Today surfaces with a high degree of texture are more preferred in architecture, interior design and textile design [16]. Woven fabrics with high texture value are also important as an element that provides peace and tranquility to people's living environment and body, with both tactile and visual textural effects.

4. RECOVERY OF PLASTIC BAGS IN SUSTAINABILITY

In the concept of sustainability, it is essential to use and maintain chemistry and renewable resources. Plastic material is normally obtained from natural sources such as petroleum gas. However,

the chemicals used in its production reveal various harms. It is a known fact that plastic has various damages. Although it has been discussed for years by environmentalists, experts, manufacturers and politicians about its harm and benefit, it may not be possible to completely remove it from our lives. It is used in almost every field. In this respect, choosing plastic materials according to the area in which they will be used is important in terms of sustainability. For example, the plastic material used in water channels or underground flooring and the plastic material used in textiles are not the same in terms of both type and quality. The production of synthetic fibers, which are petrochemical-thermoplastic derivatives, used in the textile and fashion world, instead of using them in underwear that has direct touch with the body, is important in terms of health, and this requires less synthetic production. In addition, it is important for sustainability that these synthetic materials are produced in accordance with recycling. Thus, it reduces the use of non-renewable energy sources as well as less energy use.

Biodegradable bags, degrade in nature in 12-24 months, have been developed [17]. However, these bags continue to pollute by breaking into micro particles and mixing with the soil and water. In addition, it has not yet been clarified that it will disintegrate in a short period of 12-24 months. For example; Wheat Association discussed the issue of whether bio-degradable bags are truly eco-friendly with Plastics Europe [PE], which opened a booth at the Greenweek conference in Brussels, and expressed the opinion of Michael Poulsen, the Consumer Relations and Environment Director of the association. He declared, putting expressions such as degradable or biodegradable creates confusion. Most of these plastic bags can only be dissolved under very special conditions, which are available in few garbage collection units in the world" [17].

In order to prevent visual and environmental pollution caused by plastic bags and to prevent unnecessary plastic bag usage, plastic bags are sold for a fee in Europe and Turkey. Within the scope of sustainability, preferring cloth bags instead of plastic bags is the first option that comes to mind, secondly, the use of these bags should be reduced and reused. Third, users, manufacturers and other organizations should be made aware of plastic bags and recycling should be encouraged. Although its use is practical and widespread, various harms in terms of environment and health are known.

Recently, artists and designers have done various studies and have created awareness about plastic bags. Furniture designer Brodie Neill's hourglass for 2019 called "The Capsule" draws attention to microplastic pollution in the oceans and the limited time we have to save our planet.

The New York artist Hugo McCloud chose an effective way of recycling by using the plastic bag almost like a paint. The artist created a series called "Burdened" by collaging plastic bags with the technique he developed [19].

Figure 2. Sandglass design "The Capsule" by Brodie Neill, 2019 [18]

Figure 3. Hugo McCloud, 2020, "Pineapple Express" 2019 [19]

4.1 Various Examples on the Upcycling of Plastic Bags by Weaving Design

Upcycling of waste plastic bags in artistic field is very important in terms of raising awareness in people. Different approaches and recycling studies in weaving design, fiber art, industry and artistic fields are included in this section. Sustainable design examples include studies in which waste plastic bags are mostly used as material.

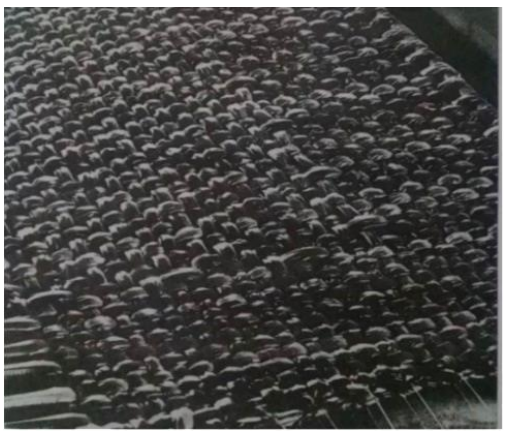

Figure 4. Edd Rossbach, 1968, newsprint and plastic bag construction [13]

Ed Rossbach designed a unique form with plastic bags and newspaper in Figure 4. The glossy effects caused by the plastic material and the matte appearance of the newspaper created a contrast on the surface. The work is woven with the original weaving technique in 75x100 dimensions.

Figure 5. Plastex fabric woven by Reform Studio (woven from plastic bags [20]

Reform Studio is a design studio founded by designer Hend Riad in Cairo, Egypt. Fabrics, which can also be called plastic fabrics, are woven by a group of women on traditional hand looms in Egypt. These fabrics are used as upholstery fabric in garden and balcony chairs with their durable, washable, dirt-repellent properties, as shown in Figure 5 [20].

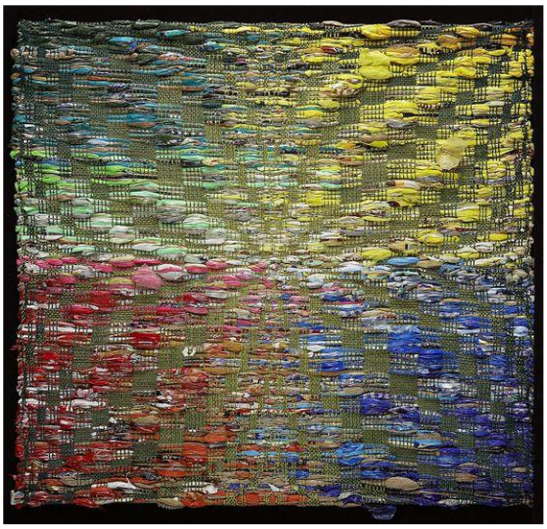

Figure 6. Julie Kornblum, 2008, wall rug named “Plastic in the Trees”, [21]

Fiber artist Julie Kornblum, known for her works on fiber art, mostly issued environmental problems and pollution in her works. The artist's tapestry work named "Plastic in the Trees" in Figure 6 affects not only the viewer with tactile sende, but also draws the viewer into the weaving. Emphasizing pollution and the environment, the artist has chosen waste plastic bags and yarn as materials and dynamically reflected the tree form to her work [21].

5. EXPERIMENTAL TEXTURE STUDIES

Plastic bags with different properties were used in 10 experimental texture studies with waste plastic market bags ande store bags. The technical difficulties and textural effects of these bags during weaving have been observed by experimental method. In this regard, in four design studies, recycled plastic bags of the Koton Store were preferred, as their softness and flexibility properties would facilitate the weaving process. On the other hand, the light color of these bags also emphasised the textural properties. In order to keep the texture in the foreground, complex weaves and colors were avoided, and a simple plain weave was used throughout the work with a sober approach. The beige color, which is neutral, is used extensively, and sometimes black and white colors are also included. Fine raw cotton yarn is used in some of the designs as warp yarn and flexible fishing line is used in some of the designs. The transparency of fishing line has made the weft threads stand out. Raw cotton yarn, on the other hand, was preferred because of its low cost, and dyeability as well as preventing the plastic bag strips from slippage in the weaving structure.

Figure 7. (a, b). Experiment 1, the surface woven by knotting (carpet weaving) technique using grocery bags has a shaggy appearance.

Experiment 1 was woven with turkish knot and waste plastic market bags of different characteristics in various colors were used. By using thick, thin, soft and rough bags together, a dimensional surface texture was obtained with a stiff and a soft feeling. While the front of the work is dashing (Figure 7a), the back has a sober surface (Figure 7b).

Figure 8. Experiment 2

Figure 9. Experiment 3

In Experiment 2, black and transparent market bags were cut into strips and woven in the plain weave. After weaving, it was burned partly. In Experiment 3, beige plastic store bags wrapped with copper wire and flat-cut beige bag strips were woven in units creating horizontal lines.

Figure 10. Experiment 4

Figure 11. Experiment 5

In Experiment 4, the copper wire used as warp. Seven rows of white plastic bag strips and four rows of copper wire wrapped by plastic bag strips were woven in units. Copper wire wrapped by plastic bag strips were pulled out through the warps. In Experiment 5, copper wire wrapped by plastic bag strips and woven flat-cut plastic bags were picked partially.

In Experiment 6, and 7 the cotton warp yarn was drawn with a wide space in the middle. Seven rows of beige and seven rows of black plastic bags were woven alternatively. In Experiment 7, ten rows of flat plastic bags and four rows paper strips were woven one after the other. By combining two materials with different properties, a semi-matt semi-gloss surface was obtained.

Figure 12. Experiment 6

Figure 13. Experiment 7

Figure 14. Experiment 8

Figure 15. Experiment 9

In Experiment 8, the copper wire was picked simultaneously with several strips of plastic bags. In the weft, the copper wire was coiled up by pulling it in partially. In Experiment 9, plastic bag strips, which were attached to the previously prepared copper loops were woven in plain weave. Then the surface is compressed.

Figure 16. Experiment 10

Asymmetrical spaces and irregularity in wefts were created by compressing the woven surface in the experiment 10. Different materials and weaves were used in each of the 10 experimental studies. In some studies, fishing line and weft threads are emphasized, while in some studies warps are highlighted. After

the woven surface came out, various manual interventions were made and the surface got bumped or transpared. Various experiments have been made, such as burning, knotting, and asymmetrical cutting of weft threads. In this respect, each of the woven designs has a different surface effect.

The results of 10 texture experiment were observed and evaluated. Among the samples, which were evaluated in terms of functional properties such as suitability for intended use, as well as aesthetic properties such as size, balance, empahsis, composition and texture, 6 trials were designated that were suitable for final designs. Based on the selected samples, 4 designs were woven and these woven surfaces were transformed into interior decoration products such as wall hanging and seperation panel. Approximately 50 Koton plastic store bags were used in the designs. Two of the designs were woven to be panels, and the other two to be used as a separator.

Figure 17. Design 1, Lale Şanlı 2017 **Figure 18.** Design 2, Lale Şanlı, 2017

Design 1 was woven in plain weave, analysing the textural qualities on Experimet 8. Fishing line was used in the warp and plastic store bags and paper were used in the weft. 112 wire warp threads were drawn. The pre-prepared image in Photoshop was printed on paper digitally and was cut into strips to be used in wefts. A surface with linear effect was obtained by weaving plastic bag strips and paper strips alternatively. After weaving was finished, light black water-based acrylic paint was sprayed on the surface The aim here is to both provide integrity with the black tones in the image on the paper surface and to break the sharp image formed on the surface. The transparency of the fishing line the warp helped to make materials in the weft prominent on surface.

In Design 2, based on Experiment 9, waste plastic store bags and copper wire were used in the weft. Flexible fishing line used in the warp facilitated the weaving process and gave it flexibility. On the other hand, the transparency of fishing line has highlighted the weft threads. Combining the plastic bag with the copper wire gave strength to the structure and enriched the surface by increasing the textural effect. The plastic bag, crumpled by the pressure of the copper wire, enriched the surface texture and added dimension. Despite the softness of the plastic bag, a rough texture is obtained with the hard and malleable feature of the copper wire.

Figure 19. Design 3 and 4, Lale Şanlı, 2017, separator, Lale Şanlı, 2017

Design 3 (left wing) was made on the basis of experiment 6. Hand-dyed cotton gray yarns were used in the warp while black, white and beige colored store bags were used in the weft, the warp yarn was drawn with a space 30 cm in the middle . The work is woven in plain weave. The weft thread is left loose in the middle and woven creating a tapering effect.

After the weaving process was finished, water-based acrylic paint was lightly touched on the beige surface with the help of a brush in order to integrate with the black colors. Thus, the sharp lines on the surface were broken. A draped and mobile surface that flows in waves is obtained.

Design 4 (right wing) was developed from experiments 5, 6 and 7. Gray cotton yarn was used in the warp, beige and white plastic bag strips were used in the weft. It is woven in plain weave. Plastic bags with two different surfaces, rough and smooth, were used in the study. Since the inner and outer colors of the bags are different, one row of beige and one row of white were used, and the beige color dominated the whole. The gray warp threads, which cut the weft passing through the middle, contrasted with the beige color and completed the work visually.

6. USAGE RECOMMENDATIONS OF THE DESIGNS

The installations and photo shots were taken to raise awareness in the Cogito Cafe Mersin where human circulation is high. The panel and the seperator were placed in appropriate places in the space. Design studies can be used for multi-purposes in other interior spaces such as restaurant, hotel, etc. where air flow is. The function of the seperator is to provide privacy and defining space.

Figure 20 shows the layout of the panel and the seperator in the space.

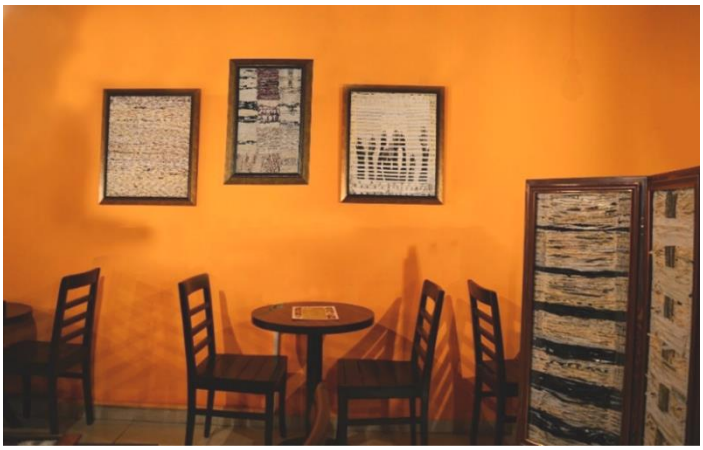

Figure 20. Designs 2, 1, 3 and 4 were placed in the Cogito Café in Mersin.

Figure 21. Exhibiting textile surfaces on the Wall

7. CONCLUSION

In order to eliminate the environmental problems caused by plastic bags and their waste, first of all, designers, manufacturers and consumers have great duties.

Although plastic bags are banned in some countries, a solution has not been found all over the world. The fact that these bags are produced cheaply, they are seen as garbage rather than packaging waste, and there is no obligation to recycle (especially in Turkey and similar countries) has increased their unconscious use day by day. On the other hand, the policies of the countries are also effective in this situation. On the one hand, the prohibition of use and on the other hand, the absence of inspections makes the law in a way meaningless.

On the other hand, plastic bags have turned into material that many artists and designers use intensively in their works in order to raise awareness. By making use of the texture possibilities of these bags, they have obtained useful products and aesthetic surfaces. While some artists have transformed this material into artistic objects, designers have made functional products. While creating environmental awareness, they also succeeded in transforming these bags into usable products.

In this research, designs have been developed for upcycling of waste plastic bags. In the scope of the research, in which the design-based research method was applied, waste plastic bags were cut, folded, twisted with paper, metal wire, and cotton yarn were woven with carpet knotting techniques as well as plain weave. Based on 10 trial studies, 4 weaving designs were made.

These designs can be used as textural elements both wall hanging and a divider element surface in interior spaces. It is a step taken to create social awareness in order to prevent the damage caused by waste plastic bags to the environment, by exhibiting these designs in a cafe with high human circulation.

Considering all these design studies, an interdisciplinary study is planned for the next step, where it has been demonstrated that the upcycling of plastic bags can be handled and evaluated in a textural context.

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