Designing a Specific-Exercises Bag by Recycling the Martial Arts Sports Suit to Achieve Sustainable Development

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Abstract:

Trends of sustainability and recycling products by using them in innovative designs that benefit the needs of community members is increasing. This research aimed to achieve sustainable development by designing a specialized exercise bag by recycling environmental materials. Procedures: The experimental approach was used in designing the specialized exercise bag by recycling a martial arts suit and some environmental materials, and the descriptive approach was used to study the aesthetic and functional aspects of the design. Sample: waste: (a judo suit, a rubber vehicle tire, hay, sand, rope, a glove, and plastic adhesive); human sample: (12) experts of clothing and textiles, and (13) experts of martial arts, was used to study the quality of the aesthetic and functional aspects in Designing a specialized exercise bag, and surveying experts' opinions. Research results in designing the bag: The bag's padding was designed from (a rubber vehicle tire, a mixture of sand and hay, a rope, a clip and plastic adhesive), and the bag was designed by recycling a judogi. The researchers designed a specialized exercise bag pattern to be used in designing the bag from waste martial arts suit. The aesthetic and functional quality of the design was identified in the design of the bag by designing questionnaires for aesthetic quality and functional quality, and they obtained acceptable scientific procedures in cooperation with the experts of (clothing, textile, and martial arts). Results of the aesthetic quality questionnaire showed the design quality of the specialized exercise bag according to the opinions of (12) experts (clothing and textiles). The relative weight of the opinions was (97.22%) with an arithmetic mean of (2.92) in the questionnaire dimensions (quality of design, quality of pattern measurements, quality of sewing, The quality of finishing, and the quality of the bag design as a whole) and in the dimension (quality of recycling materials) (100.00%) with an arithmetic mean of (3.00). Results of the design quality and functionality questionnaire showed the validity of the design according to the opinions of (13) experts (martial arts), and the relative weight of their opinions was (94.87%), with an arithmetic mean of (2.85) in the questionnaire dimensions (design safety, design quality, recycling quality). A relative weight (92.31%) and arithmetic average (2.77) in (the functional suitability of the specialized exercise package (as a whole), and a relative weight (89.74%) and arithmetic mean (2.69) in the (quality of implementation) dimension. The researchers concluded that the design of the specialized exercise bag for self-defense sports was acceptable by recycling the martial arts uniforms and some environmental waste, to achieve sustainable development. The design achieved aesthetic and functional quality, and provided brainstorming opportunities to design innovative, economical, and environmentally friendly sports tools that would benefit players of various sports activities.

Keywords:

Sustainable Development- eco-design- recycling- martial arts' uniform- sports waste

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Introduction:

Despite the Sustainable Development Goals' focus on responsible consumption and production, few workers in the sports product industry care about what happens to products after their use ends. With environmental degradation becoming a daily global concern, it is crucial to consider the end-of-use stage in the production and consumption of sports goods, advocate for extending producer responsibility, and view the circular economy as a

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viable alternative solution (Szto & Wilson, 2023). Sports are an essential element in enabling sustainable development and transitioning towards a green economy. Recycling sports products is a model for environmental sustainability that we must encourage to spread and develop product sustainability practices and environmental awareness in the sports field.

Raising awareness about the environmental performance of products leads to a competitive advantage for these products and an abundance of eco-friendly products in the market. Eco-design is a method to achieve this competitive advantage, as it is a methodology in product design that reduces the environmental impact of each product throughout its entire lifecycle and production cost cycle (Wimmer & Ostad-Ahmad-Ghorabi, 2007). Sports have significant potential for recycling textiles, equipment, and sports shoes used in training and competitions, as they generate a substantial amount of waste, much of which is in good condition (Finan et al., 2018).

Sports products still have a short lifecycle, where our goal should not be zero waste because the zero-waste initiative confirms the difficulty of achieving this goal (Liboiron & Lepawsky, 2022). Instead, we should aim to see these products as perpetually usable without turning into waste. Prioritizing product repair and challenging traditional ownership concepts allows for better waste-related options (Szto & Wilson, 2023). Recycling products solves many problems and helps in producing new products with lower energy consumption, making it an effective tool for protecting the environment and reducing the depletion of natural resources (Ismail et al., 2020).

The sports field consumes clothing, shoes, tools, and equipment in ways that significantly impact the environment due to the increasing volume of this waste. Recycling this waste is not tangible on the international level. An athlete generates between 6 to 7 pounds of waste annually, including items such as sneakers, tracksuits, t-shirts, shorts, leggings, socks, balls, tennis rackets, etc., leading to no less than 6000 tons of waste annually per million high-level athletes, professionals, and amateurs. This waste includes rubber, cotton textiles, synthetics, leather, artificial leather, and other materials, in addition to damaged equipment and devices used in sports activities at clubs, schools, and universities, which contain wood, plastic, and rubber waste (Savoiu & Butnarium, 2013).

Every year, thousands of tons of sports equipment are discarded. Therefore, a series of new processes have been developed to recycle sports equipment at a reasonable cost using separation systems, purifying parts of the equipment, and treating each material separately to prepare new sports equipment with efficient performance and the required safety measures (Colonna et al., 2022).

The advancement in sports equipment manufacturing has increased the environmental burden. It is estimated that 80% of a product's environmental burden is determined during the design phase. Focusing on the lifecycle of eco-friendly products and applying it in the design of sports equipment can avoid and reduce the environmental degradation associated with the production and disposal of these products (Subic & Paterson, 2006).

The growth of modern sports products and fashion-driven purchasing behavior has led to shorter product lifecycles, increased consumption, and waste. Millions of tons of sports equipment, shoes, and clothing are produced annually. Therefore, modern sports equipment design aims to prioritize environmental issues by developing and applying eco-friendly methodologies and sustainable design practices for sports products. This aims to achieve lower social costs, combat pollution, provide higher levels of environmental protection, better resource use, and reduce emissions and waste (Hanna & Subic, 2008; Subic & Paterson, 2008; Subic, 2005).

Innovations in sports products have rapidly evolved for marketing by manufacturers to meet diverse needs and changing user preferences, in addition to seizing growth opportunities. Consequently, the industry has diversified to develop modern and performance sports products, leading to shorter product lifecycles and increased waste. (Subic et al., 2009).

Judokas are required to wear the "Judogi" during training and competition, which consists of a jacket, pants, and a belt. They must adhere to specified standards and maintain cleanliness to avoid disqualification from competition (IJF, 2023; Kano, 2005). Martial arts athletes (judo, Jiu-jitsu, aikido, sambo, kurash, gushtingiri, karate, Taekwondo, Kung Fu) are similarly required to wear uniforms that respect the traditions of their sports and ensure their safety. These uniforms eventually turn into waste, and new ones are needed with increased participation in competitions, changes in age groups, or weight categories, leading to increased sports uniform waste. Researchers have therefore sought to recycle martial arts uniforms and environmental waste such as rubber vehicle tires and hay or wood shavings to design training tools for athletes, given that improper disposal and treatment of these wastes harm the environment.

The flexible materials in used tire rubber present significant environmental challenges and new technological opportunities. These complex plastic mixtures are chemically intricate, difficult to

recycle, stable in the environment, and contain toxins, with tire waste being more abundant than expected (Bowles et al., 2020). Rubber waste is disposed of through various methods: burial, burning for energy recovery, asphalt maintenance, integration into new products, and recreational use in facilities and sports fields (Valentini & Pegoretti, 2021; Makoundou et al., 2021). New opportunities for sustainable circular economy applications are provided by reprocessing rubber waste (Dabic-Miletic et al., 2021), referring to an industrial economy focused on reusing products without producing waste or pollution (Kilpeläinen, 2017).

Researchers have emphasized the importance of recycling the Judogi as a model for martial arts uniforms to design a specialized training bag with its flexible parts and padding, enabling specialized exercises for martial arts athletes. Henry (2011) notes that specialized skill and tactical exercises should be performed in a manner that aligns with the specific performance and competitive skill training. Escobar-Molina et al. (2023) add that martial arts athletes have a common need during competition: the ability to control the grip to execute skills.

Salem et al. (2023), Abd-Elghany et al. (2023), and Gomaa (2022) indicate that the Bulgarian training bag contributes to improving certain physical and skill variables for judokas. The Bulgarian bag used in these studies was designed for wrestling and other activities, and researchers believe that providing a grip on the uniform's sleeve or collar during martial arts exercises with the specialized training bag would have a better impact and appeal to athletes than the type used in those studies. The need for specialized sports training, sustainable development by recycling martial arts uniforms and some environmental materials, and utilizing available resources instead of wasting them led to the research problem of designing a specialized training bag by recycling martial arts uniforms to achieve sustainable development.

Research Questions:

1- What is the design of the padding for a specific-exercises bag to achieve sustainable development?
2- Is it possible to execute a specific-exercises bag by recycling the fabrics of martial arts sports suits instead of using new material?
3- What is the suitable pattern for a specific-exercises bag to achieve sustainable development?
4- How far is the aesthetic and functional quality of the specific-exercises bag?

Aim:

The current research aims to achieve sustainable development through designing a specific-exercises bag by recycling the environment's material. This aim can be achieved by:

1- Designing the padding of a specific-exercises bag by recycling the environment's material.
2- Designing a specific-exercises bag by recycling the fabrics of martial arts sports suits instead of using new material.
3- Designing a suitable pattern for a specific-exercises bag.
4- Investigating the aesthetic and functional quality in designing a specific-exercises bag.

Terminology:

The specific-exercises bag is a tool designed by recycling the martial arts sports suits and other environment's material. It has a flexible weight with a crescent shape. It is used for martial arts' specific exercises (operational definition by the researchers).

Methods:

Approach:

The researchers used the experimental approach to design a specific-exercises bag by recycling the fabrics of martial arts sports suits and other environment's material. In addition, they used the descriptive approach to investigate the aesthetic and functional aspects of the designed specific-exercises bag through identifying experts' opinions (clothes and textile, and martial arts).

Research community and Sample:

Research community included sports waste of martial arts athletes and some environment's waste. Sample included a judogi, a rubber vehicle tire, hay or sawdust, sand, robe, a clip and plastic sticker. In addition, a human sample including (12) experts in clothes and textile and (13) experts of martial arts were recruited for studying the aesthetic and functional aspects of the bag's design.

Research Tools:

A. **Material and equipment**: 1) Judogi waste, 2) a consumed rubber vehicle tire, 3) hay or sawdust, 4) sand, 5) a cotton robe (the length of the tire circumference plus 40 cm to get out of the tire two tips), 6) a clip and plastic sticker, 7) sewing machine, 8) paper for designing the patter, 9) paper sessors, 10) clothes sessors, 11) a computer with "AccuMark Explorer" software to design the patter.
B. **Data collection forms**:
    1. Experts Opinions form (clothes and textile) about the aesthetic quality of the specific-exercises bag's design (by the researchers)
    2. Experts Opinions form (martial arts) about the functional quality of the specific-exercises bag's design (by the researchers).

Validity and Reliability of forms:

The researchers designed two forms, one of them was to identify experts' opinions (clothes and textile) about the aesthetic aspects of the design, while the other was to identify experts' opinions (martial arts) about the functional aspects of the design. The first form was to (12) clothes and textile experts while the second was delivered to (13) martial arts experts. Using SPSS V.21, the researchers calculated validity and reliability of the forms.

First: Experts Opinions form (clothes and textile) about the aesthetic quality of the specific-exercises bag's design:

The researchers prepared the file of the Experts Opinions form (clothes and textile) about the aesthetic quality of the specific-exercises bag's design. The file included two patterns (1 and 2), execution steps, pictures for the design and the following link:

https://docs.google.com/forms/d/1urJ1pImPAIBcvNUSnI-oIOJH60xQKaeQf8jmd8TV3bk/edit

to respond using Google Forms. The form included five dimensions: 1) Quality of Design with (6) items, 2) Recycling Material with (3) items, 3) Quality of Pattern Measurements with (3) items, 4) Quality of Sewing with (4) items, 5) Quality of Final Finish with (3) items. A three-point Likert Scale was used so that "Suitable" takes (3) points, "Somehow Suitable" takes (2) points and "Not Suitable" takes (1) point. Points given to each dimension were as follows: 1) (18) points, 2) (9) points, 3) (9) points, 4) (12) points, 5) (9) points, with total mark of (57) for the whole form.

For "**Judges Validity**", the researchers presented the form to (12) clothes and textile experts to judge the suitability of each item for its relative dimension, items' wording and any other suggestions. Agreement coefficient was calculated using Cooper Equation (agreement percentage = number of agreements / [number of agreements + number of disagreements] x 100). Modifications were applied according to experts' opinions as seen in table (1).

Table (1): Agreement Coefficient of Experts' Opinions about The Quality of Specific Exercises Bag's Design

Evaluation Item	Agreements	Disagreements	Agreement Coefficient
Wording and Scientific Accuracy of Items	12	0	100%
Easiness and Accuracy of Items	12	0	100%
Suitability of Dimensions	11	1	91.66%

According to table (1), agreement percentage ranged between 91.66% and 100%. So it is acceptable.

For Internal Consistency, the researchers calculated correlation coefficients among the total mark of each item and the total mark of the whole form using Pearson's correlation coefficient, as seen in table (2).

Table (2): Correlation Coefficients among each item and the whole for according to experts' opinions about the aesthetic quality of the design

Quality of Design		Recycling Material		Quality of Pattern Measurements		Quality of Sewing		Quality of Final Finish	
Item	R	Item	R	Item	R	Item	R	Item	R
1	0.812**	7	0.963*	10	0.773**	13	0.886**	17	0.866**
2	0.781**	8	0.962*	11	0.799**	14	0.806**	18	0.828**
3	0.871**	9	0.933*	12	0.733**	15	0.824**	19	0.837**
4	0.832**					16	0.856**		
5	0.871**								
6	0.855**								

Table (2) indicates that R values are all significant on P ≤0.01 as they all approach (1). This means that the form is internally consistent and it measures what it is meant to measure.

Table (3): R Values among each item and the whole for according to experts' opinions about the aesthetic quality of the design.

Dimension	R
Quality of Design	0.922**
Recycling Material	0.915**
Quality of Pattern Measurements	0.931*
Quality of Sewing	0.891*
Quality of Final Finish	0.937*

* Significant on P ≤0,05 ** Significant on P ≤0.01

Table (3) indicates that R values are all significant on P ≤0.01 as they all approach (1). This means that the form is internally consistent and it measures what it is meant to measure. This proves the validity of the form.

Considering Reliability, the researchers calculated Cronbach's Alpha coefficient as seen in table (4).

Table (4): Reliability of Experts' Opinions about The Quality of Specific Exercises Bag's Design

Dimension	Cronbach's Alpha
Quality of Design	0.815**
Recycling Material	0.823**
Quality of Pattern Measurements	0.832**
Quality of Sewing	0.841**
Quality of Final Finish	0.838**
The whole form	0.827*

* Significant on P ≤0,05 ** Significant on P ≤0.01

Table (4) indicates that Cronbach's Alpha values are all significant on P ≤0.01. this proves the reliability of the form.

Second: Experts Opinions form (martial arts) about the functional quality of the specific-exercises bag's design:

The researchers prepared the file of the Experts Opinions form (martial arts) about the functional quality of the specific-exercises bag's design. The file included pictures of material in use, parts of the bag, the bag itself, one of the recommended exercises and a link:

https://forms.gle/erYcCarp5bhGWw1y9

to respond using Google Forms. The form included four dimensions: 1) Safety of Design (4 items), 2) Quality of Design (4 items), 3) Quality of Execution (3 items), 4) Quality of Recycling (3 items,). A three-point Likert Scale was used so that "Suitable" takes (3) points, "Somehow Suitable" takes (2) points and "Not Suitable" takes (1) point. Points given to each dimension were as follows: 1) (12) points, 2) (12) points, 3) (9) points, 4) (9) points, with total mark of (42) for the whole form.

For "Judges Validity", the researchers presented the form to (13) martial arts experts to judge the suitability of each item for its relative dimension, items' wording and any other suggestions. Agreement coefficient was calculated using Cooper Equation (agreement percentage = number of agreements / [number of agreements + number of disagreements] x 100). Modifications were applied according to experts' opinions as seen in table (5)

Table (5): Agreement Coefficient of Experts' Opinions about The Functional Quality of Specific Exercises Bag's Design

Evaluation Item	Agreements	Disagreements	Agreement Coefficient
Wording and Scientific Accuracy of Items	13	0	100%
Easiness and Accuracy of Items	12	1	92.30%
Suitability of Dimensions	12	1	92.30%

According to table (5), agreement percentage ranged between 92.30% and 100%. So, it is acceptable.

For Internal Consistency, the researchers calculated correlation coefficients among the total mark of each item and the total mark of the whole form using Pearson's correlation coefficient, as seen in table (6).

Table (6): Correlation Coefficients among each item and the whole for according to experts' opinions about the functional quality of the design.

Safety of Design		Quality of Design		Quality of Execution		Quality of Recycling	
Item	R	Item	R	Item	R	Item	R
1	0.873**	5	0.809**	9	0.876*	12	0.871**
2	0.823**	6	0.805**	10	0.890**	13	0.855**
3	0.819**	7	0.811*	11	0.829**	14	0.859**
4	0.893**	8	0.832*				

Table (6) indicates that R values are all significant on P ≤0.01 as they all approach (1). This means that the form is internally consistent and it measures what it is meant to measure.

Table (7): R Values among each item and the whole for according to experts' opinions about the functional quality of the design

Dimension	R
Safety of Design	0.902**
Quality of Design	0.910**
Quality of Execution	0.901*
Quality of Recycling	0.914*

* Significant on P ≤0,05 ** Significant on P ≤0.01

Table (7) indicates that R values are all significant on P ≤0.01 as they all approach (1). This means that the form is internally consistent and it measures what it is meant to measure. This proves the validity of the form.

Considering Reliability, the researchers calculated Cronbach's Alpha coefficient as seen in table (8).

Table (8): Reliability of Experts' Opinions about The Functional Quality of Specific Exercises Bag's Design

Dimension	Cronbach's Alpha
Safety of Design	0.905**
Quality of Design	0.913**
Quality of Execution	0.922**
Quality of Recycling	0.901**
The whole form	0.911*

* Significant on P ≤0,05 ** Significant on P ≤0.01

Table (8) indicates that Cronbach's Alpha values are all significant on P ≤0.01. this proves the reliability of the form.

Steps of designing the specific exercises bag:

The bag was designed on two phases:

1. Executing, revising and enhancing the design in addition to considering safety, specialty of performance and nature of martial arts.
2. Investigating the functional and aesthetic qualities of the specific exercises bag.

A- Designing the Martial Arts Specific Exercises Bag.

First: designing the bag padding:

1. **Bag padding pouch**: This step aimed to make a pouch (cover) for the bag filling. Through review of literature and experimentation, the researchers achieved recycling a rubber vehicle tire to make a bag filling pouch, because of its flexibility and safety, its tolerance to repeated exercises, the ease of performing specialized exercises, its semi-circular shape, and its availability at an economical cost.
2. **Weight of the bag's padding**: Sand was used to fill the bag's pouch, due to its flexibility and abundance. It was tested in performing some exercises, and the researchers discovered an increase in its specific weight, and the difficulty of completely filling the bag's pouch, which led to the presence of a gap that allowed sand particles to move inside the filling. This was treated by installing an adhesive tape. To attach the bag padding to the suit for performing exercises.
3. **Improving the weight of the bag padding material**: After experimenting with the weight of the sand padding, and observing the movement of its particles in the existing gaps due to the difficulty of filling the bag completely so as not to increase the weight of the bag, the researchers decided to use a mixture of hay and sand, and this was suitable for controlling the bag's weight and ensuring performance. The researchers suggested a mixture of sawdust and sand as an alternative to hay.
4. **Padding rope**: A rope is inserted into the padding and its two ends are in the form of a ring, and they emerge at an appropriate length from the padding, which facilitates the installation of the bag suit, transporting and storing the bag, and can also be used in performing some exercises.
5. **Closing both ends of the filling**: One end of the bag's padding was sealed with (2) plastic clips, then the padding was filled from the other end with a mixture of sand and hay and is pressed well, to form the weight of the padding. Then this end was sealed with (2) plastic clips, and a wide adhesive tape was used on the both sides of the padding.

Second: Designing the Specific Exercises Bag:

The specialized bag was designed by recycling the jacket of a judogi or a suit for martial arts sports, to achieve the sustainability of sports clothing, and the specific grip (sleeve, collar) as in the specialized sport of the player, and this went through two stages:

1. Designing the specialized bag by directly recycling a judogi jacket:

The researchers used judogi jacket waste. At this stage, the lack of stability of the padding became evident during the exercises, as only sand was used to weigh the padding. This was overcome by installing an internal adhesive to stabilize the bag padding.

2. Design of the specialized bag pattern suit (1):

The dimensions of the bag's padding were increased to its semi-crescent shape, then a pattern (1) was drawn in accordance with the parts of the judo suit jacket, and the external rotation was increased in accordance with the rotation of the implemented padding. After implementing the pattern and inserting the padding into it, a specialized exercise bag for training martial arts sports players was obtained. It is distinguished by its specific grip and flexible weight that can be controlled freely and

safely. The procedural steps for this pattern were as follows:

1. The measurements of the specialized exercise bag were taken by measuring the external rotation of the pad that had been prepared. The external rotation was 147 cm long, the internal rotation was 112 cm, and the internal rotation was carried out by rising from the middle line of the bag 32 cm.
2. A straight line was measured whose length is approximately equal to the external circumference of the bag (147 cm), and we put a point (1, 2), and the middle point of the pattern was determined and we put a point (3).
3. We rise from the middle to the highest amount (32 cm) and put a point (4).
4. We rise from both sides to a height of 30 cm above points (1, 2), and place point (5) on the right side, and point (6) on the left side.
5. We move from the middle from point (3) to the right and left, about (10: 12 cm), and place two points (6, 7).
6. The two points (5, 6), (6, 7) are connected by rotation to obtain the external rotation of the exercise bag, provided that the rotation is approximately 147 cm (the width of the bag from the outside, taking into account the width of the rotation from the sides of 12): 15 cm). To obtain a wider design of the bag from the outside so that the player can hold it during exercise, the rotation is performed from one side first, then the pattern is bent on the middle line, which is the middle line of the bag, and the external rotation is performed on the other side to ensure that the external shape of the bag matches.
7. The size of the entry and exit opening (the bag's padding) is determined at approximately (27 cm) and we place points (8) and (9) on the sides, and it is open on both sides.
8. The internal rotation of the exercise bag is delivered according to the required size (112 cm), taking into account adjusting the rotation from the inside and its consistency with the external rotation. The rotation is done from one side, then the pattern is bent on the center line and the rotation is executed from the other side to ensure that the pattern on both sides is identical.
9. Connect points (5, 8), (6, 9) and they represent the fold line of the design from the outside on both sides, which is the amount of opening necessary for the bag's padding to enter and exit.

Place of the collar of the specialized training bag (1):

1- An amount of (10 cm) is determined from the middle, starting from point (3) on both sides, where the width of the collar opening is (20 cm) to implement the location of the collar for the bag.

2- Points (10, 12), (11, 13) are connected by a straight line on both sides, taking into account that the width of the collar is parallel on both sides and slightly rounded from the bottom.

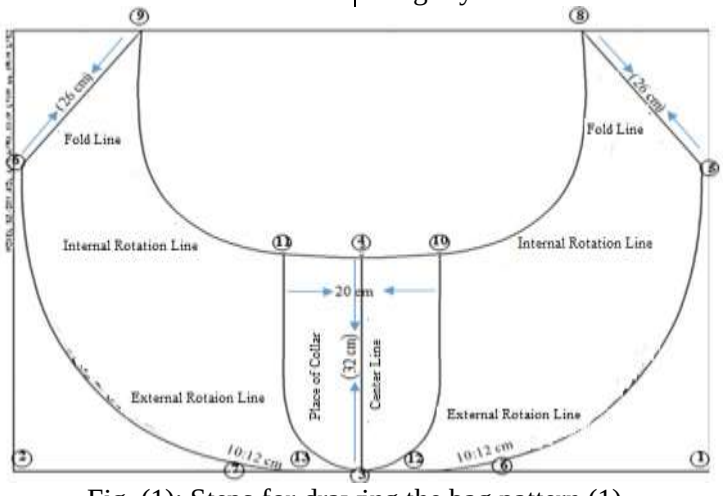

Fig. (1): Steps for drawing the bag pattern (1)

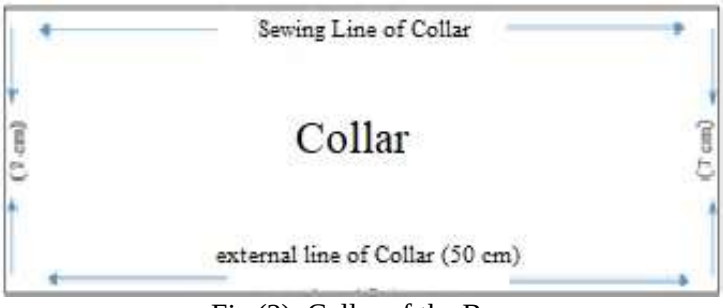

Fig (2): Collar of the Bag

3. Design of the specialized bag pattern suit (1):

The researchers aimed to achieve the highest quality and economy in designing specialized exercises, by preparing and drawing a pattern (2) in accordance with the shape of the waste judo suit jacket, and reducing the external rotation of the pattern (1), and the pattern (2) was executed and cut on the waste fabric of the judogi.

Executive Procedures for Executing the Specific Exercises Bag (Pattern 2):

First: Executive steps of designing the specific exercises bag (pattern 2)

Pattern (2) was drawn using AccuMark Explorer software. The execution followed the following steps:

1) Draw a straight line whose length is equal to the depth of the armpit of the judogi jacket, then put a point (1), (2) and this represents the half-back line and the half-front line, and its length is (30) cm.
2) Exit from point (1), (2) with two parallel horizontal lines to the right, about (27) cm, and place point (3), (4).
3) Exit from point (3) with another straight horizontal line about (48) cm and place point (5), then we draw a straight line from point (5) downward with a length of (13.5) cm and place point (6), then we connect a line from point (6) to point (3).
4) Draw a line from point (4) parallel to the line between point (3) and (6), then we exit from point (6) a line perpendicular to the line between point (3) and (6) and it meets the line coming out of point (4) in Point (7).
5) Go down from point (1) by (2.5) cm and put point (8), and go out from point (2) to the right by (10) cm and put point (9).
6) Draw a line from point (9) vertically upwards, and when it approaches point (8), a curve is drawn that connects to point (8).
7) The line is measured from point (9) to (8) to determine half the fitness amount and draw a pattern for it.

Figures (3) and Figure (4) show the steps for designing the specialized exercise bag Patron (2), and the parts of designing the specialized exercises.

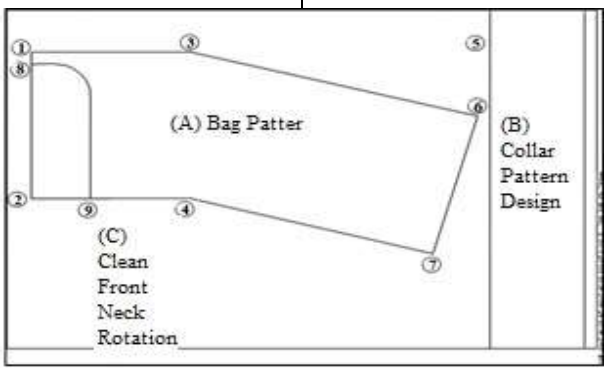

Fig. (3): Steps of drawing Pattern (2)

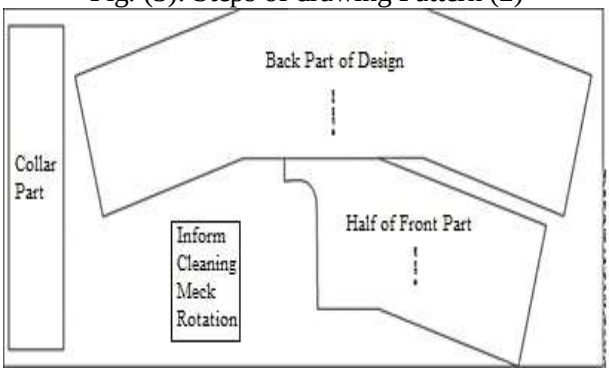

Fig. (4): Parts of the bag (pattern 2)

Second: Steps for executing and cutting the bag (pattern 2):

1. Adjust the center line of the pattern to the longitudinal direction of the fabric.
2. The pattern was attached to the fabric of the recycled judogi, taking into account that the pattern was placed on two layers of fabric, leaving an amount of (1.5 cm) of stitching, and cutting was done according to the borders of the pattern.
3. The collar pattern is cut by either placing the pattern on two layers of fabric, and cutting according to the borders of the pattern while leaving an amount of (1.5 cm) of stitching, or cutting the suit collar without the pattern from the waste of the judogi and installing it as it is.

Third: Sewing and Assembling:

1. After completing the cutting stage, the two layers of the cut fabric are placed face to face and the sewing process is completed on the

back of the fabric. Sewing begins from the beginning of the external rotation, then sewing the internal rotation, taking into account leaving the collar and the two edges of the bag open.
2. The seams are opened with scissors, and the bag is adjusted on the face, taking into account the rotation of the iron.
3. The collar is sewn by making a "spread" using scissors in the middle of the collar.
4. Adjust the center line of the collar with the center line of the specialized exercise bag.
5. The bottom layer of the collar is sewn with the bag layer, taking into account that the two layers of fabric are face to face, and the sewing process is carried out from the middle to the end line of the collar.
6. Drape (1) cm of the upper layer of the collar over the lower layer with the judo training bag, and a sewing line is made for all layers.

Picture (1): The Specific Exercises Bag Designed from Recycling the Judogi.

Results and Discussion:

The researchers conducted a survey and some procedures to design a specialized exercise bag for martial arts. Firstly, the researchers designed the padding for the bag. In step (1), they created a cover for the padding using recycled vehicle tires due to its flexibility, durability, performance safety, and crescent shape, which allows for a variety of specialized exercises and is economically available. In steps (2) and (3), they made the weight of the padding using a mixture of hay and sand, suitable for controlling the bag's weight and ensuring performance safety. In step (4), they installed a rope that extends from both ends of the padding, at an appropriate length to pull the padding into the bag, and to control it during transport and storage. In step (5), they closed both ends of the padding with two plastic clips on each end, after filling the padding cover, and secured the clips with adhesive tape on both ends of the padding. Thus, the materials and environmental waste used in the specialized exercise bag padding (recycled vehicle tire, hay, sand, cotton rope, plastic clips, wide plastic adhesive tape) answered the research question: (1) What is the design of the specialized exercise bag padding to achieve sustainable development?

The completion of the design procedures for the specialized exercise bag involved the following steps: in step 1: The specialized bag was designed by recycling a Judogi jacket directly. The researchers used waste Judogi jackets for this purpose. Initially, the padding was unstable during exercises because only sand was used for weight. This issue was resolved by installing internal adhesive to secure the padding, as mentioned in the first part of the padding design. In step 3: They modified the material composition of the padding weight to address the movement of sand particles within the padding cover by using a mixture of straw and sand. This adjustment was suitable for controlling the bag's weight and ensuring performance safety. The size of the padding mass became appropriate within the bag. Thus, the bag can be designed from a Judo suit or a suit from another martial art by cutting and sewing the unnecessary parts to closely resemble Pattern (2) illustrated in the specialized exercise bag design. By following these procedures and steps, the researchers answered the question: (2) What is the feasibility of creating a specialized exercise bag by recycling a martial arts suit to achieve sustainable development?

Upon completing the specialized exercise bag design procedures and designing a better padding filled with a sand-straw mixture, and measuring the padding dimensions. In step 2: The specialized exercise bag was designed, Pattern (1). Researchers finalized Pattern (1) to match the parts of a Judogi jacket, increasing the outer curvature to match the implemented padding's curvature. The researchers improved quality and sustainability by designing Pattern (2) to align with the recycled Judo jacket design, reducing the outer curvature compared to Pattern (1). This made Pattern (2) more suitable for the specialized exercise bag and more economical. Pattern (2) can be used to create a specialized exercise bag from recycled parts of a martial arts suit and other suitable textile waste. By following these procedures and steps, the researchers

answered the question: (3) What is the proposed design concept for the specialized exercise bag pattern to achieve sustainable development?

With these results, the research achieved its goal of enhancing sustainable environmental development and designing a specialized exercise bag for martial arts by recycling environmental materials. This aligns with the International Judo Federation's (IJF) policy to promote environmental sustainability, use recyclable products, sustainable attire, incentivize sustainable behaviors, provide selective waste disposal options, and enhance sustainability awareness (IJF 2024). The research findings align with the policy of environmental sustainability in sports, emphasizing the recycling of materials since the sports field offers significant opportunities to recycle textile waste, sports equipment, and footwear used during training and competitions, many of which are in good condition (Finan et al., 2018).

The research findings also align with initiatives to reduce waste by sustaining products and improving the lifecycle of short-lived sports products (2022 Liboiron and Lepawsky), making these products permanently usable without turning into waste, prioritizing product repair, and challenging traditional ownership concepts for better waste options (2023 Szto, & Wilson). The research also agrees that practicing material recycling helps produce new products with less energy consumption, providing an effective tool for environmental protection and reducing the depletion of natural resources (Ismail et al., 2020).

To answer the question about the aesthetic quality of the design: "How good is the aesthetic design of the specialized exercise bag?" the frequencies, percentages, and relative weight of the responses from clothing and textile specialists were calculated regarding the aesthetic quality of the specialized exercise bag design. According to the three-point Likert scale, numerical values were assigned to the scale as follows: Suitable = 3, Somewhat Suitable = 2, Unsuitable = 1. Based on this, the arithmetic mean values for the statement or dimension ranged as follows: from (1) to less than (1.67) (Unsuitable), from (1.67) to less than (2.34) (Somewhat Suitable), from (2.34) to (3) (Suitable).

Table (9) Frequencies, percentages, means, and standard deviations of clothing and textile specialists' opinions on the aesthetic quality of the specialized exercise bag design (overall). (n=12)

Indicators	Suitable		Somehow suitable		Not suitable		Mean	SD	Relative weight	Direction
	F	%	F	%	F	%				
Quality of Design	11	91.67	1	8.33	0	0.00	2.92	0.289	97.22	Suitable
Recycling Material	12	100.00	0	0.00	0	0.00	3.00	0.000	100.00	Suitable
Quality of Pattern Measurements	11	91.67	1	8.33	0	0.00	2.92	0.289	97.22	Suitable
Quality of Sewing	11	91.67	1	8.33	0	0.00	2.92	0.289	97.22	Suitable
Quality of Final Finish	11	91.67	1	8.33	0	0.00	2.92	0.289	97.22	Suitable
The whole form	11	91.67	1	8.33	0	0.00	2.92	0.289	97.22	Suitable

Results of Table (9) indicate:

1. **Aesthetic Design Quality**: The relative weights of the opinions of clothing and textile specialists on the aesthetic quality of the design reached (97.22%) with a mean of (2.92). The researchers attribute this to the suitability of the design for its intended functional and aesthetic purposes, achieving sustainable development, and reaching an acceptable level of design quality that meets its intended purpose.
2. **Recycling Material Quality**: The relative weights of the opinions of clothing and textile specialists on the quality of recycling materials reached (100%) with a mean of (3.00). The researchers attribute this to the effective use of martial arts uniforms in designing the specialized exercise bag, achieving sustainable development by recycling economical and readily available environmental materials suitable for the intended purpose.
3. **Pattern Measurement Quality**: The relative weights of the opinions of clothing and textile specialists on the quality of pattern measurements reached (97.22%) with a mean of (2.92). The researchers attribute this to the accurate measurement methods and the suitability of the specialized exercise bag for its intended design.
4. **Sewing Quality**: The relative weights of the opinions of clothing and textile specialists on the quality of stitching reached (97.22%) with a mean of (2.92). The researchers attribute this to the correct methods used for measurements, the quality of the cutting process, and execution.
5. **Final Finishing Quality**: The relative weights of the opinions of clothing and textile specialists on the quality of final finishing reached (97.22%) with a mean of (2.92). The researchers attribute this to the precision of execution and final finishing of the specialized

exercise bag using sports attire in a way that attracts players' attention and suits the diverse performance possibilities for martial arts exercises.

6. **Overall Design Quality**: The relative weights of the opinions of clothing and textile specialists on the overall design quality of the specialized exercise bag reached (97.22%) with a mean of (2.92). The researchers attribute this to the design's suitability for its intended purpose, as it was implemented in a way that suits martial arts, recycles environmental materials, and achieves both functional and aesthetic aspects of the bag. It ensures adequate safety and usability, serving martial arts practitioners and achieving sustainable development and environmental preservation by optimally utilizing martial arts uniforms and environmental materials.

Based on the above, it can be said that the opinions of clothing and textile specialists on the overall design quality of the specialized exercise bag, according to the relative weight value, reach (97.22%). This confirms that the design achieves both aesthetic and functional purposes, implementing the specialized exercise bag in a way that suits martial arts using recycled sports uniforms and some environmental materials to achieve sustainable development and environmental preservation, according to the opinions of clothing and textile specialists. The researchers explain this by the availability of design quality, showing its aesthetic value, ease of implementation steps, achieving proportionality in the design, suitable structural lines, and aligning the design with its intended functional purpose, adding a new contribution to scientific research. Additionally, the quality of recycling is evident through the economic feasibility of the design, its suitability for making the exercise bag, and as a means to safely dispose of sports and other waste in an environmentally friendly way. The quality of pattern measurements is evident in the accuracy of measurements, pattern lines, and the correct execution of the specialized exercise bag. The quality of stitching is shown by the regular stitching process, correct execution, and proper alignment of the bag's sides and collar. The quality of final finishing is evident in the correct execution of the bag, with its final shape attracting the attention of players, thereby increasing the demand for this bag among martial arts practitioners.

To answer the question about the functional quality of the design: "How good is the functional design of the specialized exercise bag?" the frequencies, percentages, and relative weight of the responses from martial arts specialists were calculated regarding the functional quality of the specialized exercise bag design. According to the three-point Likert scale, numerical values were assigned to the scale as follows: Suitable = 3, Somehow suitable = 2, Not suitable = 1. Based on this, the arithmetic mean values for the statement or dimension ranged as follows: from (1) to less than (1.67) (Not suitable), from (1.67) to less than (2.34) (Somehow suitable), from (2.34) to (3) (Suitable).

Table (10) Frequencies, percentages, means, and standard deviations of martial arts specialists' opinions on the functional quality of the specialized exercise bag design (overall). (n=13)

Indicators	Suitable		Somehow suitable		Not suitable		Mean	SD	Relative weight	Direction
	F	%	F	%	F	%				
Safety of Design	11	84.62	2	15.38	0	0.00	2.85	0.376	94.87	Suitable
Quality of Design	11	84.62	2	15.38	0	0.00	2.85	0.376	94.87	Suitable
Quality of Execution	9	69.23	4	30.77	0	0.00	2.69	0.480	89.74	Suitable
Quality of Recycling	11	84.62	2	15.38	0	0.00	2.85	0.376	94.87	Suitable
The whole form	10	76.92	3	23.08	0	0.00	2.77	0.439	92.31	Suitable

The results of Table (10) indicate:

1. **Safety of Design**: The relative weight values of martial arts specialists' opinions on the safety of the design reached (94.87%) with a mean of (2.85). The researchers interpret this to mean that the specialized exercise bag design provides adequate safety measures, flexibility, and ease of use, minimizing the need for extreme precautions to prevent injuries.
2. **Design Quality**: The relative weight values of martial arts specialists' opinions on the design quality reached (94.87%) with a mean of (2.85). This suggests that the design achieves an acceptable level of quality, fulfilling its purpose of improving the physical and skill levels of martial arts practitioners, and facilitating specialized exercises for each sport.
3. **Execution Quality**: The relative weight values of martial arts specialists' opinions on the quality of execution reached (89.74%) with a mean of (2.69). The researchers attribute this to the bag's design being suitable for martial arts, using sports attire in a way that attracts players' attention and accommodates diverse exercise possibilities.

4. **Recycling Quality**: The relative weight values of martial arts specialists' opinions on the quality of recycling reached (94.87%) with a mean of (2.85). This is explained by the adoption of sustainable development principles in design, using economically and readily available recycled environmental materials, and the sustainability of sports attire being well-received by martial arts specialists.
5. **Functional Suitability**: The relative weight values of martial arts specialists' opinions on the overall functional suitability of the specialized exercise bag design reached (92.31%) with a mean of (2.77). This indicates that the design effectively incorporates safety, usability, design quality, and execution, serving martial arts practitioners, enhancing sustainable development, and utilizing sports attire and environmental materials to reduce harmful environmental impact and waste.

Based on the above, it can be concluded that the opinions of specialists in the field of sports education on the functional suitability of the specialized exercise bag design for martial arts, according to the relative weight value, reach (92.31%). This confirms the functional suitability of the specialized exercise bag design for martial arts according to the opinions of martial arts specialists. The researchers explain this as follows: The bag design provides safety by incorporating security measures for player use, ease of use for various exercises without extreme precautions to prevent injuries. The quality of the design helps improve physical and skill levels, allowing for different specialized exercises in martial arts, using parts such as sleeves, collar, rope, and padding weight made from recycled Judogi waste. The execution quality of the bag uses environmental materials in a way that suits martial arts, attracts players' attention, and enhances their performance. The recycling quality ensures the bag is economically suitable for specialized exercises for martial arts players, aiding in the disposal of sports and other environmental waste, achieving sustainable development, and preserving the environment through safe recycling and the sustainability of the sports attire.

Summary of Results:

First: Aesthetic Quality of the Specialized Exercise Bag Design:

1. The design of the exercise bag is distinguished by the required quality of execution.
2. The design is notable for its recycling quality, economical use, and environmental means of waste disposal.
3. The measurements taken for the bag were accurate, with precise pattern accuracy.
4. The design stands out with a high-quality final appearance and excellent execution and finishing.

Second: Functional Quality of the Specialized Exercise Bag Design:

1. The design achieves safety in use, flexibility with players due to the material's flexibility, and ease of use.
2. The design contributes to the advancement of the physical and skill level of martial arts players.
3. The bag design is appropriate for martial arts, using sports attire in an attractive way and suitable for performing specialized exercises.
4. The design uses a sustainable development approach by recycling economical and easily available environmental materials, suitable for the sustainability of sports attire and environmental materials.

Conclusions:

Researchers concluded that the design of the specialized exercise bag is suitable for martial arts and performing general and specialized exercises for martial arts players such as judo, Jiu-jitsu, aikido, sambo, kurash, gushtingiri, karate, Taekwondo, and Kung Fu. The design includes safety and security factors, quality of design, and execution of the specialized exercise bag by recycling martial arts clothing and environmental waste to achieve sustainable environmental development and reduce environmental pollution.

The researchers recommend providing opportunities to brainstorm innovative sports tools that are economically feasible and environmentally friendly, benefiting players in various sports activities, creating a proposed guide for exercises that can be performed using the specialized exercise bag, to assist coaches and martial arts players, designing the Bag from Recycled Martial Arts Jacket: Utilizing pattern drawings to design from textile waste and martial arts players' clothing and creating a grading marker for the pattern of the specialized exercise bag suit that can be used to make various sizes of the specialized exercise bag.

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