



UPCYCLING FOR REPURPOSING WASTE INTO CREATIVE PRODUCTS

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Abstract. Upcycling is the process of repurposing non-used materials or products to make them more valuable or usable, with increased quality and value. However, truly little research has been conducted on the design process and/or creative ideation of upcycling in order to produce higher-quality and more valuable products. This study presents the four stages of the design process, consisting of selecting the waste products, emerging conceptions, generating ideas, and rendering a series of creative ideas. SCAMPER (substitute, combine, adjust, modify, put to other uses, eliminate, reverse), one of the practical and effective techniques to create various creative ideas, was applied in the stages of emerging conceptions and generating ideas. With the upcycling concept of waste product design utilizing SCAMPER, the results demonstrated that waste soft drink cans could be converted into five creative products: a desk watch, a picture frame, a spring paper clip, a pencil holder, and a lamp. The five products featured the upcycling of waste soft drink cans, removing the need to recycle or send them to landfills at that point in their lifecycle. Consideration was given to the design process' compatibility with creative concept generation and design. The study indicated that upcycling should be viewed as an essential component of waste management and repurposing in order to provide an intelligent answer to escalating product waste problems.

Keywords: creative products, creative design, repurpose, SCAMPER, upcycling, waste products.

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1. Introduction

It was hard to deal with the waste in a pleasant way (Moscatto et al., 2020). In particular, uncontrolled waste disposal, the release of toxic substances, and the illegal burning of waste all lead to a high number of health problems, such as cancer deaths and birth defects, and a less-than-satisfactory quality of life in general (Alaanuloluwa Ikhueso, 2018). One solution could be to offer ways to get rid of trash other than putting it in a landfill or burning it. In upcycling, waste materials could be used for something else, as long as they fit with their nature and structure. This would be easier to do if the process also gave something extra, like designing products that look great and are in style. In fact, the market tends to think of things made from waste or upcycling materials as having a “corrupted” image. Design can respond to this idea by coming up with new ideas and ways of looking at things through new objects and products (Svihla & Kachelmeier, 2020). This could convince investors of the potential of upcycling waste products (Woodall et al., 2019).

It is possible to upcycle or repurpose waste products in ways that better utilize their unique qualities and architectural make-up (Davis et al., 2016). This could be accomplished

more quickly if the process resulted in anything of value, such as the creation of aesthetically pleasing and functional products. Possible beneficiaries include up-and-coming designers, as the proposed solution centers on the actualization of self-production acts, such as the development of a series of self-designed products. This could be accomplished by the creation of a low volume “pilot design” employing creative idea generation techniques. Thus, self-production may provide a means of responding to the problem by presenting high-quality products with added value, provided that these products are conceived of and executed in a way that is both creatively viable and environmentally sustainable.

The purpose of the study is to provide answers regarding the repurposing of waste by determining waste kinds that are suitable for the purpose by either being numerous or having a large environmental impact. For the repurpose to be effective, a precise and targeted technique must be developed and used for a variety of design experiences. Self-product design would be conducted through a program in which designers have access to contemporary transdisciplinary capabilities, ranging from design to new creative products, referencing contemporary creative idea generation techniques and application. Self-product design thus becomes a preferred route to inventive design, centered on waste products and based on the SCAMPER technique’s integrated creative idea generation.

2. Upcycling

Before the notion of upcycling emerged, the term *recycling* was often used to describe environmentally benign practices that involved reusing products by synthesizing them with other additions through decomposition (Oh et al., 2016). This straightforward approach to recycling, known as “downcycling”, is distinct from “upcycling”. In other words, while traditional recycling results in a loss of value relative to the product’s potential reuse value, upcycling actually increases this value (Wegener & Aakjær, 2016). Compounding the English terms *up* and *cycling*, *upcycling* can be found in dictionaries. *Up* indicates *on a higher level or above*, and *cycling* means *to cycle*. Consequently, a design act or its effect that further raises the value of a recycling target for the aim of recycling resources best describes upcycling design. If upcycling anything counts as recycling, then giving it a new use by giving it a creative makeover qualifies (Monsù Scolaro & de Medici, 2021). The basic objective of upcycling is to repurpose and use waste materials and components in the production of a wide variety of brand-new products that are part of fully accessible cycles (Kerr & Ryan, 2001; Mont et al., 2006). For instance, the liquid-crystal display (LCD) touch screen of an obsolete mobile phone created by Company A may be repurposed as the climate control touch screen in the instrument panel of a car built by Company B, and then again as the backlit LCD panel in a data projector made by Company C. Instead of recycling the rest of the phone, its parts might be put to other use in a wide variety of different products. In conclusion, all the materials and parts used are of equal or greater worth than they were in the first implementation. Nevertheless, in order to properly cater to downstream repurposing, each of these features would need to be considered upstream in the design stage of the mobile phone.

Within the context of the upcycling concept, Xu and Gu (2015) propose five guiding principles for waste product redesign as follows.

2.1. Enhancing the overall value

Because the primary objective of upcycling is to raise the value of waste and transform it into a source of wealth, increasing that value should come first in the process. In order to adhere to such a guideline, designers are obligated to thoroughly investigate the potential worth of the waste in terms of its function, material, structure, and so on, and to do all in their power to increase that value.

2.2. Reprocessing as much of the waste as possible

In order to make the most of the waste and avoid a lot of secondary waste, redesigning using waste as the raw material should involve making every effort to cut down on the number of waste materials generated throughout the production process. In order to make a suitable program for the entire design and manufacturing process, which requires the designers to start from the source, as well as be well equipped with the sound control ability to deal with emergencies, this requires the designers to start from the source. However, not all types of waste are able to maximize their potential applications in the same way. Because of this, the designers need to have a certain level of environmental awareness in order to identify how to minimize production and ensure the appropriate treatment of waste to the greatest extent possible.

2.3. Being ecologically friendly

Even while the raw material for redesigning products originates from things that have been used up or thrown away, this does not mean that the quality of such products is poor. On the other hand, the designers ought to treat it similarly without prejudice and develop it with the same status as typical products in order to guarantee that its quality is long-lasting and to extend the amount of time that it can be used. When it comes to the design, use, and recycling of products, negative impacts on the environment should be avoided at all costs. In the meantime, product designers should focus more on taking environmentally friendly products as a design guide and avoid the use of materials that are harmful to the environment.

2.4. Keeping a close eye on the expenses

Although garbage upcycling and redesigning ought to be subject to effective cost management, this will not happen if products are unable to be properly converted into products, which will result in a significant drop in value. Therefore, the first step of the regeneration process is the design, and in this step, designers need to take all aspects of the designing process into consideration so that they can effectively control the cost of redesigning from the source.

2.5. Maintaining the aesthetic of the populace

The design principle of using commercialization as a guide should be followed by the principle of conforming to the aesthetic taste of the general audience. In accordance with this idea, the designers should have great visual quality, an acute understanding of, and be familiar with

the conditions and customs of the target market, in addition to having sensitivity regarding features that are fashionable and popular. And they do their best to avoid incorporating their own personal views and values into the design so that the end product can be considered an individual “thing” that does not adhere to the aesthetic preferences of the general audience.

3. Responsibility in waste for product design

Product design is mainly relevant and responsible for household product waste because many of these products end up in the trash. In order to achieve zero waste by design, products and packaging must never end up in a landfill. The main objective of cradle-to-cradle production is to create products that can be used and reused throughout their entire lives in ways that add value (Wilber, 2010). In general, the way design is executed falls short of this objective. There must be a dramatic change in how things are conceived, built, packaged, distributed, repaired, recycled, and disposed of at their end of life. This cannot be accomplished without a radical rethinking of product design, construction, materials, performance characteristics, and end-of-life considerations (McDonough & Braungart, 2002; Papanek, 2005; Thorpe, 2007; Vezzoli & Manzini, 2008). Design professionals and manufacturers need to think about how they might effectively enable upcoming extended product responsibility and product stewardship rules, in addition to the more obvious problems with landfills. It has been proven that product take-back for reuse has the potential to be profitable and even save a lot of money compared to purchasing new products (Klausner et al., 1998; Mazhar, 2006), and it has been suggested that product reusing is a better price for product design than recycling (Mazhar, 2006). Reducing carbon emissions and waste, utilizing, and reusing materials responsibly, and limiting energy expenditure in production cycles are all aspects of the *Reduce, Reuse, Recycle, Remove* movement that can be helped by designing with component reuse as a primary priority energy expenditure in production cycles.

There are significant differences between recycling and upcycling, which will be discussed in further depth in the upcoming sections. On the other hand, there is a dearth of research that investigates the product design of upcycling as an efficient tool for both design and waste management. Upcycling is one way that product designers can directly minimize the amount of waste from domestic products that go into the waste products. On a broader scale, upcycling can reduce the amount of material that is used in product design production.

4. SCAMPER for generating creative ideas for upcycling in product design

The creative conceptualization process underlies the preponderance of creative approaches, creative design ideas, and their practical implementation. Brainstorming, mind mapping, the SCAMPER approach, and other similar techniques have all been used to study the creative process and its effects on the generation of new and creative ideas. SCAMPER is a technique and approach that combines brainstorming and mind mapping to help generate a diverse range of creative ideas and approaches to solving challenges that necessitate unconventional thinking. SCAMPER is an acronym for the sequence of excellent creative thinking

processes invented by Bob Eberle (Gündoğan, 2019): substitute, combine, adapt, modify, magnify, minimize, put to other use, eliminate, reverse, and rearrange. Before attempting to solve problems, the SCAMPER technique develops ideas by asking a series of questions to identify potential obstacles (Choi & Kim, 2014). In order to creatively solve confusing problems without missing the most pressing ones, the SCAMPER technique employs checklists (Mohamed-Kamal Hijazi, 2016). This thinking strategy is effective for sharing concepts while solving problems creatively and for unanticipated innovations that were overlooked throughout development (Zhang et al., 2016). There are a lot of ways to get your creative ideas out there, but the SCAMPER method is unique in that it lets you use different types of creative thinking in any order and ask as many or as few questions as necessary to arrive at the best possible solution (Deng et al., 2020). The questions that lead to and support the solutions for each SCAMPER method are shown in Table 1.

Table 1. Questions for each SCAMPER technique (source: created by authors)

Checklist	Applicable questions to product design
(S) Substitute	<ul style="list-style-type: none"> ■ What assets or resources can be traded to increase the product's quality? ■ Is this product interchangeable with another? ■ What will happen if someone has a particular opinion or view-point on this product?
(C) Combine	<ul style="list-style-type: none"> ■ What if two products were joined together to create something wholly unique? ■ What if objectives or goals are merged? ■ How might one merge resources to create an innovative product strategy?
(A) Adjust	<ul style="list-style-type: none"> ■ In what ways might this product be adjusted for a different purpose or implementation? ■ In which of the figure's examples could the product be used? ■ What other suggestions do you have that would be inspiring?
(M) Modify	<ul style="list-style-type: none"> ■ Which would you choose if you could alter the product's shape and appearance? ■ What more could you highlight or stress to provide more significance? ■ Could you make any changes to this product's features to make it better?
(P) Put to other uses	<ul style="list-style-type: none"> ■ Can this product be utilized in another sector? ■ In what other ways do you believe this product would respond in a certain context? ■ Can waste from this product be repurposed to create anything new?
(E) Eliminate	<ul style="list-style-type: none"> ■ Can you come up with any ideas to simplify or minimize this product? ■ Do you have any parts, features, or processes you could get rid of? ■ What if portion of this commodity was taken away?
(R) Reverse	<ul style="list-style-type: none"> ■ What if you reversed the process or changed the steps? ■ What components could be changed to vary the product's pattern? ■ What options do you have for reorganizing this product?

5. Methodology

As a group concerning friendly and sustainable environmental issues, we chose an autoethnographic method to apply Upcycling for repurposing waste by determining waste kinds that are suitable for the purpose and have a possible negative environmental impact. Ellis (2003), the author of a well-known autoethnography, defines autoethnography as a type of self-analysis and writing that explores the personal experience of the researcher and integrates this autoethnographic article to sociocultural, ideological, and social implications and comprehensions. Autoethnography is a type of writing that illustrates the researcher's personal experience and research technique that combines self-observation and reflective examination within the framework of ethnographic research.

In order to make the method of product design from waste more apparent, the study engages in autoethnography research to involve a self-design, and then translate the results of this study into creative product design. The study aims to draw from each other researchers' own experience in order to gain a better knowledge of the process of creative product design from the waste, and then going to assess that knowledge in connection with the setting of product design practices. Therefore, autoethnography is the method that is particularly fit for attempting to comprehend to apply upcycling to design creative products from waste. The study participates in the design process with the mindset of focusing on creative idea creation during the design phases. In summary, an autoethnographic method of designing products is established as part of this study so that the objectives of the research can be realized.

The primary purpose of this design process is to identify and self-design with modes of interaction and cooperation between the creative idea generation technique (SCAMPER) and integrate innovation from design in the resolution of an upcycling waste management issue. In another sense, a new "hybridized" and creative methodology is developed, based on the integration of knowledge from different disciplines and geared toward inducing "creative short-circuits". According to Bowen et al. (2016), they are characterized as the ability of a skilled designer to creatively synthesize information from other related fields. Design should be able to anticipate how future needs will evolve in order to translate them into new concepts and inventive products. In this situation, understanding disposal concerns for some forms of waste permits their identification as a resource, complete with their identity and characteristics. The strategy focuses mostly on creative product design and presents alternative upcycling approaches. In this method, waste products can be transformed into new concepts and products with a variety of inventive designs based on a series of natural discovery concepts, thereby enhancing their unique features and identities. The most significant phases that define this strategy are outlined below.

5.1. Selecting the waste products

The wasted soft drink cans were chosen for the reason that these cans themselves are not a problem since aluminium can be recycled repeatedly without losing any of its quality (Chino, 2011). In many countries, about half of the cans being used are recycled. The problem is the other half, which is the huge number of cans that end up in rivers, on sidewalks, and on fields. When people do not know how to recycle, it hurts the environment and people's health. For

example, mining and other processes used to make new aluminium create pollution and waste energy. Single-use containers are convenient, but they are terrible for the environment. Every can that is thrown away must be replaced with a new one made from new materials. Most people do not think about this after lunch or on the bus.

5.2. Emerging conceptions that interpret, communicate, and value the identity of a new series of creative products

The result of the final product design will be reflected in the conceptual design (Brunetti & Golob, 2000). If the designer is creative enough, the work will be of great quality, value, and originality (de Bassi Padilha et al., 2017). The unique approach at this stage is the front strategy, consisting of design planning and basic detail design (Taura & Nagai, 2011). This stage requires the ability to solve difficulties involving current waste products in order to generate innovative ideas, as well as the ability to seek out uncommon creative possibilities that go beyond the conventional.

5.3. Generating ideas by sketching

Sketching up ideas gives the designer original ones, which encourages the emergence of fresh ones (Brun et al., 2016). Designers' interactions with their designs are described by Goldschmidt (2003) as an interaction in between concept and sketch; the designer recognizes sufficient evidence in the sketches and thereafter expands his or her contemplation in reaction to all of this information distribution. Sketches might include hidden creative ideas during the sketching phase.

5.4. Rendering the series of creative ideas for new product design using a 3D program

3D rendering is the process of making realistic-looking images of a model or design in two or three dimensions. It is done after a design is modelled in computer-aided design software or 3D modeling software to show the design, such as a product, building, building interior, building facade, and so on. Using special 3D rendering software, a design can be shown in a photo-realistic way in 3D rendering. It will correctly record the 3D elements used in a design and show them so they can be shown. To get the most out of their creative designs, designers can also make the rendered images scalable, navigable, and interactive.

6. Results

This study has taken this design process with the mission to solve the environmental problems in the concept of upcycling. Working with the SCAMPER technique, the study later unveiled a series of creative and simple-to-make products in the expectation that they may eventually replace single-use cans.

After selecting the waste products, the next stage is to plan the innovative upcycling of a waste soft drink can. At this point, the soft drink can is divided in half. Using the SCAMPER technique, the study opted to employ the (S) substitute technique, which considers a

45-degree slit in an oval-shaped half as a replacement for a straight, circle-shaped halve. The outcome is an attractive and uncommon oblique shape that is more inventive than a circular cross-section, as shown in Figure 1.

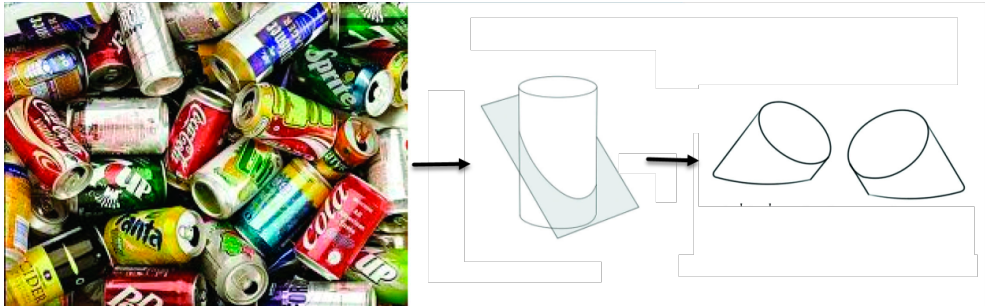


Figure 1. A 45-degree slit in an oval-shaped half of a waste soft drink can (source: created by authors)

Figure 2 shows that the first product of this study resulted from the initial concepts was a desk clock because the top and bottom of the soft drink cans are round, like a watch. By using the adapt in SCAMPER technique, the oblique-shaped face of the desk clock could be claimed to be the metaphor for a cut tree log displaying the tree's annual growth rings.

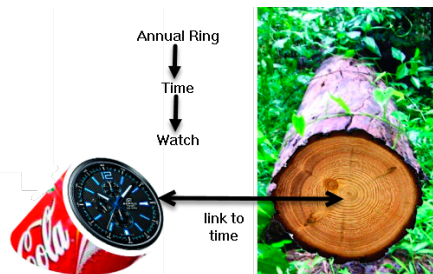


Figure 2. The shape and face of the desk clock could be related to the metaphor of a cut tree log displaying the tree's annual growth rings (source: created by authors)

Using the (R) reverse technique, the two halves of a soft drink can are put together in a way that makes them look like binoculars. So, they are made to hold pictures of animals, whether they are on land or in the water as shown in Figure 3.

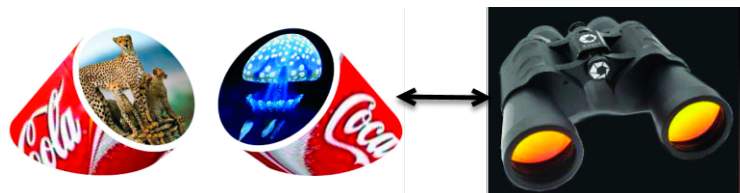


Figure 3. The two halves of a soft drink can are put together in a way that makes them look like binoculars (source: created by authors)

Using the (C) combine technique, a toy spring was attached to connect the two sides of each of the two halves of a soft drink can, allowing the user to envision a rainbow and providing for the insertion of notes or business cards as shown in Figure 4.



Figure 4. A toy spring was attached to connect the two sides of each of the two halves of a soft drink can, allowing the user to envision a rainbow and providing for the insertion of notes or business cards (source: created by authors)

Using the (E) eliminate technique, the top and bottom of a waste soft drink can be punched into little holes to hold pencils or pens, which, when filled with some slanted pencils and pens, resembles a meteor shower as depicted in Figure 5.



Figure 5. Inserting some pens and pencils into the holes on the top and bottom of a waste soft drink can imitate a meteor shower (source: created by authors)

Using the (R) reverse technique, the two halves of a soft drink can be reassembled into their original form. By creating the half-top of the can to be a lamp, the hidden light within the can's half-top could be turned on and off by rotating it. The turning on and off of the lamp's light mimics the rising and setting of the sun as shown in Figure 6.

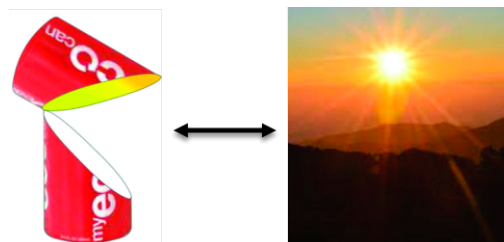


Figure 6. The turning on and off of the lamp's light mimics the rising and setting of the sun (source: created by authors)

7. Discussion

In this study, the resulting product design is not a conventional design for automated manufacturing or industrial design. However, this appears suitable when discussing sustainable product design. In the design process of emerging conceptions and generating ideas, SCAMPER played a significant role in the creative idea generation. In the process of emerging conceptions, (A) adjust was applied to grow the concept that uses natural discovery as the main idea for designing creative products, such as a desk watch, a pair of picture frames, a spring clip holder, a pencil holder, and a lamp. And in the process of generating ideas, each of the SCAMPER techniques was applied to come up with creative ideas for product design that integrate with the concept of natural discovery shown in Figures 1–6.

According to Xu and Gu's (2015) five guiding principles for redesigning waste products, the consistent outcomes of upcycling product design in this study are as follows.

7.1. Enhancing the overall value

In the design process of selecting waste products, soft drink cans were selected for the following reasons: a large number of cans end up in rivers, on sidewalks, and in fields, and when people do not know how to recycle or reuse and repurpose them, it harms the environment and the health of people. These single-use containers are convenient, yet extremely detrimental to the environment. The upcycling concept and design method are the optimal solution for this issue and show the result of repurposing a large number of waste soft drink cans to be a series of creative products with the theme of nature discovery, including a desk watch inspired by a tree's year ring, a pair of picture frames inspired by a pair of binoculars, a spring clip holder inspired by a rainbow, a pencil holder with slanted pencils and pens inspired by a meteor shower, and a lamp inspired by sunrise and sunset. Thus, these upcycling products with the concept of nature discovery serve as examples and guides for adding value to waste products or materials and transforming waste into wealth.

7.2. Reprocessing as much of the waste as possible

All of the product designs that came out of this study were designed by choosing a technique to cut waste soft drink cans into two equal parts at a 45-degree angle without making any waste. This outcome also permits each sliced half to be developed as a pair or as an independent product. In addition, the effect of the product's oblique design distinguishes it from other products that typically have a vertical base. However, using this method of the cutting component to create a creative product, such as pencil and pen holders, may have some perforation-related waste. However, drilling is considered to produce very little waste when compared to the whole part of the can that was not modified in any way, and its waste, aluminium, can be recycled. In addition, the design highlights the origin of the waste product as much as possible, for instance, without altering or adding graphics to the can's exterior. But when something must be added, it must have new functionalities and intriguing shapes and patterns that remain conceptual, such as the addition of a toy spring that connects the two halves of the can to give it a unique appearance as a rainbow arch.

7.3. Being ecologically friendly

Upcycling is the process of reusing waste products or resources to boost its worth, use, and quality. The findings of this study show how to design and repurpose waste soft drink cans into five creative products without creating trash or using recycling methods that will degrade materials or have a negative environmental impact. In order to successfully generate these five upcycling products, it is important to consider the steps that occur both before and after the actual design and production process, such as the sourcing and processing of the design as well as what happens to the product once it has reached the end of its life cycle. But this is not a minor transaction. Environmentally friendly product design is a skill that can be developed, just like any other procedure (Ng & Chan, 2020). It gets simpler when designers gain greater insight into how to approach design as a whole. It will become essential to the current design process (Hasenkamp et al., 2007).

7.4. Keeping a close eye on the expenses

Some authors (Kathy, 2019) mentioned supply chain implications as the reason why eco-friendly products are often more expensive. Producing products that have a low impact on the environment is tough, and additional prices increase the degree of difficulty. Generally, the costs associated with the production of sustainable products are also higher. These facilities are frequently shared because the majority of organic activities are too small to justify a large production plant. This necessitates a substantial amount of time and effort to ensure that organic and conventional components are produced separately. As we all know, time is money, and labour is paid on a per-hour basis (this cost will be even higher if we consider fair wages). The problem of cost factors described above does not apply to the upcycling product design in this study, as the design process from scratch costs nearly nothing due to the selection of waste soft drink cans as the design resource for upcycling products is free. The design process takes a straightforward approach to the design process. It did not require any complicated technology, but the end result is five creative upcycling products that use the SCAMPER technique to change waste to wealth.

7.5. Maintaining the aesthetic of the populace

In the current scenario, environmental products are a classification of products that have increasing relevance in the context of environmental destruction and acknowledgment of the principles of sustainability. In other words, the notion of sustainable development is becoming more widely recognized (Witek, 2020). Consumers pay attention to a variety of aspects of a product in addition to its value, cost, and commercialization factors (such as its style and branding), including aspects such as its impact on their health and the environment as well as its level of satisfaction (Vasileiadis et al., 2019). Purchase behaviour is important because it has a great deal to do with how consumers consider products, and more and more of them are choosing products that are beneficial to the environment. Marketing strategies that account for the fact that the idea of sustainable development can work well if buyers change the way they act (Huang et al., 2020). The five upcycling products designed in this study are not only environmentally sustainable but also maintain the original waste materials' patterns

and graphic design. One of the most effective upcycling techniques for product design is to highlight the product's natural elegance and simplicity. This gives consumers a sense of confidence that the product is sustainable for the environment.

7.6. Design consideration

First, the scope of the design method was limited. The main focus of this research was the "trash design" approach to reusing waste materials. This method showed how creative it can be to find new uses for old things, but it may only be a short-term answer to environmental problems. If other eco-design principles and methods are not looked at, the study may not be as useful or have as big of an effect as it could.

Second, the study did not look at the design of eco-objects in depth from the beginning to make sure they were in line with key sustainability principles. To make truly sustainable and eco-friendly products, it is important to use principles like minimizing waste in production, using local raw materials, avoiding different structural materials, reducing fittings, making sure the product breaks down naturally, and making the most of energy resources.

Third, real-world implementation and scalability: most of the design items in the study were one-of-a-kind, and the feasibility and scalability of mass production were not fully considered. Taking care of these things is important for real-world implementation and making a bigger difference in environmental problems by getting more people to use products that are environmentally friendly.

Lastly, aesthetics and deformed waste materials: the study recognized that aesthetics were a concern, especially when working with discarded cans that are deformed. No one looked into how hard it is to work with deformed waste materials and how that might affect the way upcycled products appear.

8. Conclusions

The five creative products that were designed from waste soft drink cans demonstrate the possibilities of upcycling in design. Upcycling design approach allowed the researcher to repurpose waste materials that would have otherwise been disposed of in landfills. In all, the findings of this study show that upcycling and autoethnography have the potential to become important approaches to environmentally conscious design. The products that were made as a result of this method serve as concrete illustrations of the inventive and useful possibilities that may be realized by reusing waste materials into new and unique products. Upcycling gives designers and researchers who are interested in making products that have a purpose and are socially responsible some potential new avenues to explore at a time when the world is struggling with the problems of waste and environmental sustainability.

There are a number of suggestions for further study in the area of upcycling and autoethnography in sustainable product design. Initially, the study needs a bigger sample size: upcycling and autoethnography could be tested for scalability in a variety of design contexts with a bigger sample number of goods in future studies. This may help researchers better understand the potential of upcycling in various sectors and business situations. Second, look at other potential waste materials for upcycling and reusing other just soft drink cans,

which were the primary focus of this study. Upcycling other sorts of garbage, like plastic bags or cardboard boxes, could be investigated in the future to produce innovative and environmentally friendly products. Finally, evaluate sustainable design strategies by contrasting them: While this study focused on upcycling as a design strategy, other sustainable design methods are available and should be investigated as well. Research in the future could evaluate the relative merits of methods like participatory design and user-centred design in producing environmentally friendly and respectfully received goods. Although the upcycled goods developed in this study are aesthetically pleasing and socially responsible, it is not known how they will fare in terms of durability, utility, and practicality. The long-term performance and usability of upcycled items could be studied in the future to ascertain their commercial feasibility.

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