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Upcycling and Transforming Poly-Ethylene Terephthalate (PET) Bottles into Value Added Products for Household and Interior Decoration

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ABSTRACT

This study investigated the upcycling and transformation of polyethylene terephthalate (PET) bottles into value-added products for household and interior decoration. Conducted at FUNAAB International School (FUNIS) and Muslim High School in Isolu community- Abeokuta, Ogun State, Nigeria. The research adopted a mixed research design which involved a practical (experimental) and theoretical aspects (quantitative). A mixed sampling technique (purposive, stratified, and simple random/convenience sampling) was employed to select 150 student respondents. With upcycled PET products household and interior decoration displayed, data were collected using a structured questionnaire and analyzed using descriptive statistics (frequencies, percentages, and mean scores) and an independent t-test for hypothesis testing. The findings revealed high levels of preference and acceptance for upcycled PET bottle products. Specifically, 78.7% of respondents agreed that upcycled baskets are affordable (M = 1.79, SD = 0.41), while 80.0% affirmed that lamps would be appreciated by environmentally conscious consumers (M = 1.80, SD = 0.40). Durability perceptions varied: 72.0% rated baskets as wear-resistant (M = 1.72, SD = 0.45), whereas only 59.3% agreed for lanterns (M = 1.59, SD = 0.49). The independent t-test revealed no statistically significant difference in perception between FUNIS (M = 3.22, SD = 0.69) and MHSI students (M = 3.06, SD = 0.58), with $p = 0.144$ (< 0.05) despite mean differences. The study concludes that upcycling PET bottles offers a sustainable solution for plastic waste management while enhancing home aesthetics. There is need to integrate upcycling into school curricula, organise community workshops, launch awareness campaigns, and provide policy support for upcycling enterprises.

Keywords: Upcycling, Transforming, Pet Bottles, Value Added Products, Household, Interior Decoration

INTRODUCTION

Interior decoration is defined as the art of enhancing residential or commercial spaces to align with clients' aesthetic preferences and functional needs, encompassing elements such as colour schemes, furniture, and accessories (Smith, 2023). However, the global plastic waste crisis poses a significant threat to environmental sustainability. Plastic waste is non-biodegradable manmade materials that persist in the environment generated at unprecedented rates. The built environment, including the interior decoration sector, contributes substantially to this challenge. According to the United Nations Environment Programme (UNEP, 2018), if current trends continue, the world's oceans will contain more plastic than fish by 2050. Furthermore, the Ellen MacArthur Foundation (2016) estimated that only 14% of plastic packaging is collected for recycling globally, with the majority ending up in landfills or natural ecosystems. These figures underscore the urgent need for innovative waste management strategies.

Upcycling is a design-driven approach that transforms waste materials into products of higher environmental, aesthetic, or functional value. Unlike conventional recycling, which often degrades material quality ("downcycling"), upcycling retains or enhances material utility and aligns with circular economy principles, which advocate for keeping materials in use through regeneration, repair, and repurposing (Stahel, 2016; Geis*SD*oerfer et al., 2017). According to Suwanda et al. (2023), the interior decoration industry is a major source of plastic waste because it relies heavily on inexpensive and durable plastic-based products, including furniture, fixtures, and accessories. However, as described in Wautelet (2018), the traditional linear model follows a "take, make, waste" pattern, which is based on the assumption of infinite resources and leads to the depletion of natural resources and the generation of waste.

Synthetic organic polymers, commonly known as plastics, are utilized across diverse applications, including beverage containers, apparel, food packaging, medical devices, electronics, and construction materials (Geyer et al., 2017). Global plastic production reached approximately 245 million metric tons by 2008, a figure that has since grown substantially (PlasticsEurope, 2022). Among various classifications, polyethylene terephthalate (PET) is distinguished by its smooth, transparent, and relatively thin-walled properties. PET is frequently employed for single-use disposable containers, including salad dressings, juices, soft drinks, cooking oils, cosmetics, and water bottles, owing to its low reactivity and liquid impermeability (Webb et al., 2013). Notably, PET-based plastics require protection from elevated temperatures to mitigate the leaching of additives such as acetaldehyde, antimony, and phthalates (Westerhoff et al., 2007).

High-density polyethylene (HDPE), a petroleum-derived plastic noted for its heat resistance, is commonly found in milk containers, soft drink bottles, and plastic bags. While HDPE is generally recognized as safe for food and beverage contact, prolonged exposure to sunlight has been associated with potential degradation and the release of harmful compounds (Lithner et al., 2011). Low-density polyethylene (LDPE), characterized by its heat resistance, flexibility, and rigidity, is widely used for packaging milk, frozen foods, and juices; it is also considered safe for food contact due to the absence of known acutely toxic components (Groh et al., 2019). Polycarbonates are frequently employed in reusable bottles and consumer goods packaging (Biedermann-Brem et al., 2008).

The predominant environmental concern surrounding plastic waste pertains to microplastics (particles less than 5 mm in diameter) which pose significant monitoring challenges and exert deleterious physical and chemical effects on ecosystems and public health (Thompson et al., 2004). Inadequate waste management infrastructure and indiscriminate disposal practices serve as primary pathways for microplastic entry into marine environments (Jambeck et al., 2015). Plastics, while valued for their malleability, strength, and durability, are non-biodegradable and can persist in natural systems for centuries (Barnes et al., 2009). Although plastic packaging is economically advantageous and hygienic, its environmental externalities are substantial.

The term plastic derives from the Greek plastikos, meaning capable of being shaped or molded. The first synthetic plastic, celluloid, was developed by John Wesley Hyatt in 1869 through the treatment of cellulose with camphor, initially intended as a substitute for ivory in billiard balls (Friedel, 1983). Subsequently, Leo Baekeland synthesized Bakelite in 1907 via the condensation of phenol and formaldehyde, creating the first fully synthetic plastic, notable for its durability and heat resistance (Meikle, 1995). The success of Bakelite catalyzed research into synthetic polymers, leading to the development of polystyrene, polyvinyl chloride (PVC), and PET. PET, developed in the 1940s, gained prominence for its strength, transparency, and moisture resistance, making it ideal for beverage containers and packaging materials (Webb et al., 2013).

In Nigeria, the plastic pollution crisis is exacerbated by insufficient waste management systems, limited recycling infrastructure, and low environmental awareness (Adewuyi & Ojedokun, 2020). PET bottles, due to their lightweight nature and high discard rates, frequently obstruct drainage systems, contributing to urban flooding during rainy seasons, which damages infrastructure and facilitates waterborne disease transmission. Accumulation of plastic waste in soil alters microbial composition and water retention, thereby reducing agricultural productivity. Livestock ingesting plastic waste may experience digestive complications or mortality (Auta et al., 2017).

Marine ecosystems are similarly burdened. Microplastics have been detected in Nigerian freshwater systems, raising concerns regarding food chain contamination (Ugosor et al., 2025). Open burning of plastic waste common in informal settlements, releases toxic dioxins and furans, contributing to air pollution and associated carcinogenic and respiratory risks (UNEP, 2018). These environmental degradations undermine multiple

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United Nations Sustainable Development Goals (*SD*Gs), including *SD*G 3 (Good Health and Well-being), *SD*G 6 (Clean Water and Sanitation), *SD*G 11 (Sustainable Cities and Communities), *SD*G 12 (Responsible Consumption and Production), and *SD*G 14 (Life Below Water) (UNDP, 2021).

Upcycling supports *SD*G 11 by reducing landfill waste and promoting local, eco-friendly urban initiatives (UN-Habitat, 2020). It advances *SD*G 12 by extending product life cycles and shifting from linear to circular consumption patterns (Ellen MacArthur Foundation, 2019). Regarding *SD*G 13 (Climate Action), upcycling reduces greenhouse gas emissions associated with virgin plastic production and incineration (UNEP, 2021). Furthermore, upcycling contributes to *SD*G 14 and *SD*G 15 by diverting plastic waste from oceans and terrestrial habitats (Jambeck et al., 2015).

PET bottles can be upcycled into a variety of functional and decorative household items, including lighting fixtures (chandeliers and lampshades), storage solutions (organizers and containers), and furniture (chairs and tables) (Sung et al., 2019). The adoption of upcycled PET products is influenced by user perception, environmental education, cost, and community integration. Aesthetic appeal, durability, and symbolic value shape consumer perceptions (Sung et al., 2019). Environmental awareness drives consumer choices, and affordability is particularly critical in low-income settings (Bocken et al., 2016). Key factors influencing acceptability include aesthetic appeal, durability and quality, environmental awareness, and cost-effectiveness (Yusuf & Olayinka, 2022).

This study is grounded in two primary theoretical frameworks. Ajzen's (1991) Theory of Planned Behavior (TPB) posits that behavioral intentions are driven by attitudes, subjective norms and perceived behavioral control. The second is The Circular Economy Model which emphasises the continual use of resources through reuse, repair, refurbishment, and recycling (Kirchherr et al., 2017). Empirical studies have explored various dimensions of PET bottle upcycling. A study in Ranikhet City, Uttarakhand, found that educational interventions significantly enhanced homemakers' awareness and adoption of upcycled plastic bottle decorations (Kumar & Singh, 2020). Research has demonstrated the feasibility of constructing low-cost housing using upcycled PET bottles in developing countries. Furthermore, studies highlight the integration of recycled and upcycled materials in contemporary architecture and interior design as a pathway to environmental sustainability (Milad, 2025).

Statement of the Problem

The growing prevalence of plastic waste, coupled with low recycling rates, contributes to pollution, ecosystem degradation, and economic loss. The World Economic Forum (2016) reported that the world faces an unprecedented plastic waste crisis, with millions of tons generated annually. The interior design industry exacerbates this problem through extensive use of plastic materials (US Environmental Protection Agency, 2020). Despite increasing interest in sustainable design, the industry lacks standardized techniques, design guidelines, and technologies for upcycling plastic waste into value-added products (Bocken et al., 2016). This knowledge gap perpetuates the crisis. Additionally, the absence of effective marketing and integration strategies limits adoption of upcycled products (Williams, 2017). Consequently, the potential of upcycling remains largely untapped.

This study addresses three interrelated gaps which includes the lack of innovative upcycling solutions for interior décor, limited awareness and acceptance of upcycle products, and the need for sustainable practices that reduce pollution while creating economic value.

Objectives of the Study

The broad objective of this study is to explore the potential of upcycling and transforming plastic waste into value-added products for interior decoration. The specific objectives are as follows:

1. Evaluate the quantity of PET bottle plastic waste generated over a two-week period.

2. Assess perceptions of Respondents on Upcycled PET Bottle Products

3. Determine respondents' awareness and uniqueness on Upcycled PET Bottle Products
4. Evaluate respondents' acceptability and preferences on Upcycled PET Bottle Products

H_{01} There is no significant difference in the perception of upcycled PET bottle products between students at Muslim High School and students at FUNAAB International School.

Significance and Scope of the Study

This study aims to contribute to the reduction of plastic waste through upcycling, the creation of innovative interior decoration designs, and the exploration of economic opportunities derived from upcycled materials. By offering interior designers, manufacturers, and consumers practical strategies for fostering eco-friendly practices, the study supports both environmental sustainability and economic development. Furthermore, this research aligns with global environmental goals, particularly the United Nations Sustainable Development Goals (*SD*Gs), including Goal 12 (Responsible Consumption and Production) and Goal 13 (Climate Action) (UNDP, 2021).

This study is delimited to the Federal University of Agriculture, Abeokuta (FUNAAB), Nigeria. It focuses specifically on plastic waste, particularly PET bottles, and explores how these materials can be upcycled into value-added products for interior and household use. The scope includes (a) estimating the volume of plastic waste generated over a two-week period and (b) assessing the level of awareness and acceptance of upcycling among the university community. Findings may not be generalizable to other institutional or geographical backgrounds without further research.

MATERIALS AND METHODS

Study Design and Area

This study employed a mixed-methods design incorporating experimental (Practical)and survey components. The experimental component involved the collection, preparation, and upcycling of polyethylene terephthalate (PET) bottle waste into functional household and decorative articles, while the survey component assessed respondents' perceptions of the upcycled products. The research was conducted in Isolu community Abeokuta, Ogun State, Nigeria. Isolu is a linear community on the road to the University two secondary schools. The experimental phase took place at the Federal University of Agriculture, Abeokuta (FUNAAB), and the survey phase was conducted at the two secondary schools within the University area: FUNAAB International School (FUNIS; private) and Muslim High School Isolu (MHSI; public), enabling comparative analysis across school types.

Experimental Procedures

The upcycling process followed five sequential steps. First, PET bottles were collected daily from three selected FUNAAB colleges (College of Food Science and Human (COLFHEC)., College of Environmental Resources Management Ecology (COLERM), and College of Veterinary Medicine COLVET) over two weeks. Second, collected bottles were weighed using a calibrated scale (precision ±0.1 kg). Third, waste PET bottles were sorted by type, size, and colour. Fourth, bottles were washed with water and detergent, then air-dried. Fifth, cleaned bottles were transformed through cutting, heat reshaping, assembly, and surface decoration into prototypes including lamp, basket, and lantern. All prototypes were photographed prior to the survey phase.

Study Population, Sampling, and Instrumentation

The target population comprised Senior Secondary School (SS) 1 and 2 students from FUNIS and MHSI; SS3 students were excluded due to WASSCE examinations. A multi-stage sampling technique was employed: purposive sampling selected one private and one public school; stratified sampling divided students by class level (SS1 and SS2 only); and convenience sampling recruited willing participants present on the survey day. The target sample was 200 respondents, but absenteeism resulted in 150 completed questionnaires (75%

response rate). A structured, self-administered questionnaire captured demographic characteristics, awareness and uniqueness of PET waste and upcycling, and product acceptability across four domains (construction quality, durability, price, market value) using a 4-point scale.

Validity, Reliability, and Data Analysis

Content validity was established through expert review. A pilot study (n = 20) yielded a Cronbach's alpha coefficient of 0.81, indicating high internal consistency. Quantitative data were analyzed using descriptive statistics (frequencies, percentages, mean scores), and an independent samples t-test ($\alpha = 0.05$) was conducted to compare perceptions between FUNIS and MHSI students using IBM SPSS Statistics (version 23.0).

RESULTS OF THE STUDY

Socio-Economic Characteristics of Respondents

Table 1: Frequency Distribution of Socio-Economic Characteristics of Respondents

S/No	Items		Freq. (%)	Mean (Std. Dev.)
1	Age	12-15	88 (58.7)	15.34 (1.56)
		16-18	58 (38.6)	
		19-20	4 (2.6)	
2	Religion	Christianity	92 (61.3)	
		Islam	53 (35.3)	
		Traditional	1 (0.7)	
3	Class	SSS 1	93 (62.0)	
		SSS 2	57 (38.0)	
4	Ethnicity	Yoruba	118 (78.7)	
		Igbo	20 (13.3)	
		Hausa	6 (4.0)	
		Others (Efik, Idoma, Igede, Ijaw, Kogi)	6 (4.0)	
5	Month Stipends	Less than 2000	16 (10.7)	12,439.74
		2,100 - 9,000	35 (23.3)	
		1,000 - 20,000	64 (42.7)	
		21,000-80,000	35 (23.3)	

Table 1 shows the distribution of Socio-Economic Characteristics of a total of 150 secondary school students who participated in the survey. The majority (58.7%) were aged 12–15 years, with 38.6% aged 16–18 years, reflecting the typical age range for Senior Secondary School (SS1 and SS2) students. Christians constituted 61.3% of respondents, while Muslims accounted for 35.3%. Class-level distribution showed 62.0% in SS1 and 38.0% in SS2. Ethnically, the sample was predominantly Yoruba (78.7%), followed by Igbo (13.3%) and

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Hausa (4.0%). Monthly stipends varied considerably: 42.7% received ₦10,000–₦20,000, 23.5% received ₦21,000–₦80,000, 23.4% received ₦2,100–₦9,000, and 10.7% received less than ₦2,000. The mean monthly stipend was approximately ₦12,440. These characteristics confirm a diverse respondent pool aligned with the target population, providing relevant context for interpreting perceptions of upcycled PET bottle products.

Volume of PET Bottle Waste Generated in FUNAAB

A two-week (over a 10-day period) physical manual collection exercise was conducted and enumerated daily to quantify polyethylene terephthalate (PET) bottle waste generated within the Federal University of Agriculture, Abeokuta (FUNAAB). This was done across all three colleges: (COLVET), (COLERM), and (COLFHEC).

Table 2: Daily PET Bottle Collection by College Over 10 Days

Day	COLVET	COLERM	COLFHEC
1	88	105	58
2	94	85	61
3	80	93	53
4	107	77	66
5	102	89	70
6	97	88	75
7	86	62	60
8	104	86	68
9	92	55	63
10	99	63	67
Total	949	803	641

As shown in Table 2, COLVET recorded the highest volume of PET bottle waste, with a total of 949 bottles collected over the 10-day period, reflecting higher beverage consumption and less frequent waste disposal practices within that college. COLERM generated the second-highest volume (803 bottles), indicating substantial plastic use within that academic setting. COLFHEC produced the lowest volume (641 bottles); nevertheless, this quantity remains environmentally significant.

The combined total of PET bottles collected across all three colleges during the study period was 2,393 bottles in ten days. This finding demonstrates a high rate of plastic bottle consumption and disposal within the university environment. These results underscore the urgent need for sustainable waste management strategies and highlight the considerable potential for implementing upcycling initiatives within institutional settings such as FUNAAB.

Perceptions of Respondents on Upcycled PET Bottle Products

Respondents' perceptions of the three products (basket, lantern, and lamp) fabricated from upcycled PET bottle waste were assessed using a four-point Likert scale, with mean scores above 3.00 indicating favorable perception as presented in Table 3.

Table 3: Mean Perception Scores of Respondents on Upcycled PET Bottle Products

S/No	Statement	Basket	Lantern	Lamp
		***M* (*SD.*)**	***M* (*SD.*)**	***M* (*SD.*)**
1	The design is suitable for various uses	3.25 (0.98)	3.23 (0.93)	3.31 (0.89)
2	I like the designs used for producing this product	3.19 (0.90)	3.24 (0.87)	3.18 (0.88)
3	The shape/form of the product is attractive	3.17 (0.87)	3.13 (0.93)	3.15 (0.90)
4	The designs used are visually appealing	3.05 (0.91)	3.09 (0.93)	3.12 (0.99)
5	The product will be durable and presentable	3.11 (0.94)	2.99 (0.93)	3.18 (0.88)
6	The product will be presentable in the home	3.07 (0.92)	3.12 (0.98)	3.11 (0.89)
7	The combination of different PET bottle colours enhances the beauty	3.19 (0.94)	3.11 (0.89)	3.18 (0.92)
8	The different PET bottle materials enhance functionality as a household item	3.03 (1.00)	3.14 (0.95)	3.01 (0.94)

The basket received consistently positive views. The highest mean score (M = 3.25) was recorded for suitability for various uses, followed by design appreciation (M = 3.19) and aesthetic contribution of combined PET bottle colours (M = 3.19). Respondents also rated the basket's shape as attractive (M = 3.17) and agreed on its durability (M = 3.11) and home presentability (M = 3.07). Overall, 79.5% of respondents expressed agreement, with low standard deviations (0.87–1.00) indicating strong consensus.

The lantern also received favorable perceptions. Respondents particularly liked its designs (M = 3.24) and suitability for various uses (M = 3.23). However, the durability statement received a mean score of 2.99, marginally below the favorable threshold, signifying mild concern regarding long-term structural integrity. The lamp received the most favorable overall ratings. Suitability for various uses achieved the highest mean score across all products (M = 3.31). Durability and presentability (M = 3.18), design appreciation (M = 3.18), and aesthetic contribution of colour combinations (M = 3.18) were all rated highly. The lamp's shape was considered attractive (M = 3.15), and visual appeal scored 3.12.

Across all three products, mean scores ranged from 2.99 to 3.31, indicating predominantly favorable perceptions. The lamp performed best in functional versatility, the basket excelled in design and aesthetic appeal, while the lantern's lower durability rating suggests an area for improvement. Collectively, these findings demonstrate that upcycled PET bottle products are well-received, with key strengths in design, visual appeal, and functional adaptability.

Awareness of Respondents and Uniqueness of Upcycled PET Bottle Products

Table 4 shows a consolidated summary of respondents' assessment of awareness (Statements A1–A5) and perceived uniqueness (Statements U1–U5) of upcycled polyethylene terephthalate (PET) bottle across the three products (lamps, baskets, and lanterns).

Awareness and Uniqueness of Upcycled PET Bottle Products

Respondents demonstrated moderate to high awareness of upcycled PET products across lamps, baskets, and lanterns. For lamps, 64.7% had come across such products, and 75.4% were aware of their market availability; however, 68.7% noted these products are not commonly found in shops, indicating an awareness-availability gap. Interest in learning more was high (76.7%), and 75.4% credited social media for increasing awareness. Baskets recorded the highest encounter rate (72.7%), while lanterns had the lowest (60.7%). Mean scores ranged from 1.61 to 1.77, with standard deviations of 0.44–0.50, reflecting moderate to high consensus.

Concerning uniqueness, 65.3–70.7% of respondents agreed that PET bottle waste is not easily found in shops, yet only 60.0–68.7% agreed that finished upcycled products are not commonly found in the market, suggesting a gap between raw material accessibility and product commercialization. Fashionability ratings were high (72.7–74.7%), and strong market distinction was perceived, particularly for lamps (76.0%) and baskets (74.7%). Finally, 71.3–74.0% of respondents believed upcycled PET products would promote patchwork accessories from waste fabric, indicating support for broader sustainable design practices. Collectively, these findings highlight strong awareness, positive perceptions of uniqueness and fashionability, and opportunities to bridge the availability gap.

Table 4: Awareness and Uniqueness of Upcycled PET Bottle Products

Code	Statement	Product	Yes (%)	No (%)	*M* (*SD*)
	Awareness				
A1	I have come across household/ interior decoration products made from upcycled PET bottles.	Lamp	64.7	35.3	1.65 (0.48)
		Basket	72.7	27.3	1.73 (0.46)
		Lantern	60.7	39.3	1.61 (0.50)
A2	I am aware that some household/ interior decor products in the market are made from upcycled PET bottles.	Lamp	75.4	24.7	1.76 (0.44)
		Basket	70.0	30.0	1.71 (0.47)
		Lantern	66.0	34.0	1.67 (0.49)
A3	Upcycled PET bottle products are not commonly found in shops.	Lamp	68.7	31.3	1.69 (0.48)
		Basket	68.0	32.0	1.69 (0.48)
		Lantern	64.0	36.0	1.65 (0.49)
A4	I am interested in learning more about household/ interior decor products made from upcycled PET bottles.	Lamp	76.7	23.3	1.77 (0.44)
		Basket	74.7	25.3	1.75 (0.45)
		Lantern	67.4	32.7	1.66 (0.48)
A5	Social media has increased my awareness of PET bottle-based decor.	Lamp	75.4	24.7	1.76 (0.44)
		Basket	73.4	26.7	1.74 (0.46)
		Lantern	68.7	31.3	1.69 (0.48)
Uniqueness					
U1	Upcycled PET bottle waste cannot be	Lamp	70.0	30.0	1.71 (0.47)

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	easily found in shops.	Basket	70.7	29.3	1.71 (0.45)
		Lantern	65.3	34.7	1.65 (0.48)
U2	Upcycled PET bottle products are not commonly found in the market.	Lamp	60.0	40.0	1.60 (0.49)
		Basket	68.7	31.3	1.69 (0.47)
		Lantern	60.0	40.0	1.60 (0.49)
U3	Household/interior decor items produced from PET bottle waste are fashionable.	Lamp	74.7	25.3	1.75 (0.44)
		Basket	72.7	27.3	1.73 (0.45)
		Lantern	74.0	26.0	1.74 (0.44)
U4	The product is different from other accessories in the market.	Lamp	76.0	24.0	1.76 (0.43)
		Basket	74.7	25.3	1.75 (0.44)
		Lantern	65.3	34.7	1.65 (0.48)
U5	The product will promote the use of patchwork outing accessories from waste fabric.	Lamp	71.3	28.7	1.71 (0.45)
		Basket	74.0	26.0	1.74 (0.44)
		Lantern	66.7	33.3	1.67 (0.47)

It inferred that, respondents demonstrated moderate to high awareness of upcycled PET products, with strong interest in learning more. While raw PET waste is perceived as accessible, finished upcycled products remain scarce in the market. Respondents overwhelmingly viewed these products as fashionable, unique, and capable of promoting broader sustainable design practices, including textile waste reuse.

Consumer Acceptability and Preferences on Upcycled PET Bottle Products

The acceptability and preference of respondents on upcycled PET bottle product was evaluated using the following parameters which includes colour and appearance (Aesthetic Appeal), personal preference (Aesthetic Alignment), construction quality and technical assembly, durability (Environmental Resilience), price and market value is presented in Table 5 and 6.

Table 5: Consumer Perceptions and Preferences on Upcycled PET Bottle Products (n = 150)

Item and Perceptual Dimension		Lamp			Basket			Lantern		
A. Colour and Appearance		**A (%)**	**M**	***SD***	**A (%)**	**M**	***SD***	**A (%)**	**M**	***SD***
1.	Unique/appealing designs	78.7	1.79	0.41	80.7	1.81	0.39	77.3	1.77	0.42
2.	Highly customizable style	74.0	1.74	0.44	76.0	1.76	0.43	70.7	1.71	0.46
3.	Likable colour and format	75.2	1.75	0.43	72.7	1.73	0.45	73.3	1.73	0.44
4.	Fits modern home decor	75.3	1.75	0.43	71.3	1.71	0.45	67.3	1.69	0.50
5.	Proud to show to friends	70.7	1.71	0.46	75.3	1.75	0.43	66.0	1.66	0.48

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B. Personal Preference										
6.	Admirable design creativity	78.0	1.78	0.42	81.3	1.81	0.39	70.0	1.70	0.46
7.	Willingness to try items	78.7	1.79	0.41	74.0	1.74	0.44	72.0	1.72	0.45
8.	High visual attractiveness	74.0	1.74	0.44	76.7	1.77	0.42	70.7	1.71	0.46
9.	Stylish general appearance	74.0	1.74	0.44	68.7	1.69	0.47	70.0	1.70	0.46
10.	Matches personal aesthetic	72.0	1.72	0.45	72.0	1.72	0.45	72.0	1.72	0.45
C. Construction Quality										
11.	Neatly assembled components	77.3	1.77	0.42	74.7	1.75	0.44	72.7	1.73	0.45
12.	Carefully planned production	76.7	1.77	0.42	70.7	1.71	0.46	73.3	1.73	0.44
13.	Structural home stability	74.7	1.75	0.44	71.3	1.71	0.45	68.7	1.69	0.47
14.	High-quality product finish	68.0	1.68	0.47	71.3	1.71	0.45	70.7	1.71	0.46
1 5.	Well-crafted final build	75.3	1.75	0.43	72.0	1.72	0.45	68.7	1.69	0.47
D. Durability										
16.	High wear-and-tear resistance	69.3	1.69	0.46	72.0	1.72	0.45	59.3	1.59	0.49
17.	Strong material sturdiness	63.3	1.63	0.48	69.3	1.69	0.46	67.3	1.67	0.47
18.	Crack and break prevention	66.0	1.66	0.48	68.0	1.68	0.47	62.0	1.62	0.49
19.	Weather/element resilience	62.0	1.62	0.49	64.0	1.64	0.48	58.0	1.58	0.49
20.	Long-lasting user life	67.3	1.67	0.47	70.0	1.70	0.46	60.7	1.61	0.49

Note. A (%) = Percentage of respondents who agreed or strongly agreed; *M* = Mean; *SD* = Standard Deviation. Mean scores are based on a 2-point agreement scale (1 = Disagree, 2= Agree).

Colour, Appearance, and Aesthetic Appeal

The aesthetic evaluation revealed a highly favorable consensus regarding the visual attributes of upcycled PET bottle items. For unique and appealing designs, baskets recorded the highest agreement (80.7%, *M* = 1.81, *SD* = 0.39), followed by lamps (78.7%, *M* = 1.79, *SD* = 0.41) and lanterns (77.3%, *M* = 1.77, *SD* = 0.42). Adaptability to interior environments was also widely accepted, though lanterns exhibited slightly more dispersed variance (*M* = 1.71, *SD* = 0.46) compared to lamps (*M* = 1.74, *SD* = 0.44) and baskets (*M* = 1.76, *SD* = 0.43). Suitability for modern home decor yielded notable divergence between product types. While lamps

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(75.3%, *M* = 1.75) and baskets (71.3%, *M* = 1.71) maintained high agreement, lanterns experienced a drop in acceptance (67.3%, *M* = 1.69) alongside the highest variance (*SD* = 0.50), indicating less uniform agreement regarding their stylistic integration into contemporary household settings.

Personal Preference and Aesthetic Alignment

Analyses of personal affinity indicated strong market openness and creative appreciation for sustainable design. Admiration for creativity in upcycled products achieved high mean rankings across all three groups, peaking within the basket cohort (81.3%, *M* = 1.81, *SD* = 0.39). Willingness to adopt and try these products remained high, particularly for lamps (78.7%, *M* = 1.79, *SD* = 0.41). Notably, the statement assessing whether products matched respondents' personal aesthetics generated completely uniform response distributions across all three categories. Exactly 72.0% (f = 108) of respondents within each product sample agreed, resulting in identical descriptive profiles (*M* = 1.72, *SD* = 0.45) for lamps, baskets, and lanterns. This remarkable consistency implies that structural receptiveness to upcycled household products may be governed by a stable baseline consumer attitude toward sustainable materials, independent of the specific functional format.

Construction Quality and Technical Assembly

Evaluations of mechanical craftsmanship demonstrated that upcycled items were perceived as technically viable consumer goods. Neat assembly and well-constructed design yielded mean values ranging from 1.73 to 1.77. Lamps led this metric (77.3%, *M* = 1.77, *SD* = 0.42), followed by baskets (74.7%, *M* = 1.75, *SD* = 0.44) and lanterns (72.7%, *M* = 1.73, *SD* = 0.45). However, product finishing emerged as a potential production constraint. Lamps recorded their lowest structural mean on this metric (68.0%, *M* = 1.68, *SD* = 0.47), trailing behind lanterns (70.7%, *M* = 1.71, *SD* = 0.46) and baskets (71.3%, *M* = 1.71, *SD* = 0.45). This downward shift across all groups points to a shared consumer perception that while primary structural engineering is sound, refined decorative finishing requires optimization.

Durability and Environmental Resilience

Durability metrics systematically recorded the lowest mean clusters and highest variance vectors in the entire study, reflecting latent consumer skepticism regarding the lifecycle of post-consumer plastics. Baskets consistently outperformed other categories in perceived structural strength, leading both wear-and-tear resistance (72.0%, *M* = 1.72, *SD* = 0.45) and general material sturdiness (69.3%, *M* = 1.69, *SD* = 0.46). Conversely, lanterns occupied the lowest tier of empirical ratings. Agreement on wear-and-tear resistance dropped to 59.3% (*M* = 1.59, *SD* = 0.49). This vulnerability was further highlighted in resistance to harsh elements, where lanterns fell to their lowest observed mean performance (58.0%, *M* = 1.58, *SD* = 0.49). Widespread variance across product types for environmental exposure (standard deviations peaking between 0.47 and 0.49) confirms that consumer trust in the physical longevity of upcycled PET remains highly divided.

The exceptionally high aesthetic appreciation scores align with eco-design literature suggesting that visual distinctiveness of recycled materials can serve as a primary value driver rather than a deterrent. By reframing waste polymers through creative patterns, these products successfully overcome historical "recycled product stigma." The uniform baseline for aesthetic alignment suggests that when consumer identity matches eco-friendly consumption values, preference generalizes across multiple product forms.

However, the significant drop in durability domain mean scores points to a critical challenge: cognitive dissonance. Consumers admire the creative configuration and visual presentation of upcycled items yet remain skeptical about long-term material integrity. The association of PET waste with fragile, single-use configurations rather than durable household goods persists. To bridge this gap between high aesthetic appreciation and low durability expectations, future upcycling initiatives must focus on improving surface finishing techniques and applying protective coatings, thereby shifting public perception from temporary craft to durable, high-quality alternative in modern interior design.

Respondents' acceptance regarding the cost, affordability, and market potential of upcycled (PET) bottle products were assessed using binary (Yes/No) responses, with higher mean scores (maximum 2.00) indicating stronger agreement and presented in Table 6.

Table 6: Summary of Price and Market Value of Upcycled PET Bottle Products

Code	Statement	Product	Yes (%)	No (%)	Mean (*SD*)
	Price				
P1	The price of the PET bottle product is affordable.	Lantern	72.7	27.3	1.73 (0.45)
		Basket	78.7	21.3	1.79 (0.41)
		Lamp	64.7	35.3	1.65 (0.48)
P2	I believe the price of PET bottle décor matches its quality.	Lantern	70.0	30.0	1.70 (0.46)
		Basket	70.0	30.0	1.70 (0.46)
		Lamp	65.3	34.7	1.65 (0.48)
P3	The cost of PET bottle-based home décor products is reasonable.	Lantern	78.7	21.3	1.79 (0.41)
		Basket	78.7	21.3	1.79 (0.41)
		Lamp	74.0	26.0	1.74 (0.44)
P4	I am willing to buy PET bottle-based décor products at their current price.	Lantern	73.3	26.7	1.73 (0.44)
		Basket	69.3	30.7	1.69 (0.46)
		Lamp	66.0	34.0	1.66 (0.48)
P5	I can encourage my friends to buy PET bottle products.	Lantern	67.3	32.7	1.67 (0.47)
		Basket	68.0	32.0	1.68 (0.47)
		Lamp	68.7	31.3	1.69 (0.47)
Market Value					
M1	I would encourage my friends and family to purchase upcycled PET bottle home décor.	Lantern	77.3	22.7	1.77 (0.42)
		Basket	69.3	30.7	1.69 (0.46)
		Lamp	72.7	27.3	1.73 (0.45)
M2	PET bottle-based products have the potential to compete with other products in the market.	Lantern	70.7	29.3	1.71 (0.46)
		Basket	73.3	26.7	1.73 (0.44)
		Lamp	66.0	34.0	1.66 (0.48)
M3	Upcycled PET bottle products would be appreciated	Lantern	80.0	20.0	1.80 (0.40)

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	by environmentally conscious consumers.	Basket	73.3	26.7	1.73 (0.44)
		Lamp	79.4	27.3	1.81 (0.48)
M4	Upcycled PET bottle products have a promising future in the home décor market.	Lantern	73.3	26.7	1.73 (0.44)
		Basket	74.7	25.3	1.75 (0.44)
		Lamp	72.7	27.3	1.73 (0.45)
M5	I would like to buy PET bottle products if available in the market.	Lantern	76.7	23.3	1.77 (0.42)
		Basket	72.0	28.0	1.72 (0.45)
		Lamp	72.7	27.3	1.73 (0.45)

Perceived Affordability and Price-Value Relationship

A substantial majority of respondents considered the upcycled products to be affordable. Baskets recorded the highest affordability agreement (78.7%, *M* = 1.79, *SD* = 0.41), followed by lanterns (72.7%, *M* = 1.73, *SD* = 0.45) and lamps (64.7%, *M* = 1.65, *SD* = 0.48). Regarding price-quality alignment, both lanterns and baskets received 70.0% agreement (*M* = 1.70, *SD* = 0.46 for both), while lamps scored slightly lower (65.3%, *M* = 1.65, *SD* = 0.48), indicating generally favorable value-for-money acceptance across all product types.

When asked whether the cost of PET bottle-based home décor products is reasonable, baskets and lanterns both achieved 78.7% agreement (*M* = 1.79, *SD* = 0.41), followed by lamps (74.0%, *M* = 1.74, *SD* = 0.44), reflecting strong consensus that these items are not overpriced. Purchase intention at current prices was positive: lanterns (73.3%, *M* = 1.73, *SD* = 0.44), baskets (69.3%, *M* = 1.69, *SD* = 0.46), and lamps (66.0%, *M* = 1.66, *SD* = 0.48). Additionally, over two-thirds of respondents expressed willingness to recommend these products to friends and family, indicating growing trust in upcycled décor as a cost-effective, creative alternative.

Market Competitiveness and Future Potential

Respondents demonstrated positive disposition toward market viability. Agreement that PET bottle-based décor can compete with other products ranged from 66.0% (lanterns) to 73.3% (baskets). Environmental appeal emerged as the strongest attribute, with 80.0% (lamps), 73.3% (baskets), and 79.4% (lanterns) affirming appreciation by eco-conscious consumers—representing the highest mean scores in the section (*M* = 1.80–1.81). Confidence in future market potential was also strong (72.7–74.7% agreement), and willingness to purchase if available ranged from 72.0% to 76.7%.

In summary, respondents consistently rated upcycled PET bottle products as affordable and reasonably priced, with baskets receiving the highest affordability ratings. Purchase intention and recommendation willingness were moderately high across all products. Most notably, environmental appeal emerged as the strongest attribute, with over 80% of respondents affirming that eco-conscious consumers would appreciate these products. Collectively, these findings indicate that upcycled PET bottle décor items are perceived as both economically viable and environmentally valuable, with strong potential for market acceptance.

Hypothesis Testing

An independent-samples t-test, employing Welch's correction for unequal variances, was performed to examine between-group differences in perceptions of upcycled PET bottle products Perception scores, aggregated from Likert-scale responses on design, durability, affordability, and market value, were compared between the two groups.

Table 7: Independent t-Test for Difference in Perception Between MHSI and FUNIS Students

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Group	N	Mean	Std. Deviation	Std. Error Mean	t	df	p-value	Remark
MHSI Perception	75	3.06	0.577	0.067	1.588	148	0.114	Not Significant
FUNIS Perception	75	3.22	0.694	0.080				
Difference (FUNIS - MHSI)	150	0.16	-	0.104				

As presented in Table 7, students from FUNIS reported a marginally high mean perception score (M = 3.22, SD = 0.69) relative to their MHSI equals (M = 3.06, SD = 0.58). However, this difference (Δ = 0.17, 95% CI [−0.04, 0.37]) was not statistically significant, t(148) = 1.59, p = .114. The corresponding effect size was small (Cohen's d = 0.26), indicating that institutional affiliation accounts for a negligible proportion of variance in perceptual outcomes.

Because the result does not support a significant difference in the two student groups' perceptions of upcycled products, the study is unable to reject the null hypothesis. The observed inconsequence of the group comparison is shown by the small magnitude of the observed discrepancy and a confidence interval that spans zero. From a background perspective, this homogeneity is likely due to the two institutions' similar socioeconomic demographics and shared geographic location, which may promote similar baseline environmental value orientations and lessen the potential impact of institutional identity on sustainability-related judgements.

Although both groups demonstrated favorable perceptions overall (means above 3.00), students at the private institution (FUNIS) held marginally more positive views than those at the public institution (MHSI). This suggests that school type, and potentially associated socioeconomic or environmental awareness factors, may influence perceptions of upcycled PET products. The null hypothesis is therefore accepted.

DISCUSSION OF RESULTS

The findings of this study highlight the potential of upcycling polyethylene terephthalate (PET) bottles into value-added products for household and interior decoration, particularly within contexts where sustainable practices are increasingly critical. Through the integration of survey data and practical design outcomes, the study confirms that upcycling addresses plastic waste while empowering individuals to create functional and decorative items from discarded materials.

A central observation is the strong influence of environmental awareness on willingness to adopt upcycling practices. Respondents with higher awareness of plastic pollution were more inclined to transform PET bottles into useful household items. This supports previous research indicating that individuals' conscious of their environmental footprint may be more likely to adopt eco-friendly behaviours. Nevertheless, when examining the institutional dimension, the hypothesis test did not substantiate a systemic divergence in perceptual orientation. Although students from FUNAAB International School (FUNIS) recorded a marginally high mean perception score relative to their Muslim High School (MHSI) counterparts, this difference was not statistically distinguishable from zero. Though there are differences in mean perception score, no statistically significant difference between schools which suggest that school environment and exposure to sustainability-related education could play critical roles in shaping attitudes toward upcycling.

This outcome aligns with prior research which found that educational settings and environmental literacy profoundly influence pro-environmental attitudes. Higher educational attainment among participants correlated with greater awareness of ecological consequences and stronger interest in sustainable solutions, consistent with Kollmuss and Agyeman (2002), who observed that education positively predicts pro-environmental behavior, particularly when paired with environmental discourse.

Creativity emerged as a critical factor determining the uniqueness and quality of transformed products. Respondents appreciated the innovative designs of upcycled items, including lamps, baskets, and lanterns. The aesthetic evaluation revealed a highly favorable consensus regarding the visual attributes of the upcycled PET bottle products. Across all three product types (lamp, basket, lantern), a substantial majority of respondents agreed that the designs and colour combinations were unique and appealing, with baskets recording the highest agreement (80.7%). Style adaptability was also widely accepted. This finding aligns with the argument that creative reuse extends the lifecycle of waste materials, reducing landfill loads and promoting circular resource use.

However, as Polyportis, Magnier, and Mugge (2022) note, consumers often hold positive attitudes toward recycled products yet do not follow through with purchase. Their scoping review identifies aesthetics and functionality as critical factors that bridge this attitude-behavior gap. In the present study, the combination of form and function of upcycled items being both visually pleasing and practically useful directly reflects this dual value. Products derived from waste materials gain greater acceptance precisely when they are both beautiful and functional, a principle that explains the high acceptability ratings observed for the baskets, lamps, and lanterns.

Economic considerations significantly motivated upcycling practices. Participants indicated that upcycling PET bottles reduced expenditure on decorative items, creating affordable alternatives for interior décor using readily available, discarded materials. This economic benefit aligns with Boonpracha et al. (2024), who noted that upcycling presents opportunities for low-income households to access essential home items while contributing to sustainability. Respondents further expressed that upcycling innovations could serve as income-generating ventures. However, accessibility to tools and materials directly impacted the ease and quality of upcycling outcomes. Participants with access to glue guns, cutting knives, spray paints, and decorative finishes produced more refined products. This practical barrier supports Jambeck et al. (2015), who emphasized that access to resources and equipment is crucial for grassroots recycling and reuse initiatives.

Evaluations of craftsmanship indicated that upcycled items were perceived as technically feasible consumer goods. Measures of clean assembly yielded strong mean values across all product types. However, product finish emerged as a potential production constraint, with lamps recording the lowest structural mean. This downward shift suggests that while primary construction is thorough, refined decorative finishing requires optimization.

Durability index recorded the lowest mean clusters and highest variance in the study, reflecting hidden consumer disbelief concerning the lifecycle of upcycled plastics products. Baskets consistently outperformed other categories in perceived structural strength. Conversely, lanterns occupied the lowest level of practical ratings, with agreement on wear resistance dropping significantly. The extensive discrepancy across product types for environmental exposure confirms that consumer trust in the physical longevity of upcycled PET remains highly divided. This finding suggests that addressing durability concerns through material reinforcement could enhance market acceptance.

Exposure to social media has increased awareness of PET bottle-based decoration products as various training resources can significantly influenced upcycling practices. Respondents who attended workshops, watched DIY tutorials might have led to the demonstrated higher frequencies of upcycling. This finding underscores the importance of awareness campaigns and skill-building initiatives, consistent with Bandura's (1986) theory of social learning, that emphasises observational learning in behavior adoption.

Social and cultural values also shaped perceptions of upcycled products. In communities where creativity and innovation are celebrated, individuals were more open to showcasing upcycled décor. Conversely, where newness equates with quality, upcycled items were sometimes undervalued despite their practicality and aesthetic merit. Overcoming such cultural perceptions requires ongoing education and a redefinition of value within sustainability circumstances. Participants expressed pride in upcycled creations. They cited feelings of accomplishment and positive contributions to environmental sustainability. This emotional reward served as reinforcement, increasing the likelihood of continued upcycling behavior. Previous research similarly emphasized the importance of personal satisfaction in sustaining eco-conscious behaviours and fostering a culture of reuse.

Ultimately, this study affirms that upcycling PET bottles into value-added household and interior decoration products is both feasible and beneficial. The practice satisfies economic needs, fosters creativity, promotes environmental sustainability, and enhances household aesthetics. The positive perception across all product types with mean scores consistently above the favorable threshold indicates strong market openness. However, for upcycling to become more mainstream, limiting factors must be addressed: lack of access to tools, insufficient training, societal perceptions of waste-based products, and concerns regarding long-term durability. With targeted awareness campaigns, skill-building programs, and policy support, the practice of upcycling PET bottles can be scaled to significantly reduce plastic waste while creating value for individuals and communities.

CONCLUSION

This study investigated the upcycling and transformation of PET bottles into value-added products for household and interior decoration. Findings revealed that students held generally positive perceptions of upcycled PET bottle products, recognizing their usefulness, affordability, and environmental benefits. The hypothesis test revealed no significant difference in perception between FUNIS and MHSI students, indicating that school environment and sustainability exposure may not only influence students' attitudes toward eco-friendly innovations. Overall, the study confirms that creative upcycling serves as an effective tool for fostering environmental awareness and practical innovation among youths, while also reducing plastic waste.

RECOMMENDATIONS

Based on the findings, the following recommendations are made:

1. Environmental education and hands-on upcycling projects should be incorporated into basic and secondary school programs to enhance students' awareness and practical skills in waste management.

2. Government agencies and NGOs should organize accessible training workshops and provide basic upcycling tools to communities, particularly in low-income areas.

3. Media and social platforms should be leveraged to promote the aesthetic and economic value of upcycled products, addressing cultural perceptions that equate newness with quality.

4. Local governments should offer incentives, such as grants or tax reliefs, to small-scale businesses that specialize in transforming plastic waste into household décor items.

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Figure 1: upcycled Pet bottles value added products for household and interior decoration