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Review

Embedding Green Product Attributes Preferences and Cultural Consideration for Product Design Development: A Conceptual Framework

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Abstract: In the past ten years, the increasing customer awareness of environmental sustainability has driven the development of green products. As the initiator of product development, this situation can challenge product designers. Since customers may have varied expectations and preferences for green products, it depends on the green attributes embedded in the product and cultural value influences. As the natural behavior setting, cultural value has been proven to influence customer preferences in the literature. However, it was identified that previous studies had not clearly defined the consideration of cultural values in green product design. Therefore, this study aimed to generate a conceptual framework for embedding cultural value consideration in green product design. A comprehensive review of green product design and cultural values has been performed to align the relevancies for constructing the conceptual framework. Bibliographic analysis using the PRISMA approach was also performed to identify the current trend of green product design. It was expected that the proposed conceptual framework could be used as supporting insight in determining the customers' preferences as an essential process for green product development.

Keywords: sustainability; green product attributes; environmental impact; cultural value; green manufacturing

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1. Introduction

The global population is projected to exceed 9.7 billion and 11.2 billion by 2100 [1]. To fulfill the need of this rapid population expansion, manufacturers may improve their production capacity and gain more profit. However, if improperly managed, the improving production capacity can indirectly affect the environment, such as overusing natural resources, waste generation during production, and increasing gas emissions. To overcome these issues, the government has enacted environmental protection rules to minimize the ecological effect during production and product use [2]. The manufacturers must consider that the products produced are ecologically beneficial over their entire life cycle. Products with intrinsic environmental attributes are generally called green products [3].

Preferences for green products have rapidly increased in industrialized developed and developing nations, as they realized that green products aim to minimize the environmental impact now and in the future [4]. This study noticed that researchers have different perspectives to define the attributes of green products, such as minimized energy consumption, eliminated waste generation, non-hazardous to the living environment, reduced usage of natural resources and so forth [3,5]. However, customers' knowledge and interest in green products may vary from each other's, depending on how they perceive the green products' attributes that can fill their preferences. Customers may view and value these attributes favorably or negatively, depending on their perspective on the benefit they can obtain from the product. Cultural values set as customers' natural characters or behaviors might influence product preferences and purchasing decisions [6].

Cultural values, which define consumers' inherent characteristics or behaviors, might impact the range of green product preferences [7]. Cultural values' effect on customer preferences is a crucial element that product designers need to consider while developing new products. Ulrich and Eppinger [8] explained that consumer preferences for a product should be considered in the early stage of product design and development. At the same time, the customer's preferences may be affected by cultural values. Therefore, the designer needs to determine which specific attributes of green product may impact the customer's preferences and choose the optimal design that strikes a balance between cultural values. However, there is no solid approach to relate the design of green product and the influences of cultural values from the other studies. This paper aims to overview related studies on green attributes preferences and cultural value influences for green product design.

This paper is classified into three main phases to achieve the stated objective. First, the product design, customer preferences, green product attributes, and cultural value are described. In this phase, the importance of each aspect is identified. The second phase elaborates on the potential correlation between green product attribute preferences and cultural value influences. The last phase concerns discussing a conceptual framework involving green product attributes to develop product design. The potential contribution of knowledge and practices is also explained in this paper's last section.

2. Product Design and Customer Preferences

The customers' preferences should be considered when designing new products [9]. It is a critical phase in product design to obtain product acceptance in the market. Customers' preferences include their initial assessments of a product's value and the outcomes of their evaluation of its benefits, which may be followed by their readiness to purchase and utilize the product [10]. Because each product has unique characteristics, customers' preferences for one product could be altered when they buy another. Wang and Tseng [11] described four aspects, i.e., the diversity in personalities and choices might impact the customer preferences, such that:

a. The variety in personality, value, and range of the products contributed to the heterogeneity of customer preferences;
b. When a customer selects a new kind of product, the most preferred product's chosen qualities are altered;
c. Each purchaser has a distinct viewpoint while making a purchase since their emotional condition and available funds may have an impact;
d. The attribute a consumer selects while making a purchasing decision typically affects their choice to consider the other attributes.

It was believed that preferences for the products could be considered as an abstract impression and altered by various reasons, such as the product's design, utility, and price [6]. Because the concepts used in the development of product design for all phases were focused on the preferences of the customer or product users, designers are required to determine consumer preferences at the beginning stages of the designing process [8]. The illustration of the design phase is depicted in Figure 1.

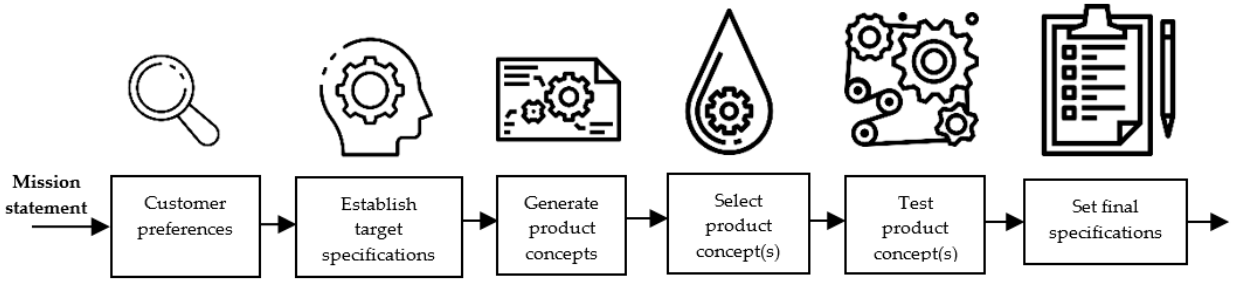

Figure 1. The product design process [8].

As indicated in Figure 1, customer preferences need to be identified in the design process's early stages. For example, suppose the preferences of customers were precisely discovered. In that case, it may also assist designers in conceiving a product concept, modifying product requirements, and defining final product specifications. However, because individual customers' tastes might differ significantly, determining customer preferences has always been challenging for product designers.

When creating new products, manufacturers prioritize considering potential customers' preferences and technical needs to ensure that their products succeed on the market. In the process of making a product, the designers are in charge of clearly defining the ideal product specifications based on what the customers want. Hasdogan [12] pointed out that the look of the product, its usefulness, and its price are the three conventional features that are the most critical factors that impact customers' purchase decisions. Regarding eco-friendly goods, environmental education and advocacy have taken on a more central role in recent years. Consequently, the designer needs to comprehend which particular environmentally friendly design attribute has the potential to affect consumer preferences and select the right ecologically friendly design attributes.

3. Green Product Attributes and Preferences

Growing demand for raw materials has a negative impact on the environment by increasing waste production, reducing the quality of environmental resources, and increasing pollution. Excessive use of natural resources, high pollution levels, and overpopulation might contribute to environmental problems [3]. According to Steffen et al. [13], ecological issues have persisted because environmental preservation efforts have lagged behind the depletion of natural resources and the rise in waste production. To overcome this challenge, it is necessary to offer solutions for addressing human needs while reducing environmental impact. The main understanding of this condition is that it is a strategy for achieving sustainable development [14].

Sustainable development may be realized by taking into account the three pillars. According to Beckerman [15], sustainable development promotes social equality and accountability, monetary prosperity, and ecological protection. Concerning the concept of sustainable development is the problem of what is to be preserved and developed and over what period [16]. Therefore, companies are advised to increase the number of eco-friendly products on the market to support sustainable development [17]. Environmentally friendly goods, often known as green products, have a minimal environmental impact throughout their entire cycle [3].

During the manufacturing process, companies may include eco-friendly or green attributes in the design of their products, such as reduced raw material use, reduced energy consumption, and the use of materials that are good for the environment [18]. When the products spread to the market, however, not all consumers are concerned with the negative environmental impact [19] since customer perceptions and knowledge of the green characteristics influence choices for green products [20]. Each attribute may influence customer preferences positively or negatively. As indicated in Table 1, the present research examines the classification of green product attributes from various perspectives.

Table 1. Green product attributes from previous studies.

Green Product Attributes	Authors
- Rebuildable. - Recyclable. - Easy to repair. - Easy to maintain. - Service. - Modularized. - Less material usage. - Biodegradable. - Easy to disassemble.	[21,22]
- Easy to disassemble. - Harmless to the living environment. - Biodegradable. - Reduce material used. - Easy to transfer or retain. - Energy saving.	[3,22,23]
- Energy reduction. - Utilized recycled materials and alternative materials to use fewer resources. - Less emission. - Reduces the packaging's weight, volume, and dimension. - Recyclability, the ability to be taken apart, and modularity. - Regular services.	[3,24]
- Reduces the material and energy consumption of a product. - Reduces harmful emissions, dispersion, and production. - The number of recyclable materials should be increased. - Maximizes the sustainable use of renewable resources. - Minimizes product and service intensity. - Extends the durability of a product. - Evaluates and reduces the environmental effect. - Has an "effective economy." - Improves the effectiveness of the utilization phase.	[3,25]
- Uses non-toxic substances. - Less energy and during the consumption production phase. - Uses high-quality and minimizes weight. - Extends lifetime with product service and upgrading. - Considers upgrading, repairing and recycling. - Minimizes joining elements of the product.	[26,27]
- Lightweight materials. - Eliminated hazardous materials. - Energy saving. - Disassembles easily. - Uses assembly techniques to increase the product's end-of-life. - Extends product lifetime by upgrading and maintaining the product. - Eliminated waste generation.	[3,25]
- Resources efficiencies. - Lightweight packaging. - Easy to reuse. - Easy to disassemble. - Harmless to the users' living environment. - Ease of disposal. - Uses recycled material. - Optimizes the product's life cycle.	[21,27]
- Product service system (PSS). - Maintainable. - Upgrades easily. - Modularized design.	[25,28]

The study on green product design is becoming essential to be performed. By performing a systematic search on green product design in the current relevant literature, the researchers of this study noticed that research on green product design is still interesting to other researchers. This search technique was adjusted to Scopus, Web of Science databases PsycINFO, and EBSCO, using the following search phrases: "Green product" and "Design". All searches were conducted for the last five years between 2017—2023 to obtain the current information regarding green product design. They include English-language journal publications, review papers, and research reports. The criteria for selection were referred to on the PRISMA statement [29]. The mapping of the existing research on green product design in the fields of engineering, business, and environmental science was the major purpose of the search. All publications published before 2017 were omitted from the search. At this level, 803 search articles were eliminated. At this level, 324 records were extracted.

The study relies only on primary research, review articles, and conference papers. Every instance of duplication was rigorously examined. To ensure the quality and relevance of academic material, including the review process, the abstracts of the publications were thoroughly examined for analysis and clarification. Each study article was then subjected to a thorough assessment. The following exclusion rule was intended to restrict to English-language publications. One non-English-language article was eliminated from the research. We picked 185 papers after reviewing each article on the inclusion specified above and exclusion criteria.

As seen in Figure 2 and Table 2, China is indicated as having the highest number of research publications in green product design, followed by India, the United States, Italy, Malaysia, Canada, the United Kingdom, Brazil, and France. However, the attributes of green product design are differently defined. For instance, reduced material utilization or lightweight material were defined as green product qualities that focused on lowering the usage of natural resources. It was done to protect the environment [18,30,31]. Previous research also found that environmentally friendly attributes focused on reducing the amount of waste produced throughout the disposal phases of the products. This can be accomplished by taking into consideration the attributes of being reused easily [32–34], having a product that is made from recycled material [35–37].

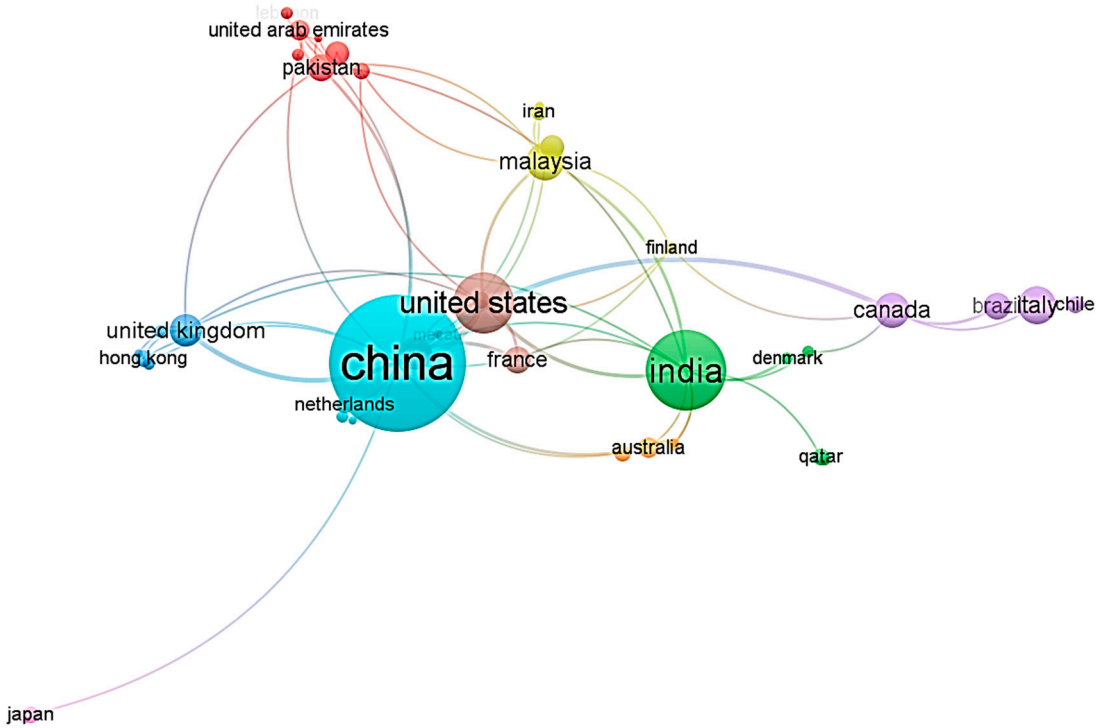

Figure 2. Country on green product design research by systematic search from 2018 to 2023.

Table 2. Number of documents for green product design from 2018 to 2023.

Country	Number of Document
China	73
India	30
United States	20
Italy	10
Malaysia	10
Canada	9
United Kingdom	8
Brazil	6
France	6

Green products should also be environmentally safe [18,38,39]. Consider the case of an environmentally friendly product that, although being made from recycled or recyclable materials, contributes to environmental damage. In such a scenario, this may, nevertheless, have an effect on customer choices when it comes to the purchase of the goods, particularly because of the potential risks to one's health connected to utilizing the product. Studies conducted in the past identified the utilization of biodegradable material as one of the green product attributes that can help reduce environmental contamination [31,40–42]. Efficiency in energy use is another quality of environmentally friendly products [43–46]. The topic of global warming has recently come to the forefront of environmental concerns, drawing the attention of governmental legislation and manufacturing companies. In both the consumption and manufacturing phases, manufacturers are making efforts to market products with energy efficiency attributes to boost their customers' preferences and contribute to decreasing global warming. Finally, eco-label has been recognized as a green product attribute [47–50]. According to D'Souza [47], eco-labels are a useful tool for informing consumers about the environmental advantages of a product. This is especially true for customers who have a very limited grasp of the situation. The following is a summary of some of the numerous characteristics of eco-friendly products that may be discovered.

3.1. Resources Efficiency

Evaluating resource efficiency throughout the production and utilization stages has emerged as a key technique for minimizing the negative impact on the environment and simultaneously supporting the continued and sustainable growth of resources [51]. However, the existing body of research presents some contrasting viewpoints about the appropriateness of resource allocation. Most research performed in the past focused on issues associated with the efficiency of energy consumption. These issues included the utilization of electricity [52], water efficiency [53,54], and the efficiency of material [55–57]. When talking about environmentally friendly products, resource efficiency should be addressed across the whole of the product's life cycle, beginning with the raw material phase and continuing through the manufacturing, consumption, and disposal phases. On the other hand, it is general knowledge that customers pay greater attention to the payment of bills for resource utilization than to the quantity of resources utilized during manufacturing. This is because more focus is placed on the bills for energy consumption [23,30]. Many electric home devices available today encourage energy use reduction for example. The consumer's preference for products with a lower energy consumption rate, which are, therefore, more cost-effective, may grow if the product's label includes stars that indicate various energy usage rates, and the consumer refers to those stars.

3.2. Weight Reduction

The majority of products are composed of diverse components. Larger and heavier products may increase the usage of natural resources, which could lead to their depletion. D'Souza et al. [47] argued strongly for a product with fewer materials and a lower size or weight in order to promote the sustainable development of the resources. Considering that several capabilities may be included into a single product [55], multifunction products can reduce natural resource usage [3]. Multifunction products include photocopiers and printers with scanning capabilities, as well as mobile phones with email, an alarm clock, a calendar, and a calculator. This additional feature may be used to boost customer preferences and indirectly reduce natural resource consumption. Additionally, the size and weight of a product with a single function may be reduced. However, how customers view the product with this attribute may be challenging. When this attribute is adopted, the product's quality may affect customer preferences. When reducing a product's weight, it is essential to preserve its quality and performance to gain customer preference.

3.3. Using Non-Toxic Material

Many different kinds of materials may be used to make a product. For example, suppose a material contains components that are detrimental to the environment. In that case, it may be necessary to handle it in a particular way, either while it is being used or after it has been used. In most cases, consumers would purchase a product made with non-toxic ingredients rather than one that contains harmful ones [58]. However, even if the product performs well, has an appealing look, and fulfills its intended functions, the customer's preferences may still be altered if it includes hazardous substances. Therefore, to lessen a product's influence on the environment and safeguard consumers' health, product designers should only use non-toxic materials [59].

3.4. Using Recyclable Material

An objective of sustainable development was to guarantee that future generations would have access to the planet's natural resources, and one method this was achieved was through sustainable development. This objective can be fulfilled in the product's design by reducing the amount of raw materials that are utilized in the manufacturing process of the product [60–62]. Products made from recyclable materials may be recycled an unlimited number of times and made into new products until the actual lifespan of the materials has passed and they can no longer be used.

3.5. Using Recycled Material

Utilizing recycled materials to produce a product is another method that can be used to cut down on the consumption of natural resources [3,63]. However, consumers could have varying preferences for the product that uses this attribute, especially related to the product's level of quality. An exhaustive evaluation of the product's quality is still necessary, even if the product is created from recycled materials with the intention of reducing the negative impact it has on the environment. The customer's demand for environmentally friendly products may increase if the product contains high-quality recycled components.

3.6. Reusable

There are many products on the market that are only intended to be used for a limited time and then thrown away. A designer of a product can consider the attribute of reusable design to prevent the product from being thrown away before its primary function is finished [64]. This characteristic may enable the customer to save money from purchasing a new product. As a result, waste generation can be avoided. Some reusable products are refillable water bottles, reusable shopping bags, cloth diapers, and other products that are comparable in this regard [65].

3.7. Easy to Maintain

Customers can undertake their upkeep on green products since their designs have features that make them simple to maintain [66]. This makes it possible for consumers to reduce their environmental impact. Regarding its environmental impact, this feature's goal was to increase the product's durability so that it may be used for a longer time before being discarded [67]. Therefore, it is essential and should be given that there be a guideline for performing self-maintenance. Furthermore, other features, such as those that make the product simple to dismantle and its replacement parts readily available, should also be incorporated to facilitate the procedure of product maintenance.

3.8. Providing Product Service

Customers need to be provided with product services from the manufacturer for the product's lifespan to be extended and for there to be less of an effect on the environment [68]. The producer can readily determine what the consumers desire and obtain feedback about their product if they utilize this attribute. In addition, maintaining a healthy connection with customers and manufacturing partners may be accomplished by offering excellent service. Thus, it is feasible to meet the demands of the consumer. Some examples of services that may be provided are product warranty, dematerialization, regular maintenance, remanufacturing, product rental, and substitution or replacement [3,25].

3.9. Eco-Label

The majority of customers do not adequately comprehend the aim of green products now available on the market. Incorporating the eco-label feature served the dual function of indirectly increasing customer desire for the product benefits they will receive when purchasing the product and providing information about the environmental benefit [50]. Giving customers pertinent information through eco-labels can boost their preferences for purchasing environmentally friendly products [69]. Customers would also feel more assured because products with eco-labels were shown to be more persuasive than those without them [57]. According to D'Souza et al. [47], there are a few different approaches to eco-labelling that may be considered. One of these approaches suggests that to avoid confusion, the eco-label's verbal and visual components need to be constructed in an acceptable manner. A reliable eco-label guarantees the product's legitimacy in promoting environmental conservation. Consequently, it is preferable to have a government certification rather than a self-declaration.

3.10. Biodegradable Material

Customers typically do not have the knowledge or the routine to dispose of waste from a product in the appropriate rubbish box. The use of biodegradable components in product design is becoming more widespread to reduce negative impact on the natural world [42]. By using a biodegradable material, the waste of the product may be broken down biologically by microorganisms in a relatively short duration. This can be accomplished by using a biodegradable substance [70]. For instance, for products packed using polymeric materials to be biologically degraded, a large amount of additional time may be required, in contrast to products with organic packaging, such as material made from soya. This is because polymeric substances do not break down in the same way that organic materials do [42].

3.11. Easy to Upgrade

The product of being easy to update can also be employed as an effective technique to reduce the amount of trash generated and the amount of material required [71]. Customers can improve a product's functionality through an upgrade process, which prolongs the product's lifespan. Customers can have their product preferences met, provided that the product in question can be updated. When implementing this trait, it is vital to remember that it is not difficult to disassemble, and that spare parts are readily available [72]. As

shown in Table 3, there are a number of possible approaches that may be used to relate green product preferences in the literature.

Table 3. Matrix strategies green product attributes relate to the customer preferences.

Green Product Attributes	Potential Design Strategies	References
Ecolabel	To reduce confusion, use important information and define the eco-principal label's purpose.	[47,57,73]
	Instead of self-declaration, use an eco-label issued by the government.	[47,74]
	Customers easily comprehend the symbols used on eco-labels.	[47,57,73]
Resources efficiency	Maximize material effectiveness.	[31,75]
	Reduce the amount of waste and emissions generated when using the product.	[3,76]
	Provide consumers with information, such as an estimate of the resources they will spend during the next month or year (e.g., electricity consumption).	[3,76]
Harmless material/non-toxic material	Eliminate hazardous materials to lessen environmental and health impacts.	[77,78]
	Consider substituting inferior materials with more sustainable alternatives.	[77,78]
	Ensures that non-recyclable components may be discarded in an eco-friendly way.	[77,78]
	Despite the use of non-toxic materials, the product's quality and durability must be ensured.	[77,78]
	If harmful materials are unavoidable, use them only when essential.	[30]
Product services	Offer product advice or a brief explanation of the product's different features and functionalities.	[79,80]
	Provide routine maintenance, upgrades, the availability of spare parts, and quick customer service.	[25,79]
	Recovery and refurbishment should be utilized during the disposal phase to decrease landfill waste.	[25,79]
	Offer product leasing as an alternative to product buying so that the manufacturer may pick up the product at the end of the product's life cycle.	[24,25,79,81]
Easily maintained	Simple to replace and disassemble for self-repair and upgrade.	[18,23,72,82]
	Make design by module.	[82,83]
	The availability of spare parts in the market.	[84–86]
Reducing size or weight	Minimize material usage and combination	[3]
	Should not affect the qualities.	[87]
	Utilize high-quality, durable materials to preserve the product's performance.	[30,31,64]
Using recyclable material	Concentrates on optimal recycle ability and high recycled material content.	[3]
Using biodegradable material	Utilize natural organic material; product waste should be easily biodegradable.	[3,31,88]
	Consider the product's durability.	[31]
	If hazardous materials must be utilized, they should be eliminated or minimized as much as feasible.	[89]
Using recycled material	Remove the negative effects component of recycled materials.	[36]
	Consider product quality while using recycled materials.	[36]
	It should not diminish the usefulness of the product.	[36]
Easily reused	Used component quality assurance should be designed appropriately.	[90]
Upgrade easily	Easy to disassemble to access defective components.	[72,82,83]
	Modular design.	[30]
	Easy disassembly construction	[72,83]

As indicated in Table 3, numerous consumer preference-enhancing tactics were outlined in prior research. However, as previously indicated, customer preferences for green product qualities can be conveyed in a variety of ways. A product with green features may have positive or negative consequences on a customer's purchasing decision [17]. Numerous organizations have sought to show and assert that their products are ecologically beneficial without receiving the necessary certification [47]. This may result in increasing reluctance among consumers who purchase environmentally friendly products. Young et al. [91] discovered that preferences may be affected by a variety of aspects, including degree of knowledge, financial stability, peer pressure, and cultural norms. A review of the cultural significance of preferences for eco-friendly products is provided in the next section.

4. Cultural Value and Green Product

The natural environment of a social connection, or how a civilization organizes its practices inside the group, may be characterized as culture [92,93]. According to Hofstede [92], culture is a concoction of mental training that distinguishes one group of people from another. According to Birukou et al. [94], culture is a collection of customs that have developed over time for a particular reason. The many aspects of culture may be broken down into three categories: pattern, behavior achievement, and character translation. Another definition of culture is the social training of the mind that distinguishes members of one human group from members of another [92]. Scholars highlighted that culture is a group natural mindset that exhibits a pattern of behaviors that have formed over time in a way that may distinguish one group from another.

Cultural values derived from individual and situational aspects of human existence may also have an influence on customers' choices for a product [6,95,96]. Salmi and Sharafutdinova [50] claim that cultural value serves as a "lens" through which consumers view a product and may have an effect on their purchasing choices. Bloch [6] showed how cultural values may affect people's choices for particular products. This study demonstrated that customer preferences, including cultural values, may influence the process of creating product designs, particularly in determining the form of the object. Bloch's models of customer preferences that take into account cultural factors while producing a product are shown in Figure 3.

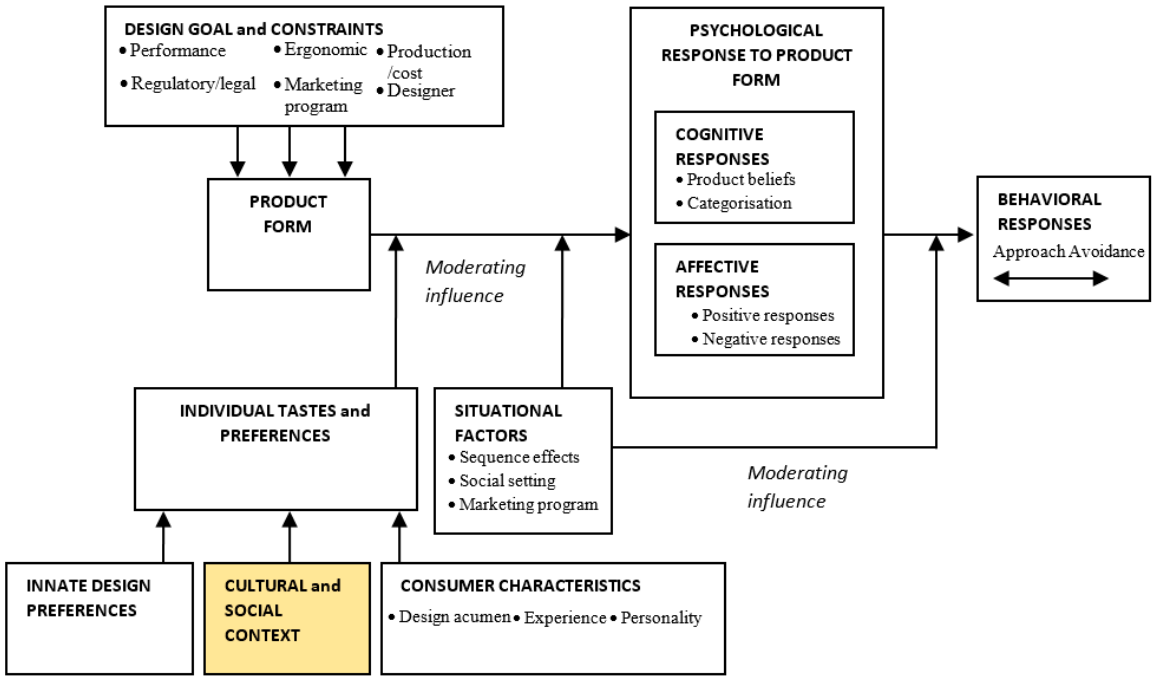

Figure 3. Consumer responses model (Reproduced from [6]).

As seen in Figure 3, it has been determined that cultural values impact customer preferences. This study, however, was limited to the cultural impact on customer preferences based on traditional product features. According to Salmi and Sharafutdinova [96], cultural values may be used to obtain insight into the preferences of customers for a specific product. On the other hand, these studies simply indicated the preferences of customers for conventional product attributes. There is a lack of research that investigates the cultural effects of selecting environmentally friendly products. For example, the concern of customers regarding green product quality that is made from recycled material attributes. The customers may have different perceptions in terms of its quality compared to the virgin material. It can reduce the preferences of customers to select green product. Therefore, it is necessary to provide the designer with significant information to help them determine the most appropriate green features for their design depending on cultural factors.

There are several perspectives on the definition and characteristics of culture. However, Hofstede [92] established a theory defining the characteristics of cultural values. Multiple study fields have created and confirmed this idea, including marketing, organization, individual, group, and national levels. The five cultural aspects of Hofstede's theory are masculinity–femininity, high–low uncertainty avoidance, collectivism–individualism, long- and short-term orientation, and high- and low-power distance. Given the variety of theories for the green product, a framework that simply explains the aspects of consumer preferences for green products has been developed. It was discovered that conventional elements like appearance, usability, and price had the most influence on consumer decisions. The aspects of preferences must be extended to incorporate the green product's attributes in order to ascertain consumer preferences for green products.

4.1. Collectivism–Individualism

In contrast to being alone, collectivism emphasizes being a part of a group that protects its members' interests in exchange for allegiance. Individualism, which is defined as the desire to exclusively take care of oneself and remain socially isolated, is the antithesis of collectivism [92]. The previous study used this cultural dimension to identify customer preferences. Huff and Kelley [97] analyses the effect of collectivism and individualism on organizational trust and customer inclinations in seven nations. Frost et al. [98] evaluated the relationship between collectivist and individualist characters with online purchase intentions. As demonstrated by the findings, individual traits affect online customers. These two experiments demonstrated that the collectivism–individualism dimension may be utilized to detect individual consumer purchasing preferences. Individualism–collectivism may also impact consumer choices for green products. Yu et al. [99] explained that the growth in environmental awareness has affected consumers' intention to buy green products. This awareness can be influenced by collectivism or individualism characteristics. Customers with a collectivist orientation prefer green products since they want to contribute to environmental conservation. Individualistic customers, on the other hand, consider green products out of self-interest and are uninfluenced by the preferences of others. In other words, the customers with this intention consider protecting the environment through their own desires.

4.2. Masculinity–Femininity

The disparity between gender roles may be seen in the manifestations of masculinity and femininity. The masculine culture places greater emphasis on assertiveness, the attainment of riches, realizations, and success. The caring of others, lifestyle, and improving one's quality of life are more important in the feminine culture [92]. Several studies have utilized this dimension to examine the characteristics of customers' purchase intent. Moon et al. [100] used masculinity to evaluate customer preferences when purchasing customized goods. Srite [101] evaluated a model to estimate the impact of four Hofstede cultural characteristics on consumer acceptance of a product's perceived usability and utility. They discovered that only the masculinity–femininity dimension affected the two

product features considerably. Consequently, this dimension can also assess consumer preferences for green products. Green products are created with incorporated environmental features (such as reusable and recycled materials) to decrease material use, which might affect the quality, durability, and the appearance of the product. In turn, this might affect customer preferences.

A significant level of masculinity in customers is more likely to care about the product's usability and quality than anything else. Thus, shoppers may compare green and traditional products. Suppose they discover that the quality of the green product is poorer. This might decrease their favor for the goods, as product quality is essential to boosting customer preferences [102]. Masculinity may also influence consumer choices about physical attractiveness. Customers may select a product with a black color because, in comparison to pink, which is often associated with femininity, they feel more confident with the product's stronger look when purchasing a product with a black color. The choice of green products can be determined entirely by the green product's objectives to minimize the environmental effect. In contrast to consumers with high masculinity, customers with high femininity may be attracted to the product's appearance, such as color, texture, and form, since they desire a modest and beautiful product. Nevertheless, this relies on the individual characteristics of the customers. Despite the fact that corporations may make green products with excellent quality and a decent appearance, people may still perceive green products differently, as they may exhibit masculine or femininity while choosing green products.

4.3. Uncertainty Avoidance

Uncertainty avoidance refers to the degree to which individuals see uncertainty and ambiguity as threatening, and hence, want to avoid these circumstances [92]. Uncertainty is still one of the most prevalent issues affecting customers' willingness to pay more for green products, despite the abundance of studies promoting environmental protection [41]. Not everyone can be deemed "green purchasers" with a superior grasp of green products than "non-green consumers." Sometimes both green and non-green consumers have an unfavorable impression of enterprises that advertise green products [103]. This might be due to the ambiguity around green products, which impacts consumer choices. For instance, green products may be created from recycled, non-hazardous, or recyclable materials, which may affect the quality and texture of the product. Customers' beliefs that green products may be of inferior quality than traditional products manufactured from virgin resources may affect their selections. Consequently, this impacts consumers' willingness to pay for green products [104]. To decrease this uncertainty, the customer may inquire with other customers who have used green products for further information about the products [105].

4.4. Power Distance

The concept of power distance may be defined as "the extent to which fewer powerful members of the organizations and institutions accept and anticipate that power has been transmitted unequally" [106]. A high power distance is evidence that the interaction between those with no power is difficult to manage since hierarchy implies inequality, and there is a possibility of dormant conflict between those with power and those with little power [92]. Inequalities in both power and income are likely to emerge as a result of the centralized and non-autonomous nature of the authority. A lower power gap, on the other hand, indicates concord between the strong and the weak, whereas collaboration among the powerless can be founded on both solidarity and accessibility to superiors [106]. The customer's decision to purchase environmentally friendly products could be heavily influenced by the power distance. Take, for instance, the lack of customer's comprehension or information regarding environmentally friendly products. Not every consumer is aware of what types of environmentally friendly products are already on the market or the advantages they may derive from making purchases in this category. In addition to this, the power distances may also be read as the capacity to make purchases. A consumer with

a lower degree of preference may have a lower preference for the environmentally friendly product because of the undesirable price compared to a customer with a greater level of desire. According to Furrer et al. [107], customers that have a large power distance rank dependability and responsiveness lower on their list of priorities.

4.5. Long- and Short-Term Orientation

The concept of long-term orientation refers to the "fostering of virtues orientated towards future benefits, notably persistence and thrift" [92]. When shopping for a certain item, performance and quality are two characteristics that should not be overlooked as significant considerations. Products that are considered a green use fewer natural resources and require less energy to produce. The researchers of this study noticed that a few attributes of green products are connected to the customers' perspective on the long term. For instance, some consumers are ready to spend a higher price for a product if it has a lower overall energy consumption because they believe it would save them money in the long run. One other attribute is the provision of product services. Product services, such as frequent maintenance, can potentially benefit a customer's long-term orientation since they can extend the product's lifetime [25]. Therefore, customers that have qualities indicative of a focus on the long term are more worried about the products' potential applications in the future. Customers' tastes may be significantly influenced by factors such as the excellent product quality and longevity, as well as the fact that environmentally friendly products benefit the environment.

5. Discussion

This article elaborates on the evaluation of product design and consumer preferences, green products, and cultural value influences. Various perspectives were used while characterizing each facet, which may be attributed to the varying goals of the many studies. It shows that obtaining consumer preferences early on in the product design is crucial to help the designers in the latter phases of the process, such as determining product requirement. It was identified that different customer preferences might be affected by cultural preferences. During the process of developing a product, several studies took into account the preferences of customers; these studies may be modified to generate an environmentally friendly product design that takes into account the impact of cultural factors. A study was performed by Lihra et al. [108]. This study concentrated on determining the preferences of customers for personalized household furniture. A method known as conjoint analysis was utilized for the purpose of determining which aspects of personalized furniture were valued the most. It was determined that considerations such as age, salary, geography, gender, and education level all had a role in determining customer preferences. In this particular research endeavor, the furniture was designed utilizing all four aspects of customization: product customization, customization time, delivery time, and pricing. The results revealed that the product price was well known as the most important attribute, followed by delivery time, product customization, and customization time considered by customers. This was determined by evaluating the weight and rank of each attribute.

Research conducted by Li et al. [109] on consumer preferences led to the creation of a strategy that proposes integrating different types of product features into the design and development of the product. To begin, a quality function deployment, also known as QFD, was applied to analyze the customer's preferences regarding technical needs. In this particular study, a personal digital assistant (also known as a PDA) served as the product stimulation. It identified seven attributes, including a quicker run time, more memory space, a lower weight, a more affordable pricing, more space for hard drive, a long term used, and less noise operation. The attribute with the highest score demonstrated that the most favored feature was the quicker run time, followed by the price, more space for hard drive, and less noise operation.

In addition, it was discovered that people from various cultural backgrounds, educational levels, and value systems might produce customer preferences for a product.

Haverila [110] performed a study in Finland to determine customer purchasing intention of male respondents about mobile phone functionality. According to the findings of this survey, customer preferences about mobile phone features may be broken down into six distinct categories: aesthetics and design, components and processes, tones and games, support functions, solidity, and business usefulness. The findings indicated that the consumer preferences were most strongly influenced by the functioning of the business itself, followed by the parts, procedures, aesthetics, and design. According to the findings of earlier research, it has been discovered that establishing consumer preferences may be accomplished by analyzing the elements that influence their decisions and ranking the importance of the various characteristics in descending order. Table 4 provides a summary of the various methods that were utilized in earlier investigations.

Table 4. The ways that previous studies tried to find out customer preferences.

Approaches	Description
Determining the attributes	Considering the attributes that could influence consumer preferences, such as appearance of product, product function, price, educational, gender, culture, income, and among other things [108–110].
Evaluating the weigth of attributes	Calculating relative importance of individual characteristics using the most appropriate method (e.g., Statistical analysis, conjoint analysis, QFD, EFA, etc.) [108–110].
Identifying the preferences rank	The degree and rank of customer preferences on attributes are used to provide design idea to help designers when developing new designs [108–110].

The researchers of this study noticed that the inclusion of cultural value in green product design is still not concretely defined. Therefore, the method of product design utilized by earlier researchers, laid out in Table 4, is adapted to establish a conceptual model for integrating environmentally friendly product design while taking into account the effects of cultural value influences. The conceptual model for including cultural value influences in the development of green products is shown in Figure 4.

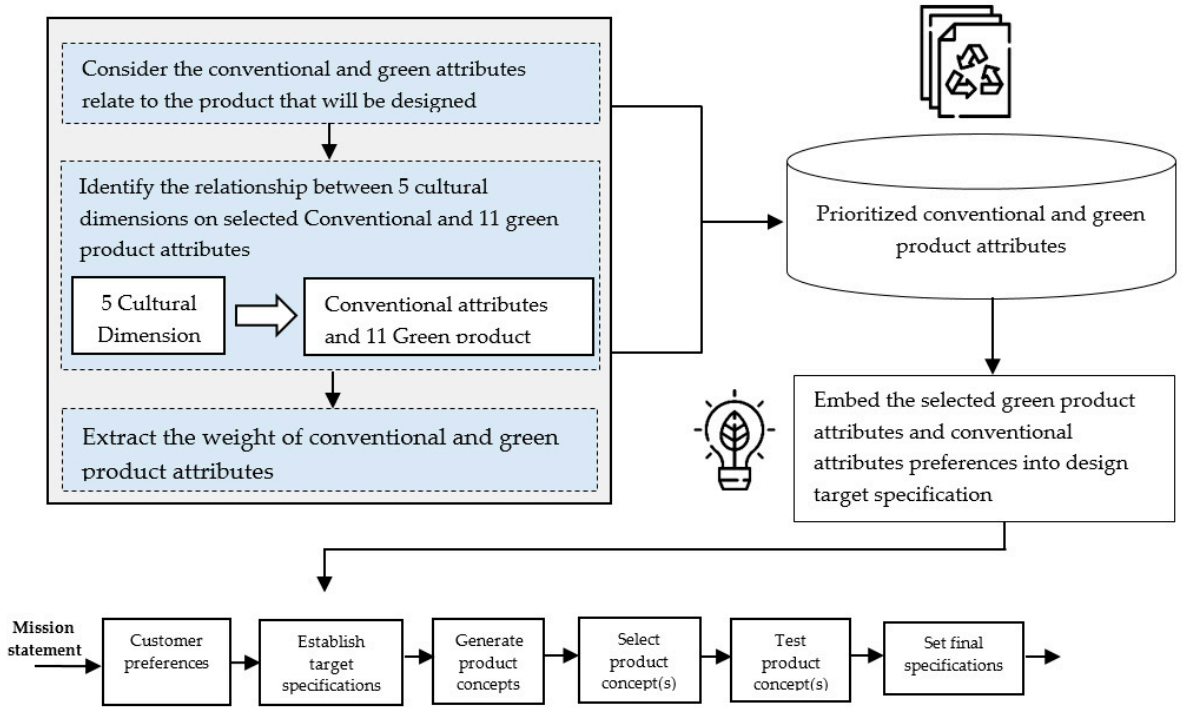

Figure 4. A conceptual framework to involve cultural influences in green product design development.

As illustrated in Figure 4, the conceptual framework is divided into three phases. In the first phase, the designer needs to consider conventional and green attributes that relate to the product that will be designed. After this has been chosen, the next phase is to determine the link among the five dimensions of cultural value on selected conventional product attributes and the eleven green product attributes. It can be identified by hypotheses testing analysis, which determines the most influenced cultural dimensions on green product attributes preferences. Based on this analysis, one can extract the identified weight of conventional and green product attributes, and the designers can determine which dimensions may provide significance on green product attribute preferences. The second phase is to prioritize the weight and identify the rank of each attribute. By this rank information, the designer may determine suitable conventional and green attributes for their intended design. However, in this phase, the designers must adjust their selected attributes by reflecting on the capital, human resources, and technical capability to produce the product. The third phase is to put their priority on both conventional and green product attributes in establishing the design specification process.

6. Conclusions and Implications

This study presented a conceptual framework for the inclusion of cultural value in green product design. It was constructed by reviewing relevant previous studies on product design and customer preferences, green products, and cultural value. Previous studies used different perspectives to formulate each attribute, especially for green product design. This study identified 11 common green design attributes with different terms and environmental concerns that can be embedded in product design from the literature. Those were: biodegradable material, resources efficiency, optimum size, weight reduction, recycled material, recyclable material, providing product services, maintain easily, easy to upgrade, easy to reuse, eco-label, and harmless to the environment. Design strategies for the identified green attributes have also been discussed. However, the researchers of this study noticed no solid framework from previous studies to determine customers' preferences for these green attributes. Customers' cultural preferences can cause these differences in that green attributes can be differently defined from each other.

Cultural value has been identified as a significant aspect in product design development, especially for determining customer preferences. In the natural behavior setting, cultural value analysis can widely and significantly capture consumer preferences for conventional and green products. Therefore, the designers can explore a deeper evaluation of the actual reason behind the customers' preferences and prepare specific detail specifications to meet the customer preferences. For customers with long-term orientation cultural value, the designers may decide what attributes can increase product lifetime. In terms of quality, the designers can consider the good quality of green products, although the product is made from recycled material. For customers with a feminine culture who may be more concerned about product appearance, the designers can consider making the appearance of green products more attractive than conventional products. As a result, taking into account cultural impacts on preferences for environmentally friendly products may be utilized to assist the choice made by designers when selecting the technical parameters for a design throughout the design process.

The proposed conceptual framework is expected to contribute to both practice and theory. For practice, the conceptual framework can be used as a point of view on considering cultural value influences when designing green products. In terms of theory, the conceptual framework that was given may be used to expand the strategies when researching consumer preferences for environmentally friendly products. The conceptual framework in this study only used 11 green design attributes. Further study can elaborate more on green product attributes in identifying customer preferences. It can be helpful to serve more ideas to designers. For example, the attributes that focus on product lifetime extensions and reduce waste generation, such as modular and easy-to-disassemble designs, make the customer easily replace the malfunctioning part rather than buy a new product. In

addition, the consideration for performing an actual case study on green product design using product stimuli can also be performed by further study to confirm the applicability of the proposed framework.

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References

1. United Nations. Population. United Nations. Available online: https://www.un.org/en/global-issues/population (accessed on 15 September 2022).
2. Sreen, N.; Yadav, R.; Kumar, S.; Gleim, M. The impact of the institutional environment on green consumption in India. *J. Consum. Mark.* **2020**, *38*, 47–57. [CrossRef]
3. Ljungberg, L.Y. Materials selection and design for development of sustainable products. *Mater. Des.* **2007**, *28*, 466–479. [CrossRef]
4. Yadav, R.; Pathak, G.S. Determinants of Consumers' Green Purchase Behavior in a Developing Nation: Applying and Extending the Theory of Planned Behavior. *Ecol. Econ.* **2017**, *134*, 114–122. [CrossRef]
5. Kwon, H.J.; Ahn, M.; Kang, J. The Effects of Knowledge Types on Consumer Decision Making for Non-Toxic Housing Materials and Products. *Sustainability* **2021**, *13*, 11024. [CrossRef]
6. Bloch, P.H. Seeking the Ideal Form: Product Design and Consumer Response. *J. Mark.* **1995**, *59*, 16–29. [CrossRef]
7. Thøgersen, J.; Alfinito, S. Goal activation for sustainable consumer choices: A comparative study of Denmark and Brazil. *J. Consum. Behav.* **2020**, *19*, 556–569. [CrossRef]
8. Ulrich, K.T.; Eppinger, S.D. *Product Design and Development*, 5th ed.; McGraw-Hill/Irwin: New York, NY, USA, 2012.
9. Blijlevens, J.; Creusen, M.E.; Schoormans, J.P. How consumers perceive product appearance: The identification of three product appearance attributes. *Int. J. Des.* **2009**, *3*, 27–35.
10. Zeithaml, V.A. Consumer Perceptions of Price, Quality, and Value: A Means-End Model and Synthesis of Evidence. *J. Mark.* **1988**, *52*, 2–22. [CrossRef]
11. Wang, Y.; Tseng, M. Incorporating probabilistic model of customers' prefer-ences in concurrent engineering. *CIRP Ann.* **2008**, *57*, 137–140. [CrossRef]
12. Hasdoğan, G. The role of user models in product design for assessment of user needs. *Des. Stud.* **1996**, *17*, 19–33. [CrossRef]
13. Steffen, W. *Global Change and the Earth System: A Planet Under Pressure*; Springer Science & Business Media: Berlin/Heidelberg, Germany, 2006.
14. Brundtland, G.H. World Commission on environment and development. *Environ. Policy Law* **1985**, *14*, 26–30. [CrossRef]
15. Beckerman, W. 'Sustainable Development': Is it a Useful Concept? *Environ. Values* **1994**, *3*, 191–209. [CrossRef]
16. Leiserowitz, A.A.; Kates, R.W.; Parris, T.M. Sustainability Values, Attitudes, and Behaviors: A Review of Multinational and Global Trends. *Annu. Rev. Environ. Resour.* **2006**, *31*, 413–444. [CrossRef]
17. Luchs, M.G.; Naylor, R.W.; Irwin, J.R.; Raghunathan, R. The Sustainability Liability: Potential Negative Effects of Ethicality on Product Preference. *J. Mark.* **2010**, *74*, 18–31. [CrossRef]
18. Masui, K.; Sakao, T.; Kobayashi, M.; Inaba, A. Applying Quality Function Deployment to environmentally conscious design. *Int. J. Qual. Reliab. Manag.* **2003**, *20*, 90–106. [CrossRef]
19. Roberts, J.A. Green consumers in the 1990s: Profile and implications for advertising. *J. Bus. Res.* **1996**, *36*, 217–231. [CrossRef]
20. MacDonald, E.; Whitefoot, K.; Allison, J.T.; Papalambros, P.Y.; Gonzalez, R. An Investigation of Sustainability, Preference, and Profitability in Design Optimization. In Proceedings of the International Design Engineering Technical Conferences and Computers and Information in Engineering Conference, Montreal, QC, Canada, 15–18 August 2010; pp. 715–728. [CrossRef]
21. Roy, R. Sustainable product-service systems. *Futures* **2000**, *32*, 289–299. [CrossRef]
22. Steenis, N.D.; van der Lans, I.A.; van Herpen, E.; van Trijp, H.C. Effects of sustainable design strategies on consumer preferences for redesigned packaging. *J. Clean. Prod.* **2018**, *205*, 854–865. [CrossRef]

23. Vinodh, S.; Rathod, G. Integration of ECQFD and LCA for sustainable product design. *J. Clean. Prod.* **2010**, *18*, 833–842. [CrossRef]
24. Yang, X.; Moore, P.; Pu, J.-S.; Wong, C.-B. A practical methodology for realizing product service systems for consumer products. *Comput. Ind. Eng.* **2009**, *56*, 224–235. [CrossRef]
25. Maxwell, D.; van der Vorst, R. Developing sustainable products and services. *J. Clean. Prod.* **2003**, *11*, 883–895. [CrossRef]
26. Luttropp, C.; Lagerstedt, J. EcoDesign and The Ten Golden Rules: Generic advice for merging environmental aspects into product development. *J. Clean. Prod.* **2006**, *14*, 1396–1408. [CrossRef]
27. Wang, J.; Yu, S.; Qi, B.; Rao, J. ECQFD & LCA based methodology for sustainable product design. In Proceedings of the 2010 IEEE 11th International Conference on Computer-Aided Industrial Design & Conceptual Design 1, Yiwu, China, 17–19 November 2010; Volume 2, pp. 1563–1567.
28. De Coster, R. Bateman, R.J. Sustainable product development strategies: Busi-ness planning and performance implications. *Proc. Inst. Mech. Eng. Part B J. Eng. Manuf.* **2012**, *226*, 1665–1674. [CrossRef]
29. Moher, D.; Liberati, A.; Tetzlaff, J.; Altman, D.G.; the PRISMA Group. Reprint—Preferred Reporting Items for Systematic Reviews and Meta-Analyses: The PRISMA Statement. *Phys. Ther.* **2009**, *89*, 873–880. [CrossRef] [PubMed]
30. Byggeth, S.; Broman, G.; Robèrt, K.-H. A method for sustainable product development based on a modular system of guiding questions. *J. Clean. Prod.* **2007**, *15*, 1–11. [CrossRef]
31. Dangelico, R.M.; Pontrandolfo, P. From green product definitions and classifications to the Green Option Matrix. *J. Clean. Prod.* **2010**, *18*, 1608–1628. [CrossRef]
32. Albort-Morant, G.; Henseler, J.; Cepeda-Carrión, G.; Leal-Rodríguez, A.L. Potential and Realized Absorptive Capacity as Complementary Drivers of Green Product and Process Innovation Performance. *Sustainability* **2018**, *10*, 381. [CrossRef]
33. Awan, U.; Arnold, M.G.; Gölgeci, I. Enhancing green product and process innovation: Towards an integrative framework of knowledge acquisition and environmental investment. *Bus. Strateg. Environ.* **2021**, *30*, 1283–1295. [CrossRef]
34. Coelho, P.M.; Corona, B.; ten Klooster, R.; Worrell, E. Sustainability of reusable packaging–Current situation and trends. *Resour. Conserv. Recycl. X* **2020**, *6*, 100037. [CrossRef]
35. Guo, S.; Choi, T.-M.; Shen, B. Green product development under competition: A study of the fashion apparel industry. *Eur. J. Oper. Res.* **2020**, *280*, 523–538. [CrossRef]
36. Essoussi, L.H.; Linton, J.D. New or recycled products: How much are consumers willing to pay? *J. Consum. Mark.* **2010**, *27*, 458–468. [CrossRef]
37. Nguyen, X.H.; Tran, H.L.; Nguyen, Q.H.; Luu, T.P.A.; Dinh, H.L.; Vu, H.T. Factors influencing the consumer's intention to buy fashion products made by recycled plastic waste. *Manag. Sci. Lett.* **2020**, *10*, 3613–3622. [CrossRef]
38. Mahmoud, T.O. Impact of green marketing mix on purchase intention. *Int. J. Adv. Appl. Sci.* **2018**, *5*, 127–135. [CrossRef]
39. Panda, T.K.; Kumar, A.; Jakhar, S.; Luthra, S.; Garza-Reyes, J.A.; Kazancoglu, I.; Nayak, S.S. Social and environmental sustainability model on consumers' altruism, green purchase intention, green brand loyalty and evangelism. *J. Clean. Prod.* **2020**, *243*, 118575. [CrossRef]
40. Al-Oqla, F.M.; Hayajneh, M.T. A hierarchy weighting preferences model to optimise green composite characteristics for better sustainable bio-products. *Int. J. Sustain. Eng.* **2021**, *14*, 1043–1048. [CrossRef]
41. Chen, K.-J.; Galinato, S.P.; Marsh, T.L.; Tozer, P.R.; Chouinard, H.H. Willingness to Pay for Attributes of Biodegradable Plastic Mulches in the Agricultural Sector. *Horttechnology* **2020**, *30*, 437–447. [CrossRef]
42. Moshood, T.D.; Nawanir, G.; Mahmud, F.; Mohamad, F.; Ahmad, M.H.; AbdulGhani, A. Biodegradable plastic applications towards sustainability: A recent innovations in the green product. *Clean. Eng. Technol.* **2022**, *6*, 100404. [CrossRef]
43. Issock, P.B.I.; Mpinganjira, M.; Roberts-Lombard, M. Drivers of consumer attention to mandatory energy-efficiency labels affixed to home appliances: An emerging market perspective. *J. Clean. Prod.* **2018**, *204*, 672–684. [CrossRef]
44. Lee, H.; Lee, M.; Lim, S. Do Consumers Care about the Energy Efficiency of Buildings? Understanding Residential Choice Based on Energy Performance Certificates. *Sustainability* **2018**, *10*, 4297. [CrossRef]
45. Xie, X.M.; Huo, J.G.; Zou, H.L. Green process innovation, green product innovation, and corporate financial performance: A content analysis method. *J. Bus. Res.* **2019**, *101*, 697–706. [CrossRef]
46. Zhang, Y.; Xiao, C.; Zhou, G. Willingness to pay a price premium for energy-saving appliances: Role of perceived value and energy efficiency labeling. *J. Clean. Prod.* **2020**, *242*, 118555. [CrossRef]
47. D'Souza, C.; Taghian, M.; Lamb, P. An empirical study on the influence of environmental labels on consumers. *Corp. Commun. Int. J.* **2006**, *11*, 162–173. [CrossRef]
48. Mungkung, R.; Sorakon, K.; Sitthikitpanya, S.; Gheewala, S.H. Analysis of green product procurement and eco-labels towards sustainable consumption and produc-tion in Thailand. *Sustain. Prod. Consum.* **2021**, *28*, 11–20. [CrossRef]
49. Murali, K.; Lim, M.K.; Petruzzi, N.C. The Effects of Ecolabels and Environmental Regulation on Green Product Development. *Manuf. Serv. Oper. Manag.* **2019**, *21*, 519–535. [CrossRef]
50. Riskos, K.; Dekoulou, P.; Mylonas, N.; Tsourvakas, G. Ecolabels and the Attitude–Behavior Relationship towards Green Product Purchase: A Multiple Mediation Model. *Sustainability* **2021**, *13*, 6867. [CrossRef]
51. Zheng, J.; Chen, A.; Zheng, W.; Zhou, X.; Bai, B.; Wu, J.; Ling, W.; Ma, H.; Wang, W. Effectiveness analysis of resources consumption, environmental impact and production efficiency in traditional manufacturing using new technologies: Case from sand casting. *Energy Convers. Manag.* **2020**, *209*, 112671. [CrossRef]
52. Trotta, G. Electricity awareness and consumer demand for information. *Int. J. Consum. Stud.* **2021**, *45*, 65–79. [CrossRef]

53. Han, H.; Lee, J.-S.; Trang, H.L.T. Kim, W. Water conservation and waste reduc-tion management for increasing guest loyalty and green hotel practices. *Int. J. Hosp. Manag.* **2018**, *75*, 58–66. [CrossRef]
54. Jin, W.; Zhang, H.; Liu, S.; Zhang, H. Technological innovation, environmental regulation, and green total factor efficiency of industrial water resources. *J. Clean. Prod.* **2019**, *211*, 61–69. [CrossRef]
55. Allwood, J.M.; Ashby, M.F.; Gutowski, T.G.; Worrell, E. Material efficiency: A white paper. *Resour. Conserv. Recycl.* **2011**, *55*, 362–381. [CrossRef]
56. Mayyas, A.T.; Omar, M. Eco-Material Selection for Lightweight Vehicle Design. In *Energy Efficiency and Sustainable Lighting—A Bet for the Future*; IntechOpen: London, UK, 2020. [CrossRef]
57. Rashid, N.R.N.A. Awareness of Eco-label in Malaysia's Green Marketing Initiative. *Int. J. Bus. Manag.* **2009**, *4*, 132. [CrossRef]
58. Wandosell, G.; Parra-Meroño, M.; Alcayde, A.; Baños, R. Green Packaging from Consumer and Business Perspectives. *Sustainability* **2021**, *13*, 1356. [CrossRef]
59. Tan, C.N.L.; Ojo, A.O.; Thurasamy, R. Determinants of green product buying decision among young consumers in Malaysia. *Young Consum.* **2019**, *20*, 127–137. [CrossRef]
60. Gungor, A.; Gupta, S.M. Issues in environmentally conscious manufacturing and product recovery: A survey. *Comput. Ind. Eng.* **1999**, *36*, 811–853. [CrossRef]
61. Bhatia, M.; Jain, A. Green Marketing: A Study of Consumer Perception and Preferences in India. *Electron. Green J.* **2013**, *1*. [CrossRef]
62. Rajadurai, J.; Zahari, A.R.; Esa, E.; Bathmanathan, V.; Ishak, N.A.M. Investigat-ing Green Marketing Orientation Practices among Green Small and Medium Enter-prises. *J. Asian Finance Econ. Bus.* **2021**, *8*, 407–417. [CrossRef]
63. Tezer, A.; Bodur, H.O. The Greenconsumption Effect: How Using Green Products Improves Consumption Experience. *J. Consum. Res.* **2020**, *47*, 25–39. [CrossRef]
64. Fuller, D.A.; Ottman, J.A. Moderating unintended pollution: The role of sustainable product design. *J. Bus. Res.* **2004**, *57*, 1231–1238. [CrossRef]
65. Khan, M.S.; Saengon, P.; Alganad, A.M.N.; Chongcharoen, D.; Farrukh, M. Consumer green behaviour: An approach towards environmental sustainability. *Sustain. Dev.* **2020**, *28*, 1168–1180. [CrossRef]
66. Li, B.; Wang, Y.; Wang, Z. Managing a closed-loop supply chain with take-back legislation and consumer preference for green design. *J. Clean. Prod.* **2021**, *282*, 124481. [CrossRef]
67. Ajukumar, V.; Gandhi, O. Evaluation of green maintenance initiatives in design and development of mechanical systems using an integrated approach. *J. Clean. Prod.* **2013**, *51*, 34–46. [CrossRef]
68. Chang, C.-H. How to Enhance Green Service and Green Product Innovation Performance? The Roles of Inward and Outward Capabilities. *Corp. Soc. Responsib. Environ. Manag.* **2017**, *25*, 411–425. [CrossRef]
69. Cai, Z.; Xie, Y.; Aguilar, F.X. Eco-label credibility and retailer effects on green product purchasing intentions. *For. Policy Econ.* **2017**, *80*, 200–208. [CrossRef]
70. Song, J.H.; Murphy, R.J.; Narayan, R.; Davies, G.B.H. Biodegradable and compostable alternatives to conventional plastics. *Philos. Trans. R. Soc. B Biol. Sci.* **2009**, *364*, 2127–2139. [CrossRef] [PubMed]
71. Nedumaran, D.G. *Green Marketing on Customer Behaviour Towards Usage of Green Products*; SSRN: Rochester, NY, USA, 2020. [CrossRef]
72. Umeda, Y.; Kondoh, S.; Shimomura, Y.; Tomiyama, T. Development of design methodology for upgradable products based on function–behavior–state modeling. *Artif. Intell. Eng. Des. Anal. Manuf.* **2005**, *19*, 161–182. [CrossRef]
73. Gallastegui, I.G. The use of eco-labels: A review of the literature. *Eur. Environ.* **2002**, *12*, 316–331. [CrossRef]
74. Bratt, C.; Hallstedt, S.; Robèrt, K.-H.; Broman, G.; Oldmark, J. Assessment of eco-labelling criteria development from a strategic sustainability perspective. *J. Clean. Prod.* **2011**, *19*, 1631–1638. [CrossRef]
75. Birch, A.; Hon, K.; Short, T. Structure and output mechanisms in Design for Environment (DfE) tools. *J. Clean. Prod.* **2012**, *35*, 50–58. [CrossRef]
76. Zhang, L.; Zhan, Y.; Liu, Z.; Zhang, H.; Li, B. Development and analysis of design for environment oriented design parameters. *J. Clean. Prod.* **2011**, *19*, 1723–1733. [CrossRef]
77. Becker, M.; Edwards, S.; Massey, R.I. Toxic Chemicals in Toys and Children's Products: Limitations of Current Responses and Recommendations for Government and Industry. *Environ. Sci. Technol.* **2010**, *44*, 7986–7991. [CrossRef]
78. Braungart, M.; McDonough, W.; Bollinger, A. Cradle-to-cradle design: Creating healthy emissions—A strategy for eco-effective product and system design. *J. Clean. Prod.* **2007**, *15*, 1337–1348. [CrossRef]
79. Aurich, J.; Fuchs, C.; Wagenknecht, C. Life cycle oriented design of technical Product-Service Systems. *J. Clean. Prod.* **2006**, *14*, 1480–1494. [CrossRef]
80. Mont, O.K. Clarifying the concept of product–service system. *J. Clean. Prod.* **2002**, *10*, 237–245. [CrossRef]
81. Armstrong, C.M.; Niinimäki, K.; Kujala, S.; Karell, E.; Lang, C. Sustainable product-service systems for clothing: Exploring consumer perceptions of consumption alternatives in Finland. *J. Clean. Prod.* **2015**, *97*, 30–39. [CrossRef]
82. Shimomura, Y.; Umeda, Y.; Tomiyama, T. A proposal of upgradable design. In Proceedings of the First International Symposium on Environmentally Conscious Design and Inverse Manufacturing, Tokyo, Japan, 1–3 February 1999. [CrossRef]

83. Umemori, Y.; Kondoh, S.; Umeda, Y.; Shimomura, Y.; Yoshioka, M. Design for upgradable products considering future uncertainty. In Proceedings of the Second International Symposium on Environmentally Conscious Design and Inverse Manufacturing, Tokyo, Japan, 11–15 December 2001. [CrossRef]
84. Huiskonen, J. Maintenance spare parts logistics: Special characteristics and strategic choices. *Int. J. Prod. Econ.* **2001**, *71*, 125–133. [CrossRef]
85. Markeset, T.; Kumar, U. Design and development of product support and maintenance concepts for industrial systems. *J. Qual. Maint. Eng.* **2003**, *9*, 376–392. [CrossRef]
86. Niggeschmidt, S.; Helu, M.; Diaz, N.; Behmann, B.; Lanza, G.; Dornfeld, D. Inte-Grating Green and Sustainability Aspects into Life Cycle Performance Evaluation May 2010. Available online: https://escholarship.org/uc/item/825308wk (accessed on 4 January 2021).
87. Hauschild, M.Z.; Jeswiet, J.; Alting, L. Design for Environment—Do We Get the Focus Right? *CIRP Ann.* **2004**, *53*, 1–4. [CrossRef]
88. Song, Y.; Qin, Z.; Yuan, Q. The Impact of Eco-Label on the Young Chinese Generation: The Mediation Role of Environmental Awareness and Product Attributes in Green Purchase. *Sustainability* **2019**, *11*, 973. [CrossRef]
89. Veleva, V.; Ellenbecker, M. Indicators of sustainable production: Framework and methodology. *J. Clean. Prod.* **2001**, *9*, 519–549. [CrossRef]
90. Klausner, M.; Grimm, W.M.; Hendrickson, C. Reuse of Electric Motors in Consumer Products. *J. Ind. Ecol.* **1998**, *2*, 89–102. [CrossRef]
91. Young, W.; Hwang, K.; McDonald, S.; Oates, C.J. Sustainable consumption: Green consumer behaviour when purchasing products. *Sustain. Dev.* **2010**, *18*, 20–31. [CrossRef]
92. Hofstede, G. Cultural constraints in management theories. *Acad. Manag. Perspect.* **1993**, *7*, 81–94. [CrossRef]
93. Hofstede, G.J.; Pedersen, P.B.; Hofstede, G.H. *Exploring Culture: Exercises, Sto-ries and Synthetic Cultures*; Nicholas Brealey Publishing: Boston, MA, USA, 2002.
94. Birukou, A.; Blanzieri, E.; Giorgini, P.; Giunchiglia, F. A Formal Definition of Culture. In *Models for Intercultural Collaboration and Negotiation*; Springer: Dordrecht, The Netherlands, 2013; pp. 1–26. ISBN 978-94-007-5574-1. [CrossRef]
95. Crilly, N.; Moultrie, J.; Clarkson, P. Seeing things: Consumer response to the visual domain in product design. *Des. Stud.* **2004**, *25*, 547–577. [CrossRef]
96. Salmi, A.; Sharafutdinova, E. Culture and design in emerging markets: The case of mobile phones in Russia. *J. Bus. Ind. Mark.* **2008**, *23*, 384–394. [CrossRef]
97. Huff, L.; Kelley, L. Is collectivism a liability? The impact of culture on organizational trust and customer orientation: A seven-nation study. *J. Bus. Res.* **2002**, *58*, 96–102. [CrossRef]
98. Frost, D.; Goode, S.; Hart, D. Individualist and collectivist factors affecting online repurchase intentions. *Internet Res.* **2010**, *20*, 6–28. [CrossRef]
99. Yu, Y.; Han, X.; Hu, G. Optimal production for manufacturers considering consumer environmental awareness and green subsidies. *Int. J. Prod. Econ.* **2016**, *182*, 397–408. [CrossRef]
100. Moon, J.; Chadee, D.; Tikoo, S. Culture, product type, and price influences on consumer purchase intention to buy personalized products online. *J. Bus. Res.* **2008**, *61*, 31–39. [CrossRef]
101. Srite, M. The Influence of National Culture on the Acceptance and Use of Infor-mation Technologies: An Empirical Study. In Proceedings of the AMCIS 1999, Milwaukee, WI, USA, 13–15 August 1999; Available online: https://aisel.aisnet.org/amcis1999/355 (accessed on 15 December 2020).
102. Hoe, L.C.; Mansori, S. The Effects of Product Quality on Customer Satisfaction and Loyalty: Evidence from Malaysian Engineering Industry. *Int. J. Ind. Mark.* **2018**, *3*, 20. [CrossRef]
103. Liao, Y.-K.; Wu, W.-Y.; Pham, T.-T. Examining the moderating effects of green marketing and green psychological benefits on customers' green attitude, value and purchase intention. *Sustainability* **2020**, *12*, 7461. [CrossRef]
104. Mainieri, T.; Barnett, E.G.; Valdero, T.R.; Unipan, J.B.; Oskamp, S. Green Buying: The Influence of Environmental Concern on Consumer Behavior. *J. Soc. Psychol.* **1997**, *137*, 189–204. [CrossRef]
105. Pickett-Baker, J.; Ozaki, R. Pro-environmental products: Marketing influence on consumer purchase decision. *J. Consum. Mark.* **2008**, *25*, 281–293. [CrossRef]
106. Hofstede, G. *Culture's Consequences: International Differences in Work-Related Values*; SAGE Publications: Thousand Oaks, CA, USA, 1980.
107. Furrer, O.; Liu, B.S.-C.; Sudharshan, D. The Relationships between Culture and Service Quality Perceptions. *J. Serv. Res.* **2000**, *2*, 355–371. [CrossRef]
108. Lihra, T.; Buehlmann, U.; Graf, R. Customer preferences for customized house-hold furniture. *J. For. Econ.* **2012**, *18*, 94–112.
109. Li, Y.-L.; Tang, J.-F.; Chin, K.-S.; Luo, X.-G.; Pu, Y.; Jiang, Y.-S. On integrating mul-tiple type preferences into competitive analyses of customer requirements in product planning. *Int. J. Prod. Econ.* **2012**, *139*, 168–179. [CrossRef]
110. Haverila, M. Mobile phone feature preferences, customer satisfaction and repur-chase intent among male users. *Australas. Mark. J. AMJ* **2011**, *19*, 238–246.