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Balancing sustainability and consumer demand: Exploring Gen Z interest in co-designing transformable garments

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Abstract: Transformable Garment Co-Design (TGCD) offers a variety of options and precise targeting, reducing unnecessary purchases and potentially providing a sustainable solution that aligns resource use with consumer demands. Nevertheless, this design strategy remains underutilized in the market and lacks thorough theoretical exploration. This research examines the aesthetic and functional aspects that impact the willingness of Generation Z, the predominant fast-fashion buyers in China, particularly university students, to interact with TGCD. A quantitative method was employed to survey randomly selected university students in Zhejiang Province, China. Data was gathered from 359 respondents through the WeChat social application and the Wenjuanxing questionnaire platform. Hotelling's t-squared test in SPSS was utilized to evaluate the significance of the proposed factors. The results indicated that aesthetic and functional characteristics and familiarity with TGCD significantly influence Chinese university students' readiness to adopt this design method. Further analysis revealed that comfort, durability, and types of expertise notably influence this willingness. This study advances sustainable design theory by empirically examining TGCD in China, providing this innovative strategy with an initial framework that can serve as a reference for academia and industry.

Keywords: *Comfort design, Durability features, Forms of experience, Transformable garment co-design.*

1. Introduction

Sustainable development is a critical issue for the textile and garment industry [1] as the fashion industry is the second most polluting sector worldwide [2, 3]. Sustainable strategies are crucial in mitigating various environmental, ethical, and social impacts of product creation, use, and disposal [4]. These strategies include circular fashion models, zero-waste design techniques, and promoting eco-friendly materials such as organic cotton and recycled polyester. However, existing sustainable garment design strategies have primarily focused on ethical considerations and sustainability [4, 5] while the transformative potential of sustainability in shaping consumer experiences has been less explored [6]. This highlights the need to balance environmental sustainability with consumer demand for fashionable, functional garments that meet market expectations. Meeting consumer needs is vital in encouraging broader public engagement sustainably. However, China, the world's largest garment manufacturer and consumer [7] is still in the early stages of adopting sustainable practices [8]. A 2024 survey found that China's participation in low-carbon consumption is as high as 87% [9] indicating that sustainable consumption is already widespread among the Chinese population. Nearly 80% of Chinese Gen Z youth correctly understand the concept of low carbon, with awareness highest in Eastern and Southern China [10]. As digital natives, Gen Z exhibits strong ethical consumption habits and increased purchasing power [11-14]. China's Gen Z (1995–2009) comprises 260 million people, making up 19% of the total population, with 320 million active online users contributing to a ¥4 trillion market [15]. University students represent a significant part of Gen Z [13]. Zhejiang Province in Eastern China, a key hub in

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China's garment industry [16] offers a promising market for sustainable fashion due to government-led environmental regulations, such as the "Green Manufacturing Initiative" and tax incentives for eco-friendly production, as well as the increasing interest of younger consumers, particularly university students, in innovative fashion trends [17] and the Gen Z's Higher awareness of sustainable living and growing economic power [11, 12, 14]. Sustainable strategies considering consumer preferences are more likely to gain traction in the Chinese market, particularly among Gen Z demographics open to emerging trends. Transformable Garment Co-Design (TGCD) presents a potential solution by offering multiple styling options and precise targeting to minimize excessive consumption. Despite its potential to enhance sustainability in the garment industry, TGCD remains underutilized in market practice and theoretical research due to several barriers, including technical complexities in garment transformation, economic concerns regarding production costs, and consumer hesitation due to unfamiliarity with co-design processes. Fashion decision-makers are hesitant to adopt this strategy, even though consumers from diverse cultural backgrounds have responded positively to transformable fashion [18]. Understanding how aesthetic and functional garment features influence young consumers' willingness to engage with TGCD is essential for advancing sustainable design adoption. This study identifies and examines the key factors that impact Gen Z's desire to participate in TGCD, emphasizing aesthetic and functional considerations guided by the Consumer Needs Model (FEA). By exploring these factors, the research aims to contribute to the development of sustainable design theory by expanding the understanding of consumer engagement in co-design practices, the role of functional adaptability in reducing fashion waste, and the integration of aesthetic versatility with sustainability principles, which are urgently needed within the garment industry. A quantitative research approach was employed to achieve this objective, with 359 university students from Zhejiang Province, China, recruited through a questionnaire survey to provide empirical insights into TGCD adoption.

2. Literature Review

Lamb and Kallal [19] proposed the Aesthetic, Functional, and Expressive (FEA) Consumer Needs Model, which provides a comprehensive conceptual foundation for creating almost any garment. As of 2017, a total of 126 peer-reviewed publications in English referenced [19, 20]. The broad applications of the FEA Model highlight its significance as a theoretical framework for design scholarship. The FEA Model enables designers to consider contemporary target markets and define the context of use. Moreover, it empowers designers to advocate sustainability [20]. However, co-design for transformable garments as an innovative strategy has yet to be practiced in the Chinese market. As a result, current research focuses on key variables of interest regarding aesthetics and functionality based on this model. Both aesthetics and functionality are essential factors in evaluating the sustainability of transformable garments [21, 22]. Many consumers today feel dissatisfied with passive consumption and adhering to designers' ideas [23, 24]. At the same time, companies are hesitant to pursue transformable garment design due to the challenges in accurately capturing individual needs [18]. Employing transformable garment co-design can integrate the advantages of these two sustainable approaches: co-design and transformable designs. TGCD can offer multiple options for wearers while effectively assessing and meeting their needs, presenting a sustainable solution that balances resource use with consumers' desires. Engaged participants can generate immaterial value, such as emotional and functional worth for objects, potentially reducing excessive consumption [25-27]. Previous literature has separately explored the sustainability benefits of transformable design [8, 22, 28] and co-design [29-31] in the garment industry. Most prior research on transformable garment design has concentrated on theoretical aspects, design methodology concepts, and the practical exploration of design cases [8, 32-34]. Empirical research on individuals' willingness to accept transformable fashion is limited [8, 21, 35]. At the same time, the co-design approach is primarily seen as an effective strategy for value co-creation in fashion brand studies [29-31] and it has also appeared in studies of e-customized systems Li and Chen [36] and Li, et al. [37]. Karell [33] introduced the concept of multifunction garments through modular structures within a co-design service system, which can be viewed as a foundational

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component of TGCD. However, a deeper exploration of TGCD concerning individuals' willingness has been overlooked. Peter [18] noted a positive attitude across different cultures, yet limited research has directly investigated individuals' interest in transformable fashion. This may contribute to the lack of market practices for TGCD. Regarding product design, aesthetics is especially significant since it encourages us to try new items, shapes our acceptance of unknown ones, inspires exploration and play, and guides the use [38, 39]. The aesthetic is an essential criterion for garment assessment and purchase [38] and requirements for garments using elements like line, form, color, and pattern to create visually pleasing designs [19, 40] In addition, novelty is important for determining product design preference and product sales [41]. Moreover, people are swayed by fashion trends established by celebrities and print publications and are willing to purchase impulsively if the visual presentations appeal [35]. Furthermore, Koo and Ma [42] identify changeable design as a unique aesthetic feature of transformable garments. Considering that aesthetics has a significant impact on people's attraction to transformable clothes, the following hypotheses were proposed:

H_1: The Visual pleasure of aesthetic features can directly affect Gen Z's willingness towards TGCD.

H_2: The novelty of aesthetic features can directly affect Gen Z's willingness toward TGCD.

H_3: The changeable design of aesthetic features can directly affect Gen Z's willingness toward TGCD.

H_4: Aesthetic features can directly affect Gen Z's willingness towards TGCD.

In modern society, our garments are significant in expressing our lifestyle and cultural affiliations, with functionality taking the lead [43]. Previous studies have shown that most young female consumers are attracted to functional, sustainable products [35, 44]. The functional requirements of garments include comfort, durability, and ease of use, among others [19, 45]. Among these, comfort is a crucial attribute of garment performance [46] encompassing fit, thermal, and tactile comfort [46, 47]. Furthermore, the durability of garments comprises physical, psychological, and instrumental durability [48, 49]. Additionally, the ease of using the functional features of transformable garments has been highlighted in various ways, such as the ease of matching, layering, and transformation [32]. The ability to transform allows items' aesthetic and functional aspects to adapt to multiple styles and purposes, catering to people's desires for novelty and versatility [8, 32]. This functional characteristic is expected to increase usage intensity, extend the lifespan of garment products, and reduce disposal [50]. Hence, the following hypotheses were proposed:

H_5: The Comfort of functional features can directly affect Gen Z's willingness towards TGCD.

H_6: The durability of functional features can directly affect Gen Z's willingness toward TGCD.

H_7: The ease of use of functional features can directly affect Gen Z's willingness towards TGCD.

H_8: Functional features can directly affect Gen Z's willingness towards TGCD.

Co-design is an approach that could potentially fulfill the need for consumption [6]. Designers create a new shopping experience instead of offering a finished product, fostering a sense of accomplishment and satisfaction that differs from the gratification of a quick purchase [6]. This approach reduces the pressure on object consumption and shifts the experience towards empowerment [25]. The importance of designing a shopping experience has grown [50]. Experience innovation can enhance people's immaterial satisfaction and strengthen customer relationships [30, 51]. Additionally, positive emotional experiences and psychological needs during consumption become valuable elements that may favorably influence participants' willingness [52, 53]. Furthermore, Baker, et al. [54] found that teenagers expressed excitement about the online garment co-design experience and technology. The COVID-19 pandemic has also increased internet usage, leading to a transition from in-person to online formats [55]. The hyper-personalized shopping experience, a novel form of experience enabled by digital technology, significantly affects individuals' willingness [56]. Hence, according to the literature, a research framework is proposed, as shown in Figure 1. Therefore, the following hypotheses were proposed:

H_9: Innovation of experience during TGCD can directly affect Gen Z's willingness.

H_{10}: The emotionality of experience during TGCD can directly affect Gen Z's willingness.

H_{11}: Forms of experiences during TGCD can directly affect Gen Z's willingness.

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H_{12}: Experience during TGCD can directly affect Gen Z's willingness.

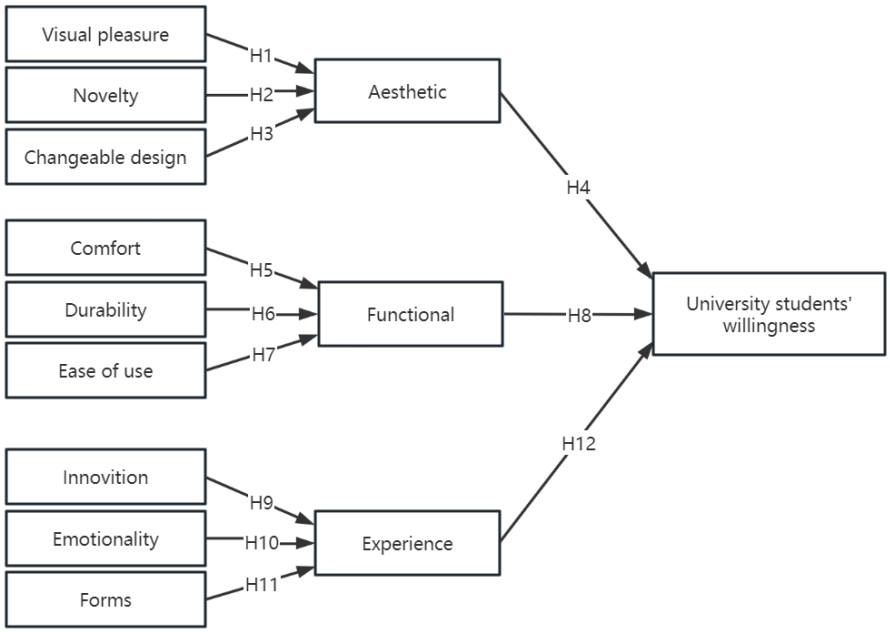

Figure 1.
Proposed Research Framework.

3. Methods

Surveys are commonly used to assess public opinion and gather data on behavioral tendencies [57]. This study employed a quantitative research approach through a structured questionnaire survey. A random sampling method was used to recruit participants, ensuring a diverse representation of university students from Zhejiang Province, China. The survey was conducted in May 2024, with 359 university students participating as representative Gen Z in China. The online survey platform Wenjuanxing, a widely used web-based survey company, was utilized for data collection. In contrast, WeChat, China's most popular social media platform, was the primary distribution channel. A total of 256 valid responses were obtained from the 359 distributed surveys, yielding a response rate of 71.3%. While this response rate is generally acceptable for survey research, potential limitations include selection bias and non-response bias, which may affect the generalizability of the findings. The study's reliance on self-reported data also introduces the possibility of response bias, as participants may have answered in a socially desirable manner rather than reflecting their actual behaviors or preferences. Measurement scales were derived from previous research to assess significant factors influencing aesthetic and functional features in Transformable Garment Co-Design (TGCD) [19, 32, 41, 51, 53, 56]. A 1-5 Likert scale was employed to measure willingness to engage in TGCD.

- Aesthetic Features: Evaluated through three dimensions, visual pleasure, novelty, and changeable design, using nine items adapted from Lamb and Kallal [19]; Ceballos, et al. [41] and Koo, et al. [32] while considering transformable aesthetic characteristics.
- Functional Features: These are assessed through comfort, durability, and ease of use. Nine items were adapted from Lamb and Kallal [19]; Fletcher [48] and Koo, et al. [32] incorporating transformable functional characteristics.
- Experience in TGCD: Measured through three dimensions, innovation of experience, emotionality of expertise, and forms of experience using seven items adapted from Choi, et al. [51]; Jain, et al. [56] and Huang, et al. [53].

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To ensure the validity and reliability of the questionnaire, a pilot test was conducted with five respondents, leading to minor modifications in wording for clarity and adjustments in scale phrasing to enhance comprehension and consistency. To refine question-wording, structure, and scale effectiveness. The questionnaire was prepared in both English and Chinese, with the Chinese version used for data collection after being validated through a back-translation process to ensure consistency and accuracy between language versions. To enhance clarity and comprehension among participants. Data collection was completed in May 2024, as specified.

4. Results

Descriptive analysis, factor analysis, reliability, and Hotelling's T-squared test were conducted for data analysis. Among those surveyed, 19.5% were male, and 80.5% were female. The students surveyed came from universities in more than four cities. University students in Shaoxing City accounted for the most significant percentage of valid responses (42.2%), followed by those in Jinhua City (35.9%). The percentages for Hangzhou City (14.8%) and Ningbo City (1.6%) followed. Additionally, 5.5% were from unidentified cities due to leaving their university's name blank. Of the respondents, 91.8% were aware of transformable clothing with partial changes. Furthermore, 79.3% were familiar with transformable clothing with overall changes, and 77.3% understood transformable clothing co-design. In addition, none of the respondents had prior experience in co-designing products. Hatcher and O'Rourke [58] recommend a minimum of 100 subjects and a 1:5 item-to-subject ratio [58]. This sample size of 256 valid responses to 25 items is suitable for factor analysis, as shown in Table 1. Bartlett's test showed that the KMO value was 0.927, and Bartlett's test of sphericity was significant ($p < 0.001$), indicating that the sample data were suitable for factor analysis.

Table 1.
KMO and Bartlett's Test.

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		0.927
Bartlett's Test of Sphericity	Approx. Chi-Square	2980.739
	d.f	190
	Significance	<.001***

Note: ***p<0.001.

Exploratory factor analysis was used to verify that aesthetic features, functional features, and experience are three distinct variables. Through stepwise dimensionality reduction, the common factors that capture the essential information of the original variables were identified. The common factors in principal component analysis are extracted using the correlation matrix analysis. In addition, question items testing "changeable design" that could not be appropriately classified under the proposed factors were eliminated to improve the interpretability and reliability of the exploratory factor analysis. Finally, the total variance explained identified three standard components with an eigenvalue larger than 1. The result of the rotated structure matrix showed that three common factors could be supported and that each factor loading was more than 0.5, which was considered a "strong" factor loading [59]. In this phase, one item with low factor loadings was deleted. Therefore, 20 scale items of this questionnaire held enough factor loading. The results indicated that aesthetic, functional, and experiential were separate variables. Cronbach's Alpha was employed to assess the reliability of internal consistency. Cronbach's alpha coefficients for all three variables varied from 0.876 to 0.907, indicating strong multi-measurement scale reliabilities, as shown in Table 2.

Exploratory factor analysis was used to confirm that aesthetic features, functional features, and experience are three distinct variables. The common factors capturing essential information from the original variables were identified through stepwise dimensionality reduction. Common factors in principal component analysis are extracted using the correlation matrix. Additionally, question items assessing "transformable design" that could not be accurately classified under the proposed factors were removed to improve the interpretability and reliability of the exploratory factor analysis. Three

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standard components with an eigenvalue more significant than one were identified based on the variance explained. The results from the rotated structure matrix supported identifying three common factors, with each factor loading exceeding 0.5, which is considered a "strong" factor loading [59]. During this phase, one item with low factor loadings was eliminated, resulting in 20 scale items that exhibited adequate factor loadings. The findings indicated that aesthetic features, functional features, and experience were separate variables. Cronbach's Alpha was used to evaluate the reliability of internal consistency. The Cronbach's alpha coefficients for all three variables ranged from 0.876 to 0.907, indicating robust multi-measurement scale reliabilities, as shown in Table 2.

Table 2.
Reliability and Validity Statistics.

	Cronbach's Alpha	**Factor Loading**
Aesthetic features	0.907	
Good colors and patterns would arouse my interest in the co-design of transformable clothing.		0.749
A good shape and silhouette would arouse my interest in the co-design of transformable clothing.		0.771
Good proportions and lines would arouse my interest in the co-design of transformable clothing.		0.809
Novelty ornamental design would arouse my interest in the co-design of transformable clothing.		0.723
Matching novelty (Color and pattern/fabrics matching) would arouse my interest in the co-design of transformable clothing.		0.777
Functional features	0.878	
Fit comfort would arouse my interest in the co-design of transformable clothing.		0.668
Thermal comfort would arouse my interest in the co-design of transformable clothing.		0.698
Touch comfort would arouse my interest in the co-design of transformable clothing.		0.709
Physical durability would arouse my interest in the co-design of transformable clothing.		0.690
Psychologically, durability would arouse my interest in the co-design of transformable clothing.		0.559
Instrumentally, durability would arouse my interest in the co-design of transformable clothing.		0.719
Ease of matching and layering would arouse my interest in the co-design of transformable clothing.		0.572
Maintaining comfort in matching and layering would arouse my interest in the co-design of transformable clothing.		0.686
Experience in TGCD	0.876	
Innovative design experience in co-designing transformable clothing may affect my decision to have it.		0.663
Innovative product experience in co-design transformable clothing may affect my decision to have it.		0.722
Psychological experience in co-designing transformable clothing may affect my decision to have it.		0.714
Emotional attachment to co-design transformable clothing may affect my decision to have it.		0.764
Physical experiences offline in co-design transformable clothing may affect my decision to have it.		0.618
Physical experiences online in co-design transformable clothing may affect my decision to have it.		0.676
Virtual or simulated experiences in co-design transformable clothing may affect my decision to have it.		0.667

Utilizing IBM SPSS Statistics 27 to test the hypothesis, a set of analyses using Hotelling's t-squared test was conducted. In the first step, Hotelling's T-squared test was utilized to test the visual pleasure and the novelty of aesthetic features in TGCD, which affect Gen Z's willingness; the result of visual pleasure according to Hotelling's T-squared test is shown in Table 3. The p-value of this item is 0.139 ($p > 0.05$). The visual pleasure of aesthetic features affecting Gen Z's willingness towards TGCD is not statistically significant, as a p-value of less than 0.05 is often regarded as statistically significant. Therefore, hypothesis 1 is not supported. The novelty results from Hotelling's t-squared test showed a p-value of 0.464 ($p>0.05$). Therefore, hypothesis 2 is not supported. Changeable design cannot conform to the typical aesthetic factor, hence, hypothesis 3 is not supported. According to Hotelling's t-squared test results, the p-value of aesthetic features is 0.016 ($p<0.05$), indicating aesthetic features ($t=3.092$, $p=0.016$) are a significant variable affecting Gen Z's willingness towards TGCD. Hypothesis 4 is

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supported. Therefore, aesthetic features are an essential variable, while the critical factors in aesthetic features affecting Gen Z's desire towards CTDG have not been verified in this step.

Table 3.
Hotelling's T-squared Test on Aesthetic Features.

	Hotelling's T-Squared	F	df1	df2	Sig	Cronbach's Alpha
Visual pleasure	3.997	1.991	2	254	0.139	0.863
Novelty	0.537	0.537	1	255	0.464	0.795
Aesthetic features	12.517	3.092	4	252	0.016*	0.907

Note: p<0.05*.

In the second step, Hotelling's t-squared test was utilized to test comfort, durability, and ease of use of functional features in TGCD, which impact Gen Z's willingness, as shown in Table 4. The result of comfort according to Hotelling's t-squared test is shown in Table 4. The p-value of this item is 0.017 (p<0.05). A p-value of less than 0.05 is often regarded as statistically significant. So, the comfort of functional features (t=4.163, p=0.017) affecting Gen Z's willingness toward TGCD is statistically significant. Therefore, hypothesis 5 is supported. The durability of functional features (t=4.553, p=0.011) affecting Gen Z's desire towards TGCD is also significant, as shown in Table 4, therefore, hypothesis 6 is supported. The result of ease of use according to Hotelling's t-squared test is shown in Table 4. The p-value of this item is 0.459 (p>0.05), as a p-value of more than 0.05 is often regarded as not statistically significant. So, the ease of use of functional features affecting Gen Z's willingness towards TGCD is not statistically significant. Therefore, hypothesis 7 is not supported. The result of functional features according to Hotelling's t-squared test is shown in Table 4. The p-value of functional features is less than 0.001 (p<0.001). A p-value less than 0.001 is typically considered to be highly statistically significant. It indicated that function features (t=3.996, p<0.001) significantly affect Gen Z's willingness towards TGCD. Therefore, hypothesis 8 is supported.

Table 4.
Hotelling's T-squared Test on Aesthetic Features.

	Hotelling's T-Squared	F	df1	df2	Sig	Cronbach's Alpha
Comfort	8.358	4.163	2	254	0.017*	0.826
Durability	9.142	4.553	2	254	0.011*	0.770
Ease of use	0.537	0.551	1	255	0.459	0.763
Functional features	28.647	3.996	7	249	<0.001***	0.878

Note: p<0.05*, p<0.001***.

In the last step, Hotelling's t-squared test was utilized to test innovation of experience, emotionality of expertise, and forms of experiences during TGCD, which affect Gen Z's willingness, as shown in Table 5. The results of the innovation of expertise, according to Hotelling's T-squared test, are presented in Table 5. The p-value for this item is 0.400 (p > 0.05). The innovation of experience does not significantly affect Gen Z's willingness during TGCD; therefore, hypothesis 9 is not supported. The results of the emotionality of expertise, also derived from Hotelling's T-squared test, are shown in Table 5. The p-value for this item is 0.381 (p > 0.05), indicating that the emotionality of experience does not significantly impact Gen Z's willingness during TGCD. Thus, hypothesis 10 is not supported. The results regarding forms of expertise, according to Hotelling's T-squared test, are displayed in Table 5. The p-value for this item is less than 0.001 (p < 0.001), suggesting that a p-value below 0.001 is typically viewed as highly statistically significant. The forms of experience (t = 20.999, p < 0.001) significantly influence Gen Z's willingness toward TGCD; therefore, hypothesis 11 is supported. The results concerning experience in TGCD, as per Hotelling's T-squared test, are illustrated in Table 5. The p-value for experience in TGCD is less than 0.001 (p < 0.001), indicating that experience in TGCD (t = 7.540, p < 0.001) significantly affects Gen Z's willingness toward TGCD, leading to the support of hypothesis 12.

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Table 5.
Hotelling's T-squared Test on Aesthetic Features.

	Hotelling's T-Squared	F	df1	df2	Sig	Cronbach's Alpha
Innovation	0.710	0.710	1	255	0.400	0.838
Emotionality	0.769	0.769	1	255	0.381	0.779
Forms	42.164	20.999	2	254	<0.001***	0.749
Experience in TGCD	41.146	7.540	6	252	<0.001***	0.881

Note: p<0.001***.

Overall, aesthetic features, functional features, and experience in TGCD are all significant variables that affect Gen Z's willingness toward TGCD. Among these, experience is the most substantial variable (t=7.540, p<0.001), followed by functional features (t=3.996, p<0.001). Aesthetic features are considered significant variables (t=3.092, p<0.05). Furthermore, forms of experiences during TGCD are highly substantial in affecting Gen Z's willingness toward TGCD (t=20.999, p<0.001). Additionally, the durability of functional features significantly impacts Gen Z's willingness toward TGCD (t=4.55, p=0.011), with the comfort of functional features following closely (t=4.16, p=0.017). The results are illustrated as a framework in Figure 2.

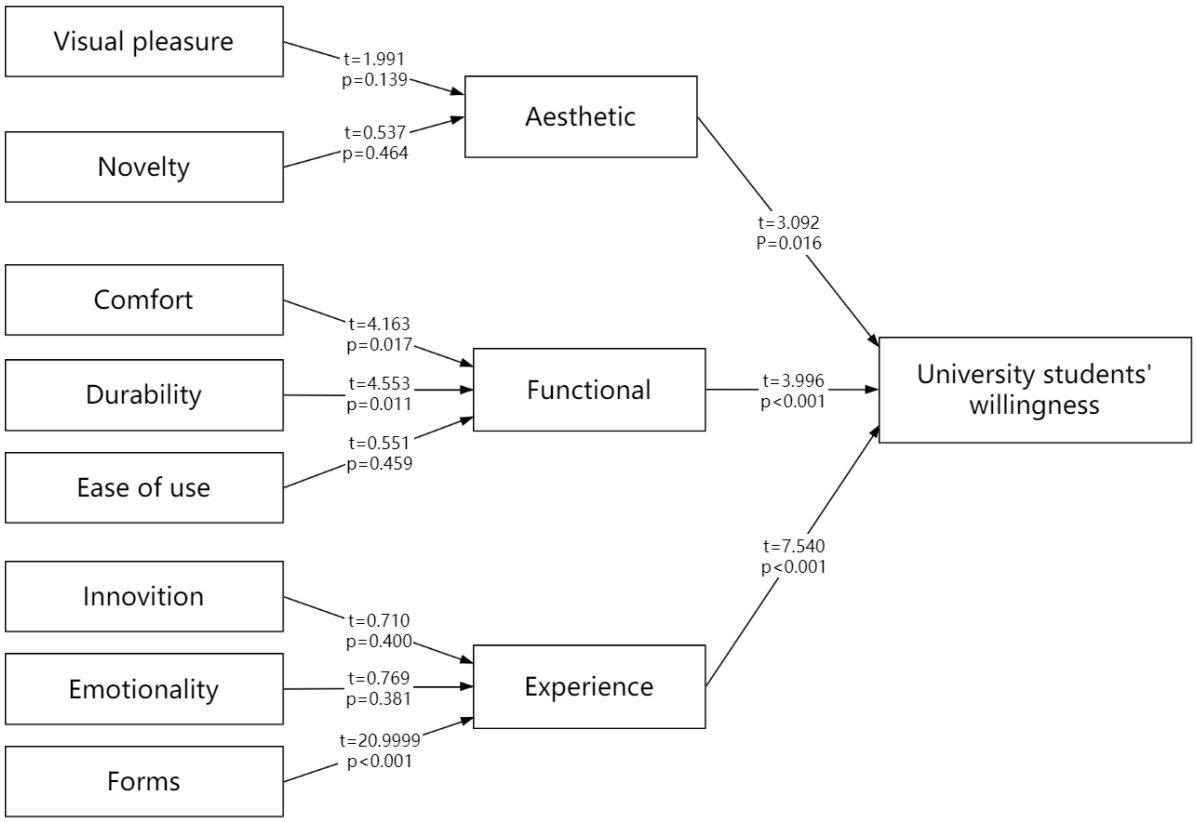

Figure 2.
Final Framework.

5. Discussion

Since Karell [33] proposed the concept of infancy stages in TGCD to integrate sustainable benefits, there has been a lack of thorough academic exploration and commercial practice regarding TGCD. This study aimed to investigate the key aesthetic and functional factors influencing the willingness of Chinese university students as representative Gen Z toward TGCD. This exploration opens more

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opportunities for developing a sustainable garment industry that is urgently in need of advancement. The results reveal that experience in TGCD is the most significant variable impacting Gen Z's willingness toward TGCD. Previous studies have also emphasized the importance of experience [30, 51, 52]. Moreover, the results confirm that the forms of expertise are highly significant, with a strong correlation ($t=20.999$, $p<0.001$), which is a compelling finding. Similarly, Baker, et al. [54] focused on teenagers' interest in online fashion co-design experiences. Additionally, online co-design experiences have become increasingly prevalent since the COVID-19 pandemic [55]. The innovative shopping experiences enabled by digital technology have greatly influenced consumers and the market [56]. This may lead to significant changes in the sustainable garment industry. The results also indicate that functional features are an essential variable influencing Gen Z's willingness toward TGCD. Previous studies support the importance of functional features in meeting people's needs [19, 44, 45]. Additionally, the results showed that the durability and comfort of functional features significantly affect Gen Z's willingness toward TGCD. Likewise, Motlogelwa [46] emphasized the critical roles of durability and comfort in garment function. Moreover, these findings align with previous studies highlighting the importance of these two factors separately [47-49]. The results also indicate that aesthetic features significantly influence Gen Z's willingness toward TGCD. This finding is consistent with earlier literature [19, 38, 40]. However, this study could not verify significant factors concerning aesthetic features. The expected results can be attributed to several factors. The experiences of empowered participants during the co-design process may generate intangible satisfaction, including emotional and functional fulfillment. Participants' desire for novelty has shifted from diverse aesthetic appearances to a deeper focus on functional experiences and emotional fulfillment. This could lead to a diminished emphasis on aesthetics and a reduced motivation to acquire additional products [25-27, 33]. In other words, this finding empirically confirms that co-design can provide an alternative means to mitigate resource waste resulting from overconsumption.

Beyond theoretical implications, this study highlights the importance of educating students about TGCD to enhance their engagement with sustainable garment design. Universities and fashion institutions should incorporate TGCD-focused coursework and hands-on workshops to familiarize students with sustainable design practices. Introducing digital co-design platforms and interactive virtual design tools can further cultivate student creativity and encourage active participation in co-design processes. Moreover, industry-academic collaborations can provide real-world co-design projects where students gain experience working with sustainable fashion brands, reinforcing the significance of functional and aesthetic considerations in TGCD. This study further broadens the theory of sustainable garment design through empirical research. It employs a co-design approach to transformable garment design to tackle the challenges garment manufacturers encounter in understanding clients' preferences for transformable garments while highlighting the benefits of merging two sustainable design methods. This implies that integrating sustainable design methods is advisable, and the investigation into TGCD marks a significant start. This study on TGCD brings practical sustainability advantages and holds considerable implications for the garment industry's sustainable transformation in China. Identifying and thoroughly examining key design elements in TGCD offers a foundational theoretical reference for companies and leaders interested in the sustainable garment industry in China, particularly those lacking market references. Further research may investigate the significant factors influencing aesthetics in TGCD. Additionally, future research could analyze the critical factors affecting TGCD across a broader spectrum, enhancing and refining this design framework. Moreover, the study sample was restricted to Zhejiang Province, China, students, and the garment categories were unclear. Future research should dive deeper and expand discussions to encompass various groups, regions, countries, or garment types. Future studies should also concentrate on more specific topics. Furthermore, effectively integrating individual sustainable design methods presents another avenue for future research. Finally, due to research limitations, a survey questionnaire was utilized in this study. Future research could explore approaches to optimize research methods.

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6. Conclusion

The research identified essential variables to address the gap in empirical research on TGCD in academia and industry. It explored the significant factors directly impacting Gen Z's willingness to engage with TGCD, focusing on Zhejiang Province, China. The results confirmed that aesthetic and functional features and overall experience are key factors influencing Gen Z's willingness to adopt TGCD, with functional features and experience particularly noteworthy. Furthermore, the study revealed that comfort and durability in function and types of experience significantly influence Gen Z's willingness to embrace TGCD, with types of experience being essential. This empirical study establishes an initial structural framework for the TGCD strategy, filling the research gap and extending the theory of sustainable garment design. Additionally, it provides manufacturers and designers in the garment industry with a theoretical foundation for design management related to TGCD.

Transparency:

The authors confirm that the manuscript is an honest, accurate, and transparent account of the study; that no vital features of the study have been omitted; and that any discrepancies from the study as planned have been explained. This study followed all ethical practices during writing.

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