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Sustainable Textile Waste Management Practices among Consumes: Implications of Textile Knowledge and Environmental Concerns

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Abstract: **Textile products are an indispensable part of our life. Our ever-growing demand for clothing and other textiles has resulted in an exorbitant increase in production, leading to the overuse of natural resources, pollutant emissions, and environmental degradation. This alarming situation can be controlled by adopting sustainable waste management practices such as reuse and recycling. A circular economy in the textile industry promotes the repair, regeneration, and reuse of used products. However, the attitude toward sustainable waste management can be influenced by many factors. The study investigates whether the consumers' sustainable waste management practice is influenced by knowledge of textiles, environmental concerns, and product preferences. A survey questionnaire was used to collect the data randomly from 328 consumers in different cities in India. The consumers were reached online and requested to volunteer to complete the questionnaire. The questionnaire results are analysed using structural equation modelling (SEM) to examine the simultaneous associations between the variables used in this study. The study results indicate that consumers' environmental concerns significantly influence their sustainable waste management practice when mediated by product preferences. The study's findings could benefit policymakers in improving consumers' knowledge of textiles, environmental concerns, and waste management**.

Keywords**: Knowledge of Textiles, knowledge of environmental concern, Product Preferences, Sustainable waste management practice, structural equation modelling (SEM), confirmatory factor analysis**

I. INTRODUCTION

Textile and clothing consumption has increased tremendously with the exponential growth of population and lifestyle changes. Fast fashion, conspicuous consumption, and lack of sustainable disposal practices have increased the demand for newer production that impacts the environment. The textile industry is one of the polluting industries in the world. Around 20% of global water pollution is from textile processing effluents. In addition to the huge amount of water being utilized for the processing, harmful chemicals from the detergents, whitening agents, colouring agents, softeners, solvents, and enzymes are let out, polluting the groundwater and the streams. Tirupur and Erode are prominent textile exporter to Europe and U.S. The industry's impact has permanently damaged downstream agricultural activity (Scott, 2015).Babu, Prakash, and Abinaya(2017)report extensive pollution due to textile production activities in Tirupur, and water quality is unfit for human consumption and irrigation. Traces of heavy metal impact the nervous system of people living around the place. The unpleasant odour emanating from the polluted water has made the living condition along the river stream terrible. The impact is such that nature is irreparable now.

Environmental awareness has also been exhibited by various possible means to the consumer for the benefit of future generations and has become a significant concern nowadays. Hence, the demand for eco-friendly products has exploded recently (Karimah et al., 2021). Thus, increasing sustainable product production by textile and apparel manufacturers. Eco-friendly fibres, natural dyes, and non-toxic chemicals have been used for manufacturing sustainable products. It has also been stated that the knowledge of manufacturing activity impacts environmental concerns (Phan et al., 2018). However, fast fashion and conspicuous consumption have decreased the turnaround time for the disposal of used garments.

On average, people throw their garments after wearing them around seven to ten times. In affluent countries, people dispose of their garments after one or two wears. Most of the disposed garments end up in landfills, and the rest are burned (Nikolina, 2019). Since using natural fibres in garment and textile manufacturing has been replaced with synthetic fibres such as acrylic, polyamide, polyester, and polypropylene, both disposal methods cause severe pollution (Dottle & Gu, 2022). Reuse of used garments is not preferred due to hygienic reasons. However, repurposing and recycling the materials is an option available. In addition, the campaign toward slower fashion has recently gained momentum (Castro-López et al., 2021). In the above context, this study aims to determine the effect of consumer knowledge of textiles and the environment on product preferences and the attitude toward sustainable waste management.

Sustainable waste management practices of consumers are the attitude and behaviour towards consuming textile material as garments or home furnishings and disposal of the textile materials. Sustainable practices will include a reduction in the consumption of textile products unnecessarily, supporting the reuse and recycling of textile products, and avoiding throwing away that may pollute the land and water and end up in landfills (Degenstein et al., 2021).

II. LITERATURE REVIEW

Sustainable consumption for individuals becomes a unique challenge and an opportunity in the present scenario. Individual consumption is shifting towards socially and ecologically sustainable consumption, which is influenced by consumer education on environmental, social, and economic preservation. Due to ecological requirements, the concept of recycling and reuse has increased in the textile and garment sector. Moreover, consumers have started to dispose of used textile products by donating to family members, friends, and charities or by reusing or recycling (Aydin, 2017; Bianchi & Birtwistle, 2010; Morgan & Birtwistle, 2009). In recycling, new products are produced from used products by retrieving the basic raw materials. As a result, the utilization of natural resources, energy consumption, and waste disposal are reduced (Awaja & Pavel, 2005).

Moreover, new products have emerged in the textile and apparel categories with retrofitting production chains. Raw-material for recycling is retrieved from pre-consumer and post-consumer waste products (Inoue & Yamamoto, 2004). PET bottles are converted into various products such as T-shirts, long underwear, sweaters, winter coats, athletic shoes, luggage bags, upholstery materials, fibrefill, sleeping bags, sound absorption applications, needle-punched products, and several automobile parts (Kalebek, 2016; Kopitar et al., 2014; Na et al., 2012; Uyanık, 2019). Eco-friendly consumption has positively impacted consumers' fashion consciousness (Gam, 2011).

The knowledge of textile product characteristics, care instructions, individuals' attitudes, apparel knowledge, and size strongly influences consumer purchase behaviour(Lang & Wei, 2019). Care labels provide product knowledge considerably to the consumer on various aspects like maintenance specification, social impacts, environmental impacts, economic impacts, etc., which result in their purchase decision (Sanad, 2016). Few care symbols, namely fibre composition, hand washing, drying, and ironing, are commonly used. In addition, the information related to social and environmental concerns associated with processes and products is represented by the Eco-label (Laitala & Klepp, 2013). In textile recycling, raw materials are derived from old clothing and used products. However, the quality of recycled yarn quality has a significant impact on product performance. So, it is essential to know used clothing materials for recycling. Moreover, the fabric parameters such as weight, cleaning methods, and shrinking behaviour in washing and ironing are required when combining various fabrics during the reuse process. Because, various fibres such as are cotton, wool, linen, silk, polyester, acrylic, acetate, and nylon are used in the textile and clothing industry.

Environmental concern values are influenced by each person's beliefs and knowledge (Lee et al., 2014; D. Scott & Willits, 1994). In addition, the parameters mentioned above are used for predicting environmental consumption behaviour(Lee et al., 2014). According to the market research analysis, the synthetic fibre category has been consumed more than the natural fibre category (Park & Kim, 2014). Moreover, polyester fibre consumption is around 75% of synthetic fibre consumption. Thus, it has resulted an environmental issue due to non-biodegradable waste accumulation (Gurudatt et al., 2003; Welle, 2011). Hence, using organic materials and eco-friendly processes like recycling is essential for addressing environmental concerns.

Moreover, these fibres are produced from petroleum-based products, which require more energy consumption and becoming a major concern for ecology balance. Generally, the chemical recycling process is preferred for synthetic fibres as it is influenced by de-polymerization. PET fibres can be converted into more useful products other than polymers (Welle, 2011). Moreover, the polyester or lycra-based disposed clothing will affect landfill space and soil pollution and require a longer period for degradation. In addition to the post-consumer waste, significant amounts of waste have been generated during the manufacturing activities like fibre scraps, yarn waste in the spinning process, fabric waste in grey fabric production in weaving, finished fabric production processes, and garmenting process. Post-industrial waste is less diverse than post-consumer waste, which is later easily converted into similar or different products. Consumers' increased environmental knowledge is witnessed by supporting environmentally friendly brands and their products (Kit et al., 2018). The earlier study revealed that consumers are willing to pay higher to purchase environmentally friendly products. Consumers' perception of products is characterized by several quality considerations, price, and risk associated with the environment (Beneke & Carter, 2015). The brand environment's friendliness influences consumers' purchasing behaviour on any specific brand.

III. METHODOLOGY

This study follows a descriptive approach with a quantitative technique. The relationships between the concepts are hypothesized as in Figure 1 and are validated using the data collected from the consumers. Data were collected through an online questionnaire measuring the knowledge of textiles, environmental concerns, product preferences, and sustainable waste management practices of the consumers in India. The questionnaire was developed through a literature review and validated through expert consultation. The questionnaire consisted of 24 items and a few demographic information. All statements in the questionnaire employ a 5-point Likert scale (1 = Strongly disagree, 2 = Disagree, 3= Neutral, 4 = Agree, 5= Strongly agree). Random sampling was employed on the database of email ids collected from various sources. After sending the link to almost 1000 email ids, 328 responses were collected. However, only 279 responses were found to be complete and useful. Secondary information was collected through questionnaires, websites, and various journals. Structural equation modelling (SEM) was used to simultaneously perform confirmatory factor and regression analysis to assess the relationship among latent constructs and their measured variables. Before the SEM analysis, the factor structure was identified using principal component factor analysis. The reliability and validity tests are also conducted before the SEM. SPSS version 18 was used to analyse the collected data, and the model was developed using AMOS version 22.

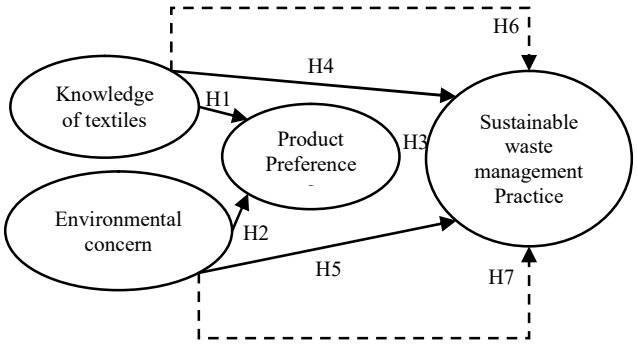


Figure 1 Conceptual Model

IV. DATA ANALYSIS AND RESULTS

The consumer demographic information was collected and analysed. The results are presented in Table 1. Most of the respondents (31.54%) are in the age group of 31 to 40 years, and the least (17.92%) of respondents are above 50 years of age group. The other age groups below 30 and 41 to 50 years make up 23.3% and 27.24%, respectively. It is also revealed that most respondents are male (65.95%), and the rest (34.05%) are female. Based on marital status, 72.04% of respondents are married, and 27.96% are unmarried. On educational qualification, it is found that 41.94% of the respondents are postgraduates, and a small number of respondents (5.38%) are of higher secondary level. Also, 30.11% of customers have undergraduate education, and 22.58% have professional education.

The 24 items of the questionnaire are analyzed for their underlying dimensions using principal component analysis and varimax rotation. The results are presented in Table 2. KMO value of 0.833 and the significance of Bartlett's test (Chi-Square=2761.620(276), P=<0.000) indicated sample adequacy and a correlated matrix structure for a possible emergence of components. Four components emerged, and the results are presented in Table 2. The factors are identified knowledge of textiles (16.853% variance), environmental concerns (14.889% variance), product preference (14.228% variance), and sustainable waste management practices (12.124% variance). Together the four dimensions measured a variance of 58.094%.

TABLE 1
Demographic Analysis

Demographic Variable	Classification	No. of respondents	Percentage
Age	Below 30	65	23.3%
	31-40	88	31.54 %
	41-50	76	27.24 %
	Above 50	50	17.92%
Gender	Male	184	65.95%
	Female	95	34.05 %
Marital Status	Married	201	72.04 %
	Unmarried	78	27.96%
Education	Higher Secondary	15	5.38 %
	Undergraduate	84	30.11 %
	Postgraduate	117	41.94 %
	Professional	63	22.58%

Table 3 presents Cronbach's alpha reliability, construct mean and standard deviation of the dimensions. The Cronbach's alpha values are 0.797, 0.763, 0.787, and 0.709 for knowledge of textiles, environmental concern, purchase preference, and Sustainable waste management practice, respectively, indicating a high internal consistency level.

Table 4 shows each construct's composite reliability (CR), average variance extracted (AVE), and correlation estimates. The values presented in the diagonals are the square root values of AVE. These values are higher than the respective row and column correlation values. CR for all the constructs is above the threshold level of 0.7. The AVE values are above 0.5 and lower than the CR. The results confirm the convergent and discriminant validity of the constructs (Hair et al., 2010).

The structural equation model is useful for assessing the causal relationship between variables and verifying the model's goodness. The items with lower factor loadings are dropped for the SEM analysis. Only 17 out of 24 items under the four constructs qualified for the final test. As the zero-order correlation between KTEX and SWMP (-0.091) is negative and negligible, the H4 and H6 are ignored in the path analysis (Figure 2). The results of the path analysis are

presented in Table 5. The goodness of fit indices is presented in Table 6.

TABLE 2
Factor Loading

Latent Variables	Observed Variables	Loading
Knowledge of Textiles (KTEX)	Cotton materials have good moisture absorbency#	0.424
	Linen materials tend to wrinkle formation	0.783
Eigen = 3.371	Silk fabrics can be washed in the home	0.697
% of var = 16.853	Sweaters are made other than wool material#	0.478
	Art silk fabrics can be washed in the home	0.675
	Moth degrades wool fabrics	0.681
Environmental concern (ENVC)	The disposal of synthetic fiber, such as polyester, can cause environmental pollution#	0.219
	Environmental pollution can occur because of the disposal of used apparel products#	0.438
Eigen = 2.978	The textile process involves chemicals and water, which are harmful to the environment	0.690
% of var = 14.889	Using organic materials and natural fiber reduces environmental pollution.	0.702
	I know very well that the term organic product means	0.742
	I know very well that the term eco-friendly product means	0.717
Product Preferences (PP)	I give importance to quality	0.662
Eigen = 2.846	I give importance to durability	0.765
% of var = 14.228	I give importance to comfortability	0.758
	I give importance to the price	0.792
	I am interested in paying a higher amount for quality / eco-friendly products	0.608
	Always consider the environmental consequences while purchasing products #	0.480
Sustainable waste management Practice (SWMP)	I give used textiles to my family members/friends#	0.428
	Always consider the possibility of recycling or reusing at the time of disposal instead of throwing it out quickly.	0.867
Eigen = 2.425	I exchange textile materials with friends and family members	0.733
% of var = 12.124	I often reuse the garments for other purposes to get the most out of them.	0.599
	I am interested in exploring new areas to reuse the products at the time of disposal	0.453
	I am willing to recycle textile waste to protect the environment	0.697
Total Var = 58.094%	KMO =0.833, Bartlett's Chi-Square=2761.620(276), P=<0.000	

Items with less than 0.5 loading are excluded from SEM analysis.

TABLE 3
Descriptive and reliability statistics of constructs (N=279)

Dimensions	Cronbach's Alpha	Mean	Standard Deviation	Number of items
Knowledge of Textiles (KTEX)	0.797	21.64	4.09	6
Environment concern (ENVC)	0.763	23.11	3.59	6
Product Preferences (PP)	0.787	24.67	3.40	6
Sustainable waste management practice (SWMP)	0.709	24.98	3.04	6

TABLE 4
Construct discriminant validity

	CR	AVE	KTEX	ENVC	PP	SWMP
Knowledge of Textiles (KTEX)	0.802	0.505	0.710			
Environment concern (ENVC)	0.805	0.508	0.283	0.712		
Product Preferences (PP)	0.842	0.519	0.282	0.531	0.720	
Sustainable waste management practice (SWMP)	0.818	0.533	-0.091	0.299	0.567	0.730

TABLE 5
Coefficient values of the regression paths

IV	DV	B	Beta	t value	P-value	R.Sq
KTEX	PP	0.067	0.117	1.715	0.086	0.294
ENVC	PP	0.382	0.497	5.434	<0.001**	
PP	SWMP	0.662	0.569	4.850	<0.001**	0.322
ENVC	SWMP	0.003	0.003	0.035	0.972	

Indirect effect with BC bootstrapping significance (5000 resamples)

IV	MV	DV	Direct	P	Indirect	P	Total	P
ENVC	PP	SWMP	0.003	0.915	0.253	0.000	0.256	0.037

The results show that knowledge of textiles did not significantly influence product preference (B= 0.067, P=0.086). Though the zero-order correlation between the variables was found previously, the insignificant results show that the presence of another variable, such as environmental concerns, nullifies their original relationship. environmental concerns influenced product preference (B= 0.382, P<0.001). Product preference is found to have a significant influence on sustainable waste management practices (B=0.662, P<0.001). However, a negligible and insignificant impact of environmental concerns is found on sustainable waste management practices (B= -0.003, P=0.972). At the same time, the zero-order correlation between them was found earlier. The indirect effect of the same variables is further analysed. The impact of environmental concerns on sustainable waste management practices mediated by product preference showed a positive and significant effect (B=0.253, P<0.000). The results clearly show a complete mediation product preference. Predictability of product preference and Sustainable waste management practices are interpreted from the R.Sq values. Knowledge of textiles and environmental concerns predict product preferences to the extent of 29.4%. Environmental Concerns and product preferences predict Sustainable waste management practices to the extent of 32.2%

The goodness of fit indices is analysed from the results presented in Table 6. The chi-square by df value is 2.399. It is slightly higher than two but far less than five, indicating a good model fit. However, the P-value of chi-square/df (P<0.000) indicates that a better model exists. The goodness of Fit Index (GFI) value (0.895), Adjusted Goodness of Fit Index (AGFI) value (0.857), and calculated Normed Fit Index (NFI) value (0.860) are less than 0.9. However, they are close to 0.9, which indicates a moderate fit. The Comparative Fit Index (CFI) value (0.912) indicates a perfect fit. Also, the Root Mean Square Error of Approximation (RMSEA) value is 0.060, less than 0.08, indicating a lower error in the measurements. Concluding on the fitness parameters, the path model fits reasonably well.

TABLE 6
Model fit summary

Parameter	Value	Suggested values
Chi-square value	268.679	-
DF	112	-
P value	0.000	> 0.05 (Hair et al., 1998)
Chi-square value /DF	2.399	< 5.00 (Hair et al., 1998)
GFI (Goodness of Fit Index)	0.895	> 0.90 (Hu & Bentler, 1999)
AGFI (Adjusted Goodness of Fit Index)	0.857	> 0.90 (Hair et al., 2006)
NFI	0.860	> 0.90 (Hu & Bentler, 1999)
CFI (Comparative Fit Index)	0.912	> 0.90 (Hooper et al., 2008)
RMR (Root Mean Square Residuals)	0.060	< 0.08 (Hair et al., 2006)
RMSEA (Root Mean Square Error of Approximation)	0.071	< 0.08 (Hair et al., 2006)

V. DISCUSSION

The study's outcome reveals that knowledge of textiles weakly correlates with product preference (r= 0.282) and environmental concern (r=0.283) but not with sustainable waste management practices (r=-0.091). Similarly, knowledge of textiles did not impact product preference (B=0.067, P=0.086) in the model. It is contrary to the findings of Horvat et al. (2019) and Robertson et al. (2018). It is interpreted that just the basicknowledge of textiles doesn't influence product preference. However, in the context of environmental protection, the knowledge about the environmental damages caused by textile products plays a major role in product preference. The study found that environmental concerns positively correlate with product preference (r=0.531). Environmental concerns have a weak positive correlation with sustainable waste management practices (r=0.299). The study by Chan (1996) and Majeed et al. (2022) proved that environmental concerns influenceproduct preferences. Ullah et al. (2022) argued that environmental awareness, education, and training would drive green innovation adoption. However, in the path model, environmental concerns impact only product preferences (B=0.382, p<0.001) and not sustainable waste management practices (B= -0.003, P=0.972). At the same time, the impact of environmental concerns on sustainable waste management practices is mediated by product preference (Indirect effect was found to be 0.253 at P<0.000).It is supportedby studies showing a gap betweenconsumer

intention and behaviour on sustainability practices in both consumption and waste disposal. Many factors have been

identified to cause this gap, such as alternate product availability, economic considerations, and product quality and functional values (Chen et al., 2021).

The study outcome recommends that sustainable waste management practices be improved by creating an environmental concern among the customers and proper marketing communication on the product features that highlight sustainability characteristics.

VI. CONCLUSION

The model for sustainable waste management practice is developed through the SEM technique. The model provides a guideline for imparting knowledge of environmental issues to consumers. It can further influence the consumers' purchase preferences and Sustainable waste management practices. The paper provides insights into Indian consumers' Textile knowledge and environmental concern about purchasing behaviour and waste management. The study findings would be useful for policymakers, manufacturers, and marketers to develop strategies to improve Indian consumers' practices toward sustainable waste management.

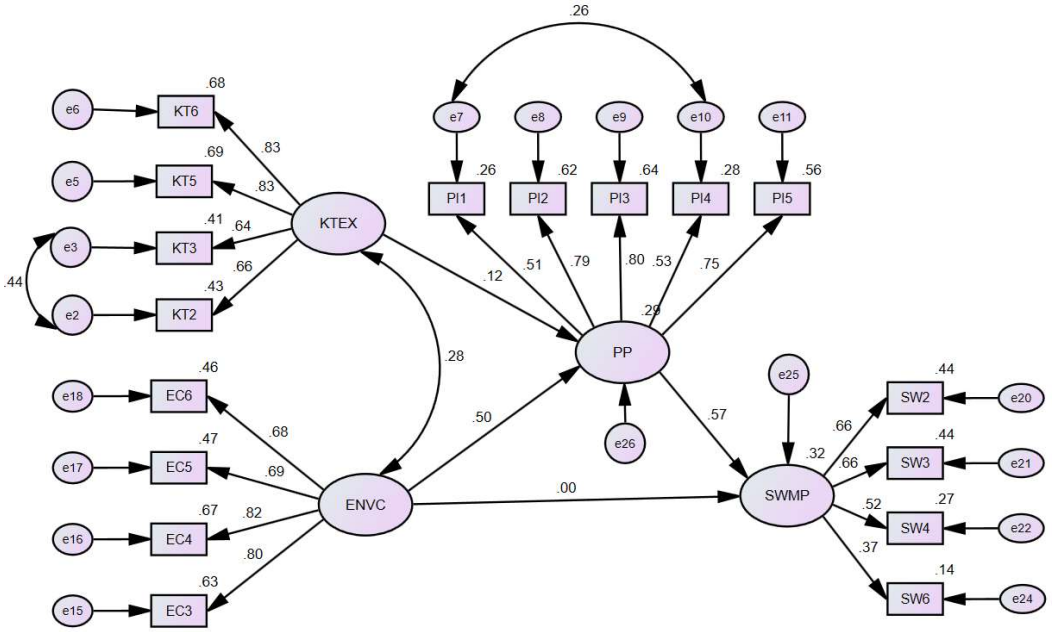
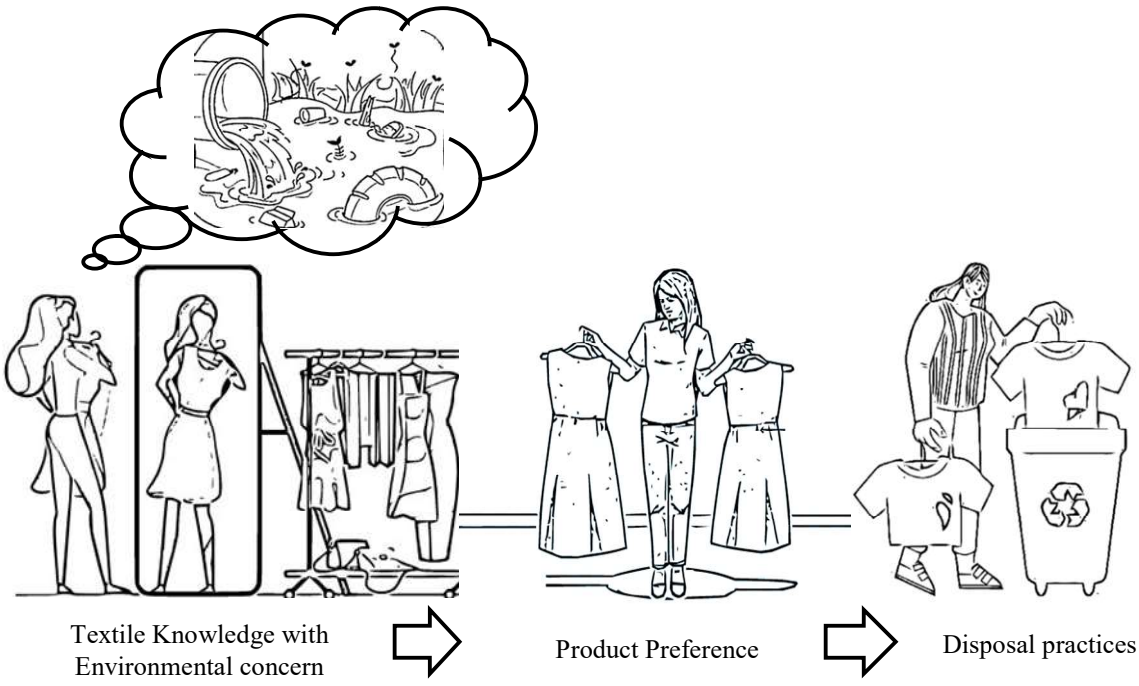


Figure 2 Structural Model with Standardized Values



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