A Study on the Impact of Green Cosmetic, Personal Care Products, and their Packaging on Consumers' Purchasing Behavior in Luzon, Philippines

Rhaniel Myxen A. Montes, Glorizen V. Delapaz, Justin Ivan D.R. Oliquino, Hannah Kressel A. Pascasio, Carlos Ignacio JR. P. Lugay
Department of Industrial Engineering
University of Santo Tomas
España Blvd., Sampaloc, Manila, Philippines
rhanielmyxen.montes.eng@ust.edu.ph, glorizen.delapaz.eng@ust.edu.ph,
justinivan.oliquino.eng@ust.edu.ph, hannahkressel.pascasio.eng@ust.edu.ph,
cplugay@ust.edu.ph

Abstract

People are becoming more aware of environmental issues such as climate change and pollution. As a result, consumers are increasingly becoming more environmentally conscious of their products. The current challenge for every industry today is to find a more sustainable and ethical way to produce goods. Brands must improve their marketing as its elements (people, price, product, and place) are crucial to respond to this challenge. The researchers identify the relationship between green products and packaging to consumers' purchasing behavior in this study. The factors included are environmental concerns/beliefs/values; environmental awareness and knowledge of the environmental impact of products and their packaging; social media influence; availability of a product in location; pricing; and product quality and benefits. The researchers utilized online survey questionnaires and assessed the relationship through Structural Equation Modeling (SEM), using SPSS. The findings indicate that the pricing and product quality, including the benefits, of green cosmetics, personal care products, and packaging affect consumers' purchasing behavior in Luzon, Philippines. The study provides new insights into Filipino consumers' perceptions of the environment. Introducing sustainable solutions to meet consumers' demand in purchasing cosmetic and personal care products will also have a vital impact and opportunities on the industry. The researchers suggest that companies should produce more green products in the market since the customers are more concerned about the ingredients of the product they consume and willing to invest more in sustainable products. Moreover, considering the significant factors of the study proved to be an effective marketing strategy.

Keywords
Consumer Behavior, Green Cosmetics, Green Personal, Care Products and Green Packaging.

1. Introduction
Cosmetics started in ancient Egypt, as Egyptians believed that one should always look presentable at any celebration they would attend, which is why one's hygiene became an essential concern for most people there (Mark 2017). Although Cosmetics and Personal Care Products, from consumers' perspective, as they thought it was just make-up and perfumes, the researchers would like to emphasize that this is not limited to these. Under the law, everyday products such as (but not limited to) shampoos, soaps, toothpaste, skin moisturizers, and deodorants were considered a part of the Cosmetics and Personal Care Industry. Today, the cosmetics industry's importance is related to its impact on everyone's life in beautification and its contribution to the global GDP. Likewise, the Cosmetics Industry in the Philippines has been booming recently. Multiple brands have been releasing innovative products in the market, from make-ups to everyday personal care such as shampoos and soaps.

The researchers have found that the fluctuation in demand for skin care products is related to the COVID-19 pandemic, which causes people to be more aware of their hygiene because of the pandemic (Allied Market Research 2020).

As the said industry grows, the environmental degradation that accompanies it increases. One of the factors that this research will tackle is cosmetic packaging. According to (Drobac et al. 2020), plastic material is standard packaging for beauty products. They even stated that if the entirety of the population consumes ten shower gels and shampoo in plastic bottles each year, consumers will produce an alarming amount of 75,000 tons of plastic waste.

Aside from its contribution to the plastic problem, in a recent report made by the Cosmetic Ingredient Review (CIR) panel in the United States of America, from of 10,500 ingredients used in personal care products, most well-known institutions do not test the safety of the ingredients used for cosmetic (greenamerica.org n.d.). It would be hard to identify if these products are safe for the environment and one's health and safety. According to (Juliano et al. 2017), sewage treatment is not effective enough to remove the danger of the toxic material caused by some cosmetics ingredients.

As of 2021, the Food and Drug Administration does not have any regulations on environmental consequences produced by the ingredients mentioned above. The only requirement for the approval of the FDA for cosmetic and personal care products is that they must not be toxic for human use, and the product should not be adulterated or misbranded. These ingredients continue to pose a threat to the environment.

Because of the problems presented above, more and more brands are making sustainable movements in terms of packaging and the product itself. Product innovations are emerging along with the integration of biotechnology. Cosmetics producers started making natural ingredients that come from cost-effective plants and will be more sustainable in the long run (Amberg et al. 2019). For a short introduction of the researcher's objectives, this study aims to analyze the impact of green products and green packaging in the cosmetics industry on the purchasing behavior of consumers and their willingness to buy repeatedly. This study will give new insights into Filipino buyers' attitudes towards the environment. In addition, the new knowledge that this research will produce will contribute to the study of consumer behavior theories affecting the cosmetics industry and its environmental impacts.

1.1 Objectives

The primary objective of this study is to identify the relationship between green products and packaging to consumer's purchasing behavior. The researchers would also like to provide a predictive model for consumers' behavior towards green personal care products. Given that, the researchers would like to answer the following question: "Does green cosmetics and personal care products with green packaging significantly affect the purchasing behavior of consumers in the Philippines?".

2. Literature Review

Previous studies and researchers have revealed that plastic as a material for packaging is large in scale. The study by Ncube et al. (2021) showed that it makes up around 40% of global plastic production, mostly from single-use plastic packaging. Ever since people invented plastic, its demand has increased day by day due to its various usage, especially as a material used for packaging material (Hahladakis et al. 2018). Due to its high usage as a material for packaging, there is much plastic waste thrown out every year. The main concern of plastic is that some plastics used are considered toxic, threatening the environment and human health as some of the plastic used in the packaging is hazardous.

According to Groh et al. (2019), it has stated that many plastics created by companies become plastic packaging materials. Most of them have hazardous chemicals totaling 906, dangerous to humans. Moreover, Bryant (2016) found out that many beauty products are used by many people every day, such as exfoliants, body scrubs, and even toothpaste containing microbeads. They are tiny, spherical particles smaller than 1 millimeter made of plastic. They seem innocent enough at first glance, but they are wreaking havoc on our environment. As a result, microplastic wildlife species were ingested, including fish and shellfish (Smith et al. 2018).

Today, the trend for a healthier way of living is increasing consumers' perceptions and interest in mainly natural products, including cosmetic products. Amberg and Fograssy (2019) emphasized that consumers today are now aware of environmental protection and sustainability questions. Currently, various green tech solutions are available in the cosmetics and personal care products industry. By using these solutions, environment-friendly natural products can be produced.

3. Methods

Figure 1 represents the conceptual framework of the study. It was based on the theoretical framework, the Theory of Planned Behavior (TBP), which includes the following factors: psychographic, information, socio-demographic, and product-related. The researchers modified the independent variables to fit the objectives of the study. The said factors of the TPB were changed to environmental concerns, beliefs, and values; environmental awareness and knowledge on the environmental impact of products and their packaging; availability of the product in location; and pricing, and product quality and its benefits, respectively. In addition, the researchers also considered social media influence under the information factor.

The study utilized a correlational research design. The researchers gathered the data using online survey questionnaires and sent them on the social media platforms, Facebook and Messenger. The target of the study were ages eighteen years old and above who reside within Luzon, which is the largest island in the Philippines and where more than half of the Filipino population lives. Additionally, considering the variables and their constructs, the computed sample size from the A-priori Sample Size Calculator for Structural Equation Models (SEM) (Soper 2021) was one hundred seventy.

As illustrated in Figure 1, the study aims to identify the relationships among the following independent variables: environmental concerns, beliefs and values, environmental awareness and knowledge of the environmental impact, social media influence, product availability, pricing, product quality and benefits, to the dependent variable consumers' purchasing behavior.

The researchers utilized SPSS 25 to determine the multivariate normality and used Mahalanobis distance to detect outliers. The analysis resulted in seven respondents that were excluded from the data. Furthermore, the researchers utilized AMOS 24 to produce a Structural Equation Model (SEM) and assess the relationship between the independent and dependent variables. The initial SEM underwent modifications to improve the model fit, removing non-significant variables from the regression weights and standardized regression weights analysis. The researchers utilized the same software, AMOS 24, to analyze the modified SEM of the study.

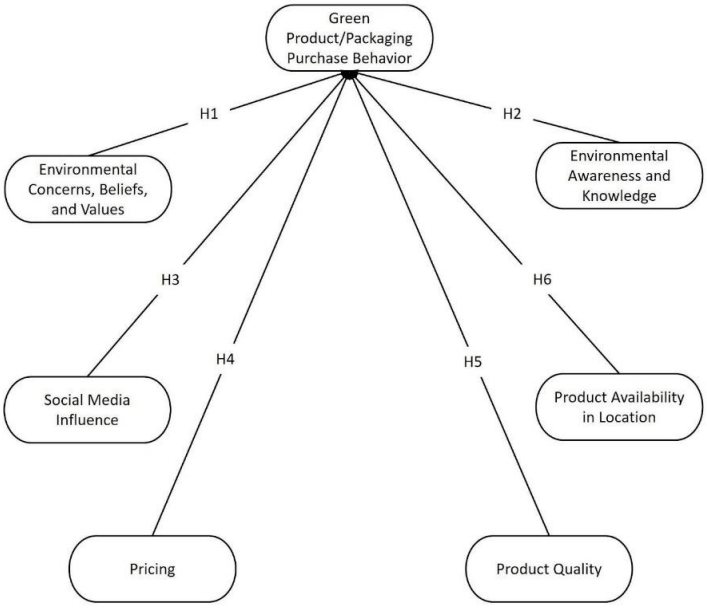

Figure 1. Conceptual Framework

4. Data Collection

The researchers gathered one hundred and seventy respondents through online surveys to target green cosmetic and personal care product consumers residing in Luzon, Philippines. The researchers utilized the Likert scale for each of the variables presented, with each question having a unit of measurement of 4 for "Strongly Agree," 3 for "Agree," 2 for "Disagree," and 1 for "Strongly Disagree" to give each latent variable is the weight of importance for the study.

Table 1. The construct and measurement of items.

Variable	Code	Constructs
Environmental Concerns, Beliefs, and/or Values	ECBV1	It is my responsibility as an individual to protect the environment.
	ECBV2	I consider the potential environmental impact of my actions when making decisions.
	ECBV3	I am willing to take environmentally motivated actions even when it might be a personal inconvenience.
	ECBV4	I am concerned about environmental issues (e.g., pollution) and their consequences.
	ECBV5	I believe in the importance of promoting environmentally friendly products.
Environmental Awareness and Knowledge of the Environmental Impact of Products and their Packaging	EAK1	I believe that my consumption negatively affects the environment.
	EAK2	I worry about resource wastage from the products that I purchase.
	EAK3	I consider the environmental impact of the manufacturing process of the products that I purchase.
	EAK4	It is important to be careful when using and disposing of products because these stages may significantly impact the environment.
	EAK5	My consumption behavior is affected by my concern for the environment.
Social Media Influence	SMI1	I usually check for reviews online before buying green cosmetics and personal care products.
	SMI2	I am more inclined to buy green cosmetics and personal care products if they are hyped or trending on social media.
	SMI3	Seeing posts and videos online about the environmental impact of trash from the product motivates me to switch to green products.
	SMI4	It is important that the brands producing green cosmetics and personal care products have a good social media presence to buy from them.
	SMI5	I tend to buy green cosmetics and personal care products more if they are posted or endorsed by influencers and celebrities on social media.
Availability of Product in Location	L1	It is difficult for me to find a physical store near my location that offers green products.

	L2	I would still consider buying a green product not available near my location by looking it up in online stores or through available delivery.
	L3	Having a product near my location tends to make me buy more of that product than products not available within my location.
	L4	It motivates me to buy the new green product if it is situated near my location.
Pricing	P1	I intend to ignore the price of a product if it is environmentally friendly and less toxic than other products.
	P2	Having a lower price or a discounted price motivates me to buy more green products.
	P3	It appeals to me to see companies switch their products and packaging to greener even if higher prices.
	P4	I am willing to pay more in purchasing green products which consist of natural ingredients.
	P5	I am willing to pay more for cosmetic products in green packaging.
Product Quality and Its Benefits	PQ1	I usually check the product's contents that I intend to buy if it is safe for the environment or one's health.
	PQ2	Seeing a product switching to greener packaging motivates me to buy that product than what I usually buy.
	PQ3	I usually compare the benefits of every product before buying.
	PQ4	I don't usually purchase green products that are less effective than non-eco-friendly products.
	PQ5	I can say that using green cosmetic products and green packaging enabled me to improve my environmental awareness.
Green Product/Packaging Purchase Behavior	GPB1	Most of the cosmetics and personal care products I use are green or eco-friendly.
	GPB2	Most of the packaging of the cosmetics and personal care products I use are eco-friendly.
	GPB3	I consistently buy green cosmetics and personal care products compared to the products that are harmful to the environment.
	GPB4	I spend more on green cosmetics and personal care products rather than conventional products in the market.
	GPB5	The number of green personal care and cosmetics found in my home is higher than conventional products.

5. Results and Discussion

5.1 Numerical Results

The researchers used the following measures to assess the SEM: Incremental Fit Index (IFI), Tucker Lewis Index (TLI), Comparative Fit Index (CFI), Adjusted Goodness of Fit Index (AGFI), and Root Mean Square Error (RMSEA). Table 2 represents the parameter estimates from the goodness of fit model statistics and the minimum cut-off for each model fit index. The fit indexes IFI, TLI, CFI, and AGFI, were considered acceptable with values greater than 0.8 (Gefen et al. 2000). Moreover, the RMSEA with values of 0.05 or below are generally considered indicative of a close-fitting model. According to Brown and Cudeck (as cited in Whittaker 2016), values between up to 0.08 or 0.10 (Hu and Bentler 1995, as cited in Whittaker 2016) are considered acceptable. All measures for the goodness of fit have a value greater than the minimum cut-off. Thus, the model represents a good fit.

Table 2. Model Fit

Goodness of fit measures of SEM	Parameter Estimates	Minimum Cut-off
Incremental Fit Index (IFI)	0.922	>0.80
Tucker Lewis Index (TLI)	0.899	>0.80
Comparative Fit Index (CFI)	0.921	>0.80
Adjusted Goodness of Fit Index (AGFI)	0.843	>0.80
Root Mean Square Error (RMSEA)	0.094	<0.05, or 0.08 to 0.10

Table 3 shows the construct validity of the study. The researchers measured the following factors: Cronbach's Alpha, Average Variance Extracted (AVE), and Composite Reliability (CR). The Cronbach's Alpha has values above 0.6, indicating an acceptable level of reliability (Hulin et al. 2001). The Composite Reliability (CR) was also considered acceptable, with values greater than 0.6 (Hair et al. 2014). Moreover, according to Lam (2012), the AVE of less than 0.5 is acceptable considering that the CR exceeds the value of 0.6. Therefore, the constructs were valid and had good reliability.

Table 3. Construct Validity of the Model

Factor	Cronbach's α	Average Variance Extracted (AVE)	Composite Reliability (CR)
Pricing	0.767	0.470	0.774
Product Quality	0.677	0.425	0.687
Green Purchase Behavior	0.921	0.675	0.912

5.2 Graphical Results

Figure 2 represents the modified Structural Equation Model (SEM) for the study on the impact of green cosmetics, personal care products, and their packaging on consumers' purchasing behavior in Luzon, Philippines. It includes three latent variables: Green Products/Packaging Purchase Behavior (GPB), Pricing (P), and Product Quality and its Benefits (PQ).

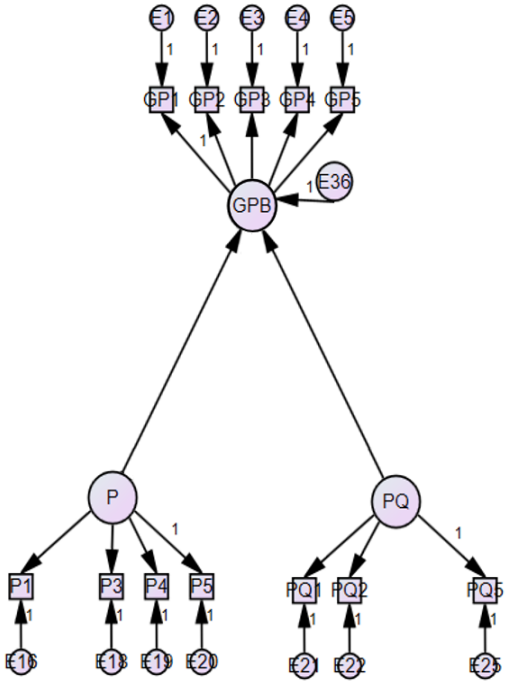

Figure 2. Modified Structural Equation Model

5.3 Proposed Improvements

The initial Structural Equation Model (SEM) analysis revealed that among six independent variables, four were non-significant. Future research could investigate other variables to determine more factors impacting green product or packaging purchase behavior. Moreover, further studies could investigate different locations and conduct comparative analyses. The restrictions resulting from the COVID-19 pandemic have become an enormous challenge for conducting student research (Elmer and Durocher 2020). Due to pandemic restrictions, the target respondents of the study were limited. Future research could conduct paper surveys and distribute them in specific locations for higher response rates and reduce biased data.

The analysis of the modified SEM findings indicates that the pricing and product quality and its benefits were the significant factors that affect the purchasing behavior of green personal care products and packaging consumers. The researchers suggest that companies produce green cosmetics and shift to green packaging as consumers are motivated to purchase environmentally friendly products. Furthermore, to emphasize increasing the public's environmental awareness, the researchers recommend that the government, companies, and organizations integrate green cosmetic products and packaging into their social media, enhancing customers' environmental awareness and responsibility.

6. Conclusion

Given the results presented, the researchers fulfilled the researchers' primary objectives. Therefore, the researchers conclude that green cosmetics and personal care products with green packaging affect the purchasing behavior in Luzon, Philippines, given that the pricing and product quality, including benefits, are accounted for.

The survey results show that 58.8 percent of the respondents mostly use green or environmental-friendly cosmetics and personal care products for the secondary objectives. However, only 47.1 percent answered that they have higher green cosmetics and personal care/hygienic products at home than conventional products. Additionally, 51.2 percent said that they spend more on green cosmetics and personal care products rather than the traditional products in the market. Based on these survey results, almost half of the respondents consider environmental considerations when purchasing a cosmetic or personal care product. In the paper, it can be seen that the green-based buying behavior in Luzon, Philippines, already has a foundation, but it still needs to be fostered.

Pricing

To further back up the result that pricing is a significant latent variable: According to Sharaf et al. (2018), the product's price has always been a substantial factor in the purchasing behavior of the consumers. It has also been an indicator to inform the market about the product's value. Many consumers nowadays are willing to spend an extra price if the product carries an additional value and helps take environmental protection (Yue et al. 2020). Moreover, a recent study (Zhang et al. 2020) stated that the price of green products in the market is relatively higher than that of traditional products. Hence, they are still growing in the market because consumers are more concerned about the impact of their purchased products.

Product Quality and Its Benefits

As mentioned in the results, the product quality and its benefits variables are also significant. A similar study (Alamsyah 2020) stated that green marketing helps to improve the green awareness of the consumers, leading to purchasing green products. The researchers observed that most companies started to adapt their business strategy to use green marketing and green packaging initiatives due to societal pressures derived from consumers' purchasing behavior and environmental concern. Thus, sustainable products and packaging are a new concept that has attracted consumers' attention in recent years (Wandosell et al. 2021).

Lastly, this study's significance aims to benefit both consumers and producers. The cost-benefit analysis (CBA) showed companies would do this. On the producers' side, the findings of this paper state that consumers are willing to pay more for greener personal care products. With that, despite investing in research and development, they will still be able to actualize an income increase as more people adapt to sustainable consumerism. Meanwhile, for the consumers, the study will benefit them as it shows producers that they are demanding better quality products that offer beneficial changes to their lives. Branding and advertisement are just one part of attracting consumers but giving good quality products will make the consumers purchase repeatedly.

References

Alamsyah, D., Othman, N & Mohammed, H., The awareness of environmentally friendly products: The impact of green advertising and green brand image.*Management Science Letters* , 10(9), pp. 1961-1968, 2020.

Allied Market Research, Available: https://www.alliedmarketresearch.com/press-release/philippines-beauty-and-personal-care-market.html, Accessed on March 9, 2021.

Amberg, N., and Frograssy, C., "Resources Communication Green Consumer Behavior in the Cosmetics Market" Available: https://www.researchgate.net/publication/334762459_resources_Communication_Green_Consumer_Behavior_in_the_Cosmetics_Market Accesed on: March 9, 2021.

Britannica, The Editors of Encyclopaedia. "Luzon", Available: https://www.britannica.com/place/Luzon. Accessed on: 26 May 2022.

Bryant, T. (2016) How The Microbead Ban Affects You. Available: https://www.refinery29.com/en-us/2016/01/100202/microbeads-beauty-products-environmental-effects

Drobal, Alivojvodic, Maksic, and Stamenovic., "Green Face of Packaging – Sustainability Issues of the Cosmetic Industry Packaging".MATEC Web of Conferences, January 2020.

Elmer, S. and Durocher, J., "Moving Student Research Forward during the COVID-19 Pandemic", Advances in Physiology Education, 44:4, pp. 741-743, 2020.

Fornell, C. and Larcker, D.F., "Evaluating structural equation models with unobservable variables and measurement error", Journal of Marketing Research, Vol. 18 No. 1, pp. 39-50, 1981.

Gefen, D., Straub, D., & Boudreau, M., Structural Equation Modeling and Regression: Guidelines for Research Practice. Communications of the Association for Information Systems, 4, pp-pp. https://doi.org/10.17705/1CAIS.00407, 2000.

Groh, K., Backhaus T., Almorth, B., Gueke, B., Inostro P., Lennquis, A., Leslie, H., Maffini, M., & Muncke, J.,"Overview of known plastic packaging-associated chemicals and their hazards" Available: https://www.sciencedirect.com/science/article/pii/S0048969718338828 Accessed on: March 9, 2022.

Hair J., Hult G.T.M., Ringle C., Sarstedt M., "A Primer on Partial Least Squares Structural Equation Modeling (PLS-SEM"), Los Angeles: SAGE Publications, Incorporated, 2014.

Hahladakis, J., Velis, C., Weber, R., & Purnell P., "An overview of chemical additives present in plastics: Migration, release, fate and environmental impact during their use, disposal, and recycling" Available: https://www.sciencedirect.com/science/article/pii/S030438941730763X Accessed on: March 9, 2022.

Hulin, C., Netemeyer, R., and Cudeck, R., Can a Reliability Coefficient Be Too High? Journal of Consumer Psychology, Vol. 10, Nr. 1, 55-58, 2001. Greenamerica.org, Available: https://www.greenamerica.org/green-living/ugly-side-cosmetics, Accessed on: March 9, 2021.

Juliano, C., and Magrini G., "Cosmetic Ingredients as Emerging Pollutants of Environmental and Health Concern. A Mini-Review", Available: https://www.researchgate.net/publication/315790334_Cosmetic_Ingredients_as_Emerging_Pollutants_of_Environmental_and_Health_Concern_A_Mini-Reviev, Accessed on: October 1, 2021.

Lam, L.W., "Impact of competitiveness on salespeople's commitment and performance",Journal Of Business Research, Vol. 65 No. 9, pp. 1328-1334, 2012.

MacCallum, R.C., Browne, M.W., and Sugawara, H., M., "Power Analysis and Determination of Sample Size for Covariance Structure Modeling," Psychological Methods, 1 (2), 130-49, 1996.

Mark, J., "Cosmetics, Perfume, & Hygiene in Ancient Egypt" Available: https://www.worldhistory.org/article/1061/cosmetics-perfume--hygiene-in-ancient-egypt, Accessed on: March 9, 2021.

Ncube, L., Ude, A., Ogunmuyiwa, E., Zulkifi, R., & Beas, I., "An Overview of Plastic Waste Generation and Management in Food Packaging Industries" Available: www.mdpi.com%2F2313-4321%2F6%2F1%2F12%2Fpdf&usg=AOvVaw2xuxPiVwsNtQ8uR0vy98uF, Accessed on: July 28, 2021.

Sharaf, M., and Perumal, S., How Does Green Products? Price and Availability Impact Malaysians? Green Purchasing Behavior?, *The Journal of Social Sciences Research*, **4**, issue 3, p. 28-34, 2018.

Smith, M., Roheim, C., Crowder, L., & Halpern, B., "Sustainability and Global Seafood" Available:https://www.researchgate.net/publication/235244301_Sustainability_and_Global_Seafood, Accessed on: July 24, 2021.

Soper, D.S. (2022). A-priori Sample Size Calculator for Structural Equation Models [Software]. Available from https://www.danielsoper.com/statcalc, Accessed on: September 3, 2021.

Wandosell, G., Parra-Meroño, M., Alcayde, A. and Baños, R., Green Packaging from Consumer and Business Perspectives, Sustainability, 13, issue 3, p. 1-19, 2021.

Whittaker, T. A. (2016). Structural equation modeling. In K. A. Pituch & J. P. Stevens. *Applied Multivariate Statistics for the Social Sciences* (6th Ed.; pp. 639 - 733). New York, NY: Routledge

Yue B, Sheng G, She S, Xu J., Impact of Consumer Environmental Responsibility on Green Consumption Behavior in China: The Role of Environmental Concern and Price Sensitivity, *Sustainability*, no. 5: 2074, Available: https://doi.org/10.3390/su12052074, Accessed on: October 3, 2021.

Zhang, X., & Dong, F., Why Do Consumers Make Green Purchase Decisions? Insights from a Systematic Review, *International Journal of Environmental Research and Public Health, 17*, 2020.

Biographies

Rhaniel Myxen A. Montes is currently a student of Bachelor of Science in Industrial Engineering from the University of Santo Tomas. She graduated Senior High School from the same university with a degree in STEM (Science, Technology, Engineering, and Mathematics). Montes has been serving as an Executive Staff for Team Publicity of the UST Engineering Student Council from the year 2020 up to present and has hosted multiple events for the organization. She received a Distinction in English from the Dubai International Benchmark Test in 2016 given in The Philippine School-Dubai and was also acknowledged as one of Dubai's Top 100 student leaders in the same year.

Glorizen V. Delapaz is an Industrial Engineering student from the University of Santo Tomas. She took up the STEM strand (Science, Technology, Engineering, and Mathematics) in her Senior High School at Technological Institute of the Philippines. She has achieved a Lean Six Sigma Yellow belt. Delapaz is currently taking up Quality Engineering as her specialization course in Industrial Engineering. She is also a Youth Leader in Every Nation Campus Philippines.

Justin Ivan D.R. Oliquino is an engineering student at the University of Santo Tomas who is currently taking up the course of Bachelor of Science in Industrial Engineering. He is also one of the pioneering batches who were the first batch of students who took up the K-12 curriculum from the Philippines and the STEM strand (Science, Technology, Engineering, and Mathematics) at FEU Diliman from the Philippines. He is currently taking up the elective course of Operations Research and Analytics as his specialization course in Industrial Engineering. He is also a member of the Industrial Engineering Circle and Operation Research Society of the Philippines from his school.

Hannah Kressel A. Pascasio is a fourth-year student at the University of Santo Tomas, and she is pursuing a Bachelor of Science in Industrial Engineering. She received a senior high school diploma in Science, Technology, Engineering,

and Mathematics (STEM) at Malate Catholic School. Pascasio is a certified Lean Six Sigma Yellow Belt (LSSYB) and is taking up Quality Engineering as a specialization course. She is currently in a research immersion program at the Department of Biomechatronic Engineering at National Taiwan University.

Carlos Ignacio Jr. P. Lugay is an Associate Professor of the Industrial Engineering Program in the Faculty of Engineering at the University of Santo Tomas, Manila, Philippines. He holds a Bachelor of Science degree in Industrial Engineering from the University of Santo Tomas, a Master of Science degree in Industrial Engineering from the University of the Philippines Diliman, and a Ph.D. in Commerce from the University of Santo Tomas. He has presented and published research outputs at both national and international levels. Dr. Lugay has been certified as a Professional Industrial Engineer by Phil. Institute of Industrial Engineers (PIIE), and as ASEAN Engineer by ASEAN Federation of Engineering Organizations. He is a member of the Philippine Assoc. of Researchers and Statistical Software Users and PIIE as well.