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Antecedents to Thai pre-service teacher eco-friendly behavior: A confirmatory factor analysis

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Abstract

The research aimed to analyze the *eco-friendly behavior* (EFB) of Thai undergraduate pre-service teachers (PSTs). Multi-stage random sampling was used to select 211 individuals majoring in industrial education from four Thai universities. The second-order confirmatory factor analysis used LISREL 9.10 and SPSS for Windows 21 was used for the descriptive statistics. Furthermore, five elements were perceived to influence PST EFB positively. This included the product's *eco-friendly price* (EFP), *eco-friendly safety* (EFS), *eco-friendly image* (EFI), *eco-friendly environment* (EFE), and finally *eco-friendly quality* (EFQ). Moreover, it was determined that a product's EFI was most important to the PSTs, followed by its EFQ, EFS, EFE, and EFP. Moreover, of the 20 items the PSTs were asked about, they believed that non-plastic bag use for EFB was judged most important. However, at the other end of EFB was a product's price importance.

Keywords: environmental sustainability, environmental product awareness, perceived behavior, student-teachers, Thailand

INTRODUCTION

Research from the United Nations Environment Program (UNEP) indicated that the global market for eco-friendly green products doubles yearly (Chen et al., 2018). As the planet moves from eight billion people in 2022 to 9.2 billion in 2040, economic growth will play a critical role in lifting individuals out of poverty while providing a pathway to a sustainable environment (United Nations Environment Program, 2011). However, growth comes at a price that requires people and governments to manage the planet's finite resources (Yolin, 2015). Furthermore, according to the UNEP, resource decoupling will require numerous governmental policy changes, corporate behavior changes, and consumer consumption patterns. Also, technological innovations frequently lead to increased resource consumption, as do affluence (consumption) and population growth (Guckian et al., 2017; Weinberger et al., 2017).

However, at the end of the supply chain is the consumer, with the message of environmental sustainability gaining ever more attention worldwide (Jan et al., 2019; Nimse et al., 2007). Also, the terms *environmentally friendly*, *eco-friendly*, and *green products* are closely related (Chockalingam & Isreal, 2016), while also be used and associated with new marketplace technologies and product innovation (De Medeiros et al., 2014). Likewise, a European Commission study conducted in Lithuania, the term '*eco-innovation*' is now used to describe the process of innovative natural resource reduction and use while minimizing harmful substance releases across the complete life-cycle (Nausėdaitė & Angelis, 2015).

Moreover, sustainable or green product consumption are similar ideas closely related in many ways, as both are intended to preserve the planet's natural but finite resources. Also, green products are considered products that use fewer resources in their production and have a lower environmental impact and risk (Sdrolia & Zarotiadis, 2019). Green products should also limit waste generation and have the ability to be recycled (Yolin, 2015).

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Contribution to the literature

- The study makes practical contributions by identifying a product's image as crucial in Thailand for eco-friendly products. However, this is at odds with other regions where pricing plays a crucial role in new consumer eco-friendly product purchasing.
- The study contributes to the research by confirming previous studies concerning university students' perceived behavior toward environmental products. The findings also expand on previous studies concerning student teachers in that it ranks the importance of new elements through the use of a second-order confirmatory factor analysis.
- It was also noted that in developing countries, including Thailand, education plays a critical role in all aspects of the discussion on eco-friendly behavior.

With the world producing 200 million tons of solid waste each year, compared to only 30 million tons in 1980, it needs solutions to its waste problems. Visualized, this represents a row of rubbish vehicles over 3,100 miles long each day (World Bank, 2013). As such, academic researchers and green consumers need to join the conversation about what constitutes eco-friendly behavior (ECB) and what factors trigger their buying preferences (Gao et al., 2022; Kim et al., 2019).

In Japan, Yolin (2015) has written that health concerns have been the main drivers of Japan's waste policy. However, today, waste disposal has grown far more complex due to a modern, technological society, which has to import most of the resources necessary for Japan's 21st-century modern society. Therefore, conserving and recycling these expensive, imported resources has moved to the forefront of modern environmental conservation and recycling thinking in Japan.

Additionally, in Japan's effort to reduce global warming, the focus is now on the size and type of vehicles (small electric and hybrid trucks) used to collect waste to reduce Japan's overall $C0_2$ emissions (Japan Environmental Sanitation Center, 2013). Moreover, new regulations have established the procedures and processes for the collection of plastic, glass, paper, and packaging waste, which are handed over to the *Japan Containers and Packaging Recycling Association,* where the waste is then re-assigned to recycling companies for the production of new products (Yolin, 2015).

Fortunately for the people of Japan and other environmentally aware global citizens, a global Nielsen (2018) survey of recycling laws indicated 81% of the individuals sampled believed strongly that firms should take responsibility for helping improve the environment. Further support for governmental and private citizen initiatives can be found in Sweden, where cans and bottles are deposited for a refund. This has led to the Swedes recycling 1.8 billion bottles and cans yearly under their so-called *pant* system (Hinde, 2020). Not to be outdone, the Swedes' Norwegian cousins also recycle 97% of their discarded plastic containers (Hickman, 2018).

Thailand has also taken steps to address its product waste problems and find workable solutions, as Thailand has been identified in the past as being the sixth-largest contributor to the world's ocean plastic waste (Styllis, 2018). Na Thalang et al. (2020) have added that Thailand creates over one million tons of discarded plastic waste every year, with 12% identified as plastic drinking containers. However, shortly before the COVID-19 pandemic wiped Thailand's 40 million tourists from Thailand's shores, the Thai government, along with 24,500 retail shops, announced in January 2020 a program in which single-use plastic bags would no longer be provided for free. Simultaneously, the Thai Pollution Control Department announced their '*Every day say no to plastic bags*' campaign while introducing a 20 year-action plan (2018-2037) on plastic waste management, which included the identification of seven plastic items that needed to be curtailed (Wipatayotin, 2020). The announcements further stated that Thais were saying 'NO' to plastic bags due to their growing awareness of plastic's environmental harm, especially to marine and sea life. However, the current Thai government policy does not include a ban on plastic water containers, which suggests that the disposal responsibility burden will be shifted from the consumer to the water bottling companies and local communities (Hickman, 2018).

Unfortunately, Hải and Mai (2013) in Vietnam have noted that although there is a higher global awareness of purchasing environmentally friendly products, Vietnamese consumers are not sufficiently aware of the importance of their ECB, especially regarding green purchasing decisions. Furthermore, the study determined that consumers were unaware of environmental issues or possessed ECB in Vietnam. However, the authors did suggest that individuals with high education in the three major cities surveyed were more worried about environmental issues than having sufficient knowledge of eco-products and green purchasing.

In Spain, Santamaría-Cárdaba et al. (2021) unfortunately concluded that of the Spanish mathematics' teachers surveyed, there was little attention paid to lecturing the contents of sustainable development goals (SDGs) from within their subject. The authors also stated that SDGs needed to be promoted

along with mathematics education because the world needs global citizens who think critically and take action to transform the world into a more sustainable and fairer place. This also agrees with research in Thailand from Arttachariya (2012) in which it was reported that a student's environmental consciousness, environmental concerns, and the level of peer pressure significantly influenced green purchasing behavior.

Globally, there can be no doubt that environmental sustainability and conservation awareness are growing (Cohen, 2015; Wipatayotin, 2020). However, the world needs to move from *green consumers* to *green citizens* (Guckian et al., 2017). Success depends on developing nations' understanding and participation where, unfortunately, consumer knowledge of environmental sustainability and green products is often minimal.

But there are solutions, with studies in Thailand and Vietnam highlighting the driving force education plays in sustainable change (Hải & Mai, 2013; Na Thalang et al., 2020; Pimdee, 2020, 2021; Preededilok, 2017). In Poland, Sady et al. (2019) also wrote that universities need to develop and contribute to sustainable development-oriented competencies through formal educational and non-formal activities. In the US, Ajilian (2014) also added that institutions of higher education are the best place to promote sustainability while helping develop society's culture of sustainability. In Indonesia, Mustikaningrum (2018) added that due to the nation's severe environmental problem, citizens need to start becoming aware of the issues and apply EFB by purchasing eco-friendly products.

Research Motivation and Objectives

The motivation for this study had several elements. Firstly, there was the desire to identify from the theory and related literature, which elements Thai student teachers might consider 'eco-friendly' (green). The second was to measure each individual's perception concerning the products or services identified. The third objective was to take the analysis and develop a guideline for developing appropriate consumer behavior, especially among the nation's youth and future leaders. Furthermore, the fourth objective was to help develop environmentally friendly and sustainable policies for the nation's future.

The main objective is to know Thai student teachers' perception of environmental products, which subsequently affects their behavior regarding their purchase and use. A secondary objective was to compare these findings and determine their consistency with other studies and theories. In particular, the second-order CFA analysis gives a deeper insight through the investigations of the factors' interrelationships from which the newly created elements are evaluated, and a determination is made concerning their importance and ranking.

LITERATURE REVIEW

Eco-Friendly Behavior

EFB can be *earth-friendly*, *environmentally friendly*, or *green living*. All these ideas, at their core, have similar objectives, including minimal degradation of our planet's air, water, land, and other natural resources. Moreover, Zaremohzzabieh et al. (2022) defined green purchase intention as a specific kind of EFB in which individuals use their purchase of eco-friendly products as an expression of their concern for the environment.

In Malaysia, Yahya et al. (2016) added that consumers with EFB exhibited traits that included the reduction of non-green product consumption, using only eco-friendly and bio-degradable products, recycling of products they use, and finally, the optimization of energy-efficient products. In Indonesia, Mustikaningrum (2018) further elaborated on the need for EFB due to illegal logging activities, industrial wastewater pollution, urban air pollution, and the declining trend in biodiversity quality. In Slovakia, Hojnik et al. (2019) noted that females expressed more EFB than males, with Slovakian consumers' eco-product consciousness having the most significant effect in channeling environmental concern into eco-friendly product purchase intention.

Eco-Friendly Products

In China, Jan et al. (2019) showed that green product consumers were more concerned with EFP's health and safety issues than their ecological or economic values. Also, consumer buying attitudes significantly positively affected green product purchase behavior. Previous consumer marketing research has also discussed, which elements are crucial to the consumer's product 'marketing mix' purchase decision-making (Kotler et al., 2019). In India, Chockalingam and Isreal (2016) discussed how to redesign the marketing mix concepts for non-EFP consumers and drew some interesting conclusions. One aspect was that non-EFP consumers would purchase an EFP if it was a bit more expensive (*price*) and could protect the environment and save water. Also, the *promotion* aspect of an EFP marketing mix should include sports stars, movie actors, or known political leaders as brand ambassadors in India. Additionally, first-time EFP purchasers stated that discount pricing was essential. Finally, secondary and university education concerning EFP was essential as well.

Finally, product safety is an essential factor to consider by both EFP buyers and their vendors. According to Chen and Chang (2012), to enhance a consumer's EFP purchase intention, companies must reduce the perceived risk of green product purchasing by giving reliable and trustworthy information to help build customer trust.

Table 1. Student-teacher university population and sample sizes

Universities	Population	Target	Sample (%)
Rajamangala University of Technology Thanyaburi (RMUTT)	1,816	88	65 (74)
King Mongkut's University of Technology Thonburi (KMUTT)	1,169	57	32 (56)
King Mongkut's University of Technology North Bangkok (KMUTNB)	1,349	65	52 (80)
King Mongkut's Institute of Technology Ladkrabang (KMITL)	1,858	90	62 (69)
Total	**6,192**	**300**	**211 (70)**

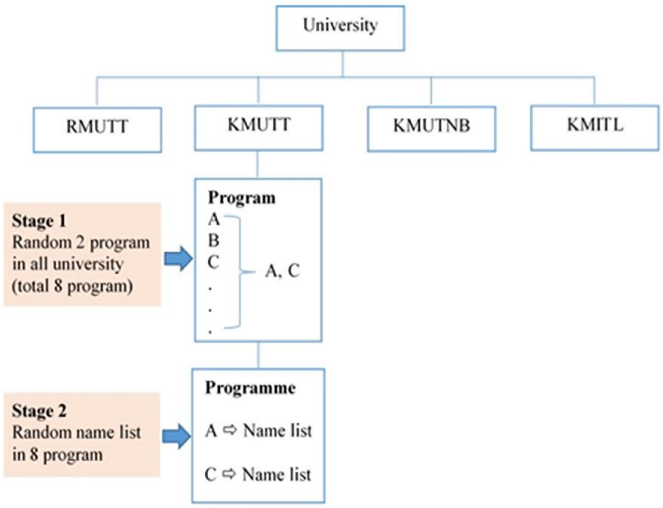

Figure 1. The study's sampling process (Source: Authors' own elaboration)

Eco-Friendly Education

To transition to a resource-constrained future, Guckian et al. (2017) have observed that society needs to create a process in which an individual's behavior is modified. An urgent requirement is to promote self-sufficiency concerning an individual's conservation behavior. Furthermore, within a consumer society, education, management of social norms, and marketing are necessities in increasing EFB attitudes into practice through eco-friendly product purchasing (McKenzie-Mohr, 2011). Also, Faisal and Naushad (2020), in their discussion about green human resource management in Saudi Arabia, noted the importance of green training and development on organizational employees' knowledge about environmental sustainability.

In Thailand, policies are being adopted to increase student EFB at all levels of education. As early as 1991, and in combination with USAID funding, Thailand's Ministry of Education set out to develop a plan to improve the curriculum in environmental education (Gallagher et al., 2000). This was combined with an effort to move away from Thai teacher-centered education (chalk and talk) to a process in which students and community members worked together to identify and solve local environmental problems such as water supply and land-use problems. Moreover, there was also a focus on the significant problem of widespread deforestation.

In 2009, another student-led project in Thailand focused on Bangkok's metropolitan area's solid waste transportation and disposal problems (Hoshiko & Akiyama, 2013). Once again, the program's success factors were attributed to non-traditional teaching, fieldwork, and discussion. Subsequently, in 2011, another similar Thai/Japanese student project was also noted for its similar successes. In the second Bangkok water use field exercise, some weaknesses from the 2009 project were identified and corrected in the follow-on 2011 project (Hoshiko & Akiyama, 2013). These included the better distribution of information, lengthier question and answer sessions from teacher lectures, improved student/teacher interactions, and fewer time pressures on students for project completions. However, it was noted that more field research time was also needed.

Fast-forwarding to 2018, in a joint WWF and Ikea Thailand 'eco-school' project, 21 Thai secondary schools were tasked to have their teachers and students study environmental sustainability through environmental development activities using methods that were designed to improve each student's analytical thinking skills, problem-solving skills, their teamwork participation, and their leadership skills (Andreou, 2018). As part of a much larger global initiative that in 2020 was purported to involve students, teachers, and communities in 67 countries, 'eco-school' initiative framework encompasses nine areas, including biodiversity, school grounds, climate change, energy conservation, global citizenship, health and well-being, transportation, waste management, and water resources (World Wide Fund for Nature, 2020).

Finally, in an examination of 105 education studies focused on the environment and conservation, Ardoin et al. (2020) determined that most environmental education initiatives achieve cognitive and affective outcomes with the keys to conservation being tied to local issues, partnerships and action. However, all these things require advanced planning and innovation.

MATERIALS AND METHODS

Population and Sample

The study's population consisted of 6,192 Thai PSTs enrolled in an undergraduate degree program for industrial education PSTs at one of four Thai institutions identified in **Table 1** and **Figure 1**.

Concerning sample sizes, Schreiber et al. (2006) have written that although there is no specific rule for the

Table 2. Questionnaire pilot study reliability and validity

Variables	Items	Validity discriminatory power (t-test)	Reliability confidence (α)
Eco-friendly price (EFP)	4	2.36-4.19	0.78
Eco-friendly safety (EFS)	5	4.32-6.26	0.88
Eco-friendly product image (EFI)	3	2.75-3.95	0.75
Eco-friendly environment (EFE)	4	4.21-5.64	0.91
Overview	20	2.36-6.26	0.94

participant numbers needed ten respondents per estimated parameter is often stated as adequate.

This is also consistent with Kline (2015) and Markus (2012), who have also stated that in studies where structural equation modeling (SEM) is used, typically 200 individuals is considered an adequate sample size. Therefore, as there were 20 estimated parameters for the study, 200 complete and audited questionnaires were established as the study's final goal (Gary, 2007). As such, a team of graduate student assistants and the authors worked with a network of faculty members and their students from each of the four schools to survey each of the targeted PSTs. Initially, multi-stage random sampling was used to classify the four universities, whose population was then divided into sub-groups according to their disciplines (**Figure 1**). Then, random cluster sampling was undertaken, and a lottery drawing method was used for the two discipline areas. This was then followed by each subject area using simple random sampling (student lottery drawing) until the sample target of 300 PSTs had been selected. Details of each university's student-teacher population in the industrial education faculties, the proposed sample target size by each university, and the final sample collected for each school are shown in **Table 1**.

The Research Instrument

The research instrument used to measure the study's 20 observed variables consisted of a six-part questionnaire (**Appendix A**). The questionnaire's part 1 contained seven items related to each pre-service teacher's (PST) biosocial characteristics and background. These items included their reported gender, university affiliation, accommodations, GPA, and monthly expenses. Additionally, two items concerning their use of EFPs were queried.

The questionnaire's second section consisted of five parts related to each PSTs' opinions regarding their eco-friendly product awareness. These included an EFP, EFS, EFI, the EFE, and EFQ of their eco-friendly green products, which were adopted from similar studies related to consumer eco-friendly/green product purchasing decisions (Jan et al., 2019; Zhang & Dong, 2020). These variables selection is also supported by authors who discuss the 4Ps (*place, product, price,* and *promotion*) and the 7Ps (*people, process*, *product, place, price, promotion,* and *physical evidence)* of the marketing mix (Anjani et al., 2018; Bahl & Chandra, 2018; Boonnarakorn et al., 2022; Chockalingam & Isreal, 2016).

Data Analysis

Data analysis was conducted in multiple ways. Firstly, the PST questionnaire data used SPSS version 21 software for the descriptive statistics analysis, with opinion assessment and ranking utilizing a five-level scale in which behavior response choices ranged from 'most appropriate' (4.50-5.00) to 'not suitable' (1.00-1.49). Additionally, the scale used 3.50-4.49 for 'very appropriate,' 2.50-3.49 as 'moderately appropriate,' and 1.50-2.49 for 'minimally appropriate' (Leekitchwatana & Pimdee, 2017). For the 2nd-order CFA, LISREL 9.10 was used.

Questionnaire Validity Assessment

To establish questionnaire item validity, a pilot study/pre-test was undertaken in which ten PSTs were selected from each of the four Thai universities/institutes (*RMUTT, KMUTT, KMUTNB*, & *KMITL*) (n=40).

Various scholars have voiced their opinions that a qualitative pre-test is crucial in developing, translating, and adapting a study's questionnaire (Presser et al., 2004), with Perneger et al. (2015) reporting that although a study's final sample size somewhat determines the pilot-test size, a good rule-of-thumb for pilot tests is 30-50 participants.

From their participation, a determination was made concerning the questionnaire quality and ease of comprehension (**Table 2**). The primary intention of the pilot study was to evaluate the validity and reliability of the five areas of items determined from the literature. Two methods determined the difficulty of the items; one was an analysis of discriminant validity (t-test), and the other was the use of a Cronbach's alpha (α) reliability confidence value (Taber, 2018). Straub et al. (2004) suggested that reliability values ≥0.60 are acceptable for a pilot study. Hinton et al. (2014) added that reliability cutoff values should use ≥0.90 for excellent reliability, 0.70-0.90 for high reliability, and 0.50-0.70 for moderate reliability.

For validity, the discriminatory power t-test was used by two groups of independent tests, with the classification power values of the questionnaire items shown in **Table 2**. It must also be noted that although

Table 3. PSTs' general characteristics responses (n=211)

General information	n	%
Gender		
Male	134	63.51
Female	77	36.49
My university/institution		
RMUTT	55	26.07
KMUTT	51	24.17
KMUTNB	52	24.64
KMITL	53	25.12
My accommodations		
Own house	45	21.33
Dormitory (outside or on-campus)	163	77.25
Home of relatives/acquaintances	2	0.95
Other (such as temple)	1	0.47
My current cumulative GPA		
Under 2.49	71	33.65
Between 2.50 & 2.99	81	38.39
3.00 or above	59	27.96
My monthly expenses		
3,000 baht or less per month ($100)	12	5.69
3,001-5,000 baht per month	60	28.44
5,001-10,000 baht per month	115	54.50
More than 10,000 baht per month	24	11.37
How often have you participated in a project or activity related to the use of eco-friendly products?		
Always	67	31.80
Never	88	41.70
Not sure	56	26.50
Which medium do you find to be most helpful for eco-friendly products?		
Facebook, Line, YouTube, etc.	152	72.04
Information boards	19	9.00
Friends or family	38	18.01
TV, newspapers, etc.	2	0.95

reliability is essential for a study, it must also be combined with its validity (Wilson, 2010).

RESULTS AND DISCUSSION

Pre-Service Teacher Characteristics

Table 3 shows that the survey's PST participants were nearly equally divided among the four schools surveyed. Also, responses indicated that 134 (63.51%) identified themselves as male, while another 77 identified themselves as female (36.49%). Additionally, 77.25% marked they were living in a dormitory provided by their institution on campus, with nearly all the remaining PSTs (21.33%) indicating they were living at 'home.' When the PSTs were asked to talk about their cumulative GPA, 38.39% responded that their GPA was between 2.50-2.99. The next group of PSTs (33.65%) indicated their GPA was lower than 2.50. The remaining 27.96% noted that their GPA was 3.00 or higher. When the group was asked about their green product activity participation, 41.70% indicated they had never participated in a 'green' product event, while another

Table 4. Proposed & actual sample sizes classified by university/institution

University	Proposed/actual sample group		
	Target	Collected	
		PSTs	%
RMUTT	88	55	62.50
KMUTT	57	51	89.47
KMUTNB	65	52	80.00
KMITL	90	53	58.89
Total	300	211	70.33

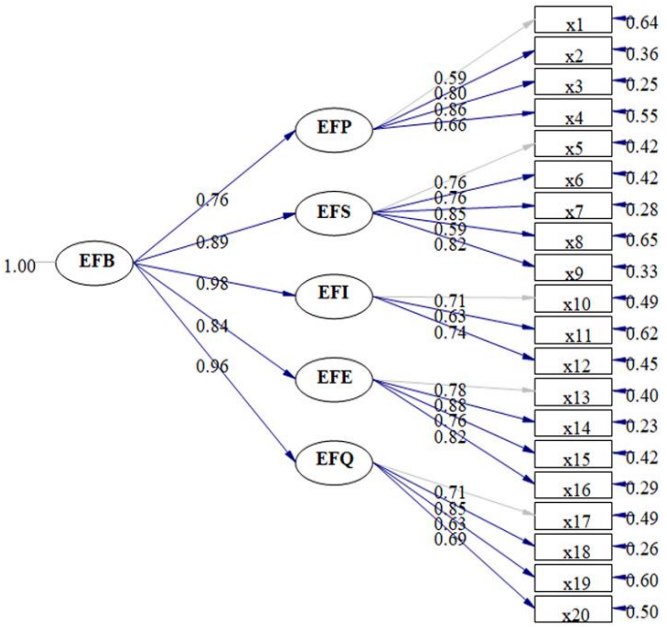

Figure 2. The second-order CFA model for Thai PST EFB (Chi-square=112.27, df=118, p-value=0.63, & RMSEA=0.00) (Source: Authors' own elaboration)

26.50% were 'unsure.' Also, 31.80% responded that they were always participating in green product activities when presented. Finally, when the respondents were asked, which media source they learned the most about green products, overwhelmingly, 72.04% chose social media platforms.

Survey Response

Table 4 shows my research team's actual sample size collected and audited, with a 70.33% final response rate. From the previously mentioned theories, the sample size of 211 was deemed statistically sufficient.

Assessment of the Model's Confirmatory Factor Analysis Goodness-of-Fit

Figure 2 shows the final results from the study's second-order CFA for Thai PSTs' EFB in which it was determined that all the elements were consistent with the empirical data. Support for this was because χ^2 was found to be not statistically significant (p=0.63), with the χ^2/df (degrees of freedom) relationship of 0.95, which is ≤2.00.

Table 5. Pearson correlation coefficient analysis, skewness, & kurtosis of the observed variables

V	x1	x2	x3	x4	x5	x6	x7	x8	x9	x10	x11	x12	x13	x14	x15	x16	x17	x18	x19	x20
x1	1.00																			
x2	.47**	1.00																		
x3	.53**	.68**	1.00																	
x4	.54**	.56**	.59**	1.00																
x5	.27**	.45**	.53**	.31**	1.00															
x6	.36**	.47**	.54**	.34**	.74**	1.00														
x7	.36**	.54**	.59**	.43**	.74**	.71**	1.00													
x8	.25**	.36**	.37**	.40**	.46**	.45**	.50**	1.00												
x9	.35**	.43**	.52**	.35**	.62**	.61**	.70**	.55**	1.00											
x10	.29**	.40**	.40**	.26**	.43**	.42**	.52**	.37**	.49**	1.00										
x11	.31**	.43**	.38**	.44**	.38**	.35**	.45**	.38**	.47**	.49**	1.00									
x12	.27**	.45**	.45**	.40**	.48**	.51**	.53**	.39**	.56**	.51**	.67**	1.00								
x13	.17*	.37**	.32**	.22**	.52**	.50**	.54**	.33**	.55**	.63**	.51**	.59**	1.00							
x14	.24**	.40**	.41**	.21**	.48**	.47**	.54**	.30**	.48**	.69**	.43**	.51**	.71**	1.00						
x15	.25**	.33**	.37**	.30**	.36**	.36**	.46**	.36**	.41**	.67**	.44**	.44**	.58**	.65**	1.00					
x16	.30**	.38**	.38**	.30**	.44**	.43**	.54**	.39**	.47**	.71**	.44**	.43**	.63**	.74**	.79**	1.00				
x17	.28**	.43**	.42**	.30**	.47**	.48**	.49**	.34**	.48**	.50**	.37**	.32**	.47**	.52**	.52**	.61**	1.00			
x18	.34**	.50**	.45**	.38**	.54**	.56**	.61**	.42**	.61**	.57**	.49**	.47**	.58**	.61**	.62**	.72**	.70**	1.00		
x19	.35**	.37**	.40**	.47**	.43**	.39**	.38**	.47**	.44**	.27**	.48**	.43**	.35**	.28**	.43**	.40**	.46**	.52**	1.00	
x20	.12	.41**	.31**	.23**	.38**	.36**	.46**	.27**	.43**	.56**	.42**	.49**	.62**	.59**	.52**	.63**	.50**	.61**	.27**	1.00
S	-.40	-.16	-.33	-.10	-.37	-.31	-.38	-.32	-.22	-.57	-.10	-.10	-.26	-.38	-.45	-.43	-.34	-.07	-.27	-.65
K	-.09	-.27	-.33	-.31	-.51	-.45	-.09	-.23	-.45	-.67	-.49	-.41	-1.03	-.94	-.33	-.77	-.50	-1.00	-.29	-.52

Note. **Sig.<.01; *Sig.<.05; V: Observed variables; S>: Skewness; & K: Kurtosis

Additionally, testing the model's fit validity employed the comparative fit index (CFI), with a suggested value ≥0.95. The study's CFI was 1.00, showing an excellent fit as well. Other scholars have recommended that the standardized root mean square residual (SRMR) and the root mean square error of approximation (RMSEA) should also be used as a measure of the models' goodness-of-fit (GoF) (Hu & Bentler, 1999; Rigdon, 1996).

The suggested values for both are ≤0.05. Therefore, further support for the model was confirmed as the study's SRMR=0.04 and the RMSEA=0.00. Additional analysis showed strong GoF values for the GFI (0.95), the AGFI (0.91), the NFI (0.99), and the RMR (0.04). Furthermore, the study's GoF also used the Akaike information criterion (AIC) and the expected cross-validation index (ECVI). Schermelleh-Engel et al. (2003) have discussed their use in detail. They have suggested that the AIC is a 'badness of fit' index (Kaplan, 2009), with lower values suggesting better fitting models. In LISREL, an AIC value is computed by use of the following formula:

$$AIC = \chi + 22t, \quad (1)$$

where t is the number of estimated parameters. For the ECVI, Schermelleh-Engel et al. (2003) wrote that the ECVI is a population parameter and evaluates how well a model fitted to the calibration sample performs in a comparable validation sample. As with the ACI, the ECVI with the smallest estimate indicates the model with the best fit. Also, a 90% confidence interval allows for assessing the estimate's precision. Therefore, from the theory criteria, the study's models met all the ACI and ECVI parameters and were added to the GoF confirmation analysis for Thai PST EFB.

Analysis of Relationships Between Observed Variables

Table 5 shows the Pearson correlation coefficient analysis of the strength of the association between each of the study's 20 variables (Hauke & Kossowski, 2011) and the analysis of skewness and kurtosis data normality of the observed variables (Kim, 2015). A Pearson's correlation coefficient analysis (**Table 5**) is used as a preliminary check to ensure that the datasets analyzed for the variables were related and that the *r*-values ($r \geq 0.30$) were not equal across the matrix (Hair et al., 2006; Mukaka, 2012).)

Moreover, in **Table 6**, it can be seen that the observed variable interrelationship correlation coefficients ranged from a low of 0.12 to a high of 0.79, with only x20 to x1 (.12) having the only statistical non-significance. In addition, it was determined that the observable variables had skewness values between -0.65 and -0.07 (below $|2|$) and kurtosis values between -1.03 and -0.09 (lower than $|7|$) (Curran et al., 1996).

Second-Order Confirmatory Factor Analysis Results

Table 6 details the combined results for analyzing the Thai PST EFB and shows that the EFB of Thai PSTs exists at a moderate to a high level (three to four). Results also revealed that the product's EFI (0.98) was most important to the PSTs. This was followed by the EFQ (0.96), the EFS (0.89), its EFE (0.84), and finally, a product's price (EFP=0.76) (**Figure 2**). We also can see

Table 6. Combined results for the analysis of Thai student-teacher EFB

Factors/observed variables	β	SE	t	R^2	CR	AVE	$\overline{x}$	SD	EFB level
Eco-friendly product price (EFP)	**0.76**	**0.10**	**7.58****	**0.57**	**0.82**	**0.54**	**3.44**	**0.84**	**Moderate**
1. Eco-friendly products are not too expensive (x1).	0.59	-	-	0.35			3.40	1.07	Moderate
2. Eco-friendly product prices are appropriate for what is received (x2).	0.80	0.09	8.59**	0.64			3.54	0.94	Most
3. Eco-friendly products offer good value for the price (x3).	0.86	0.09	8.83**	0.75			3.61	1.02	Most
4. Eco-friendly product prices correspond to my income (x4).	0.66	0.07	8.77**	0.45			3.24	1.06	Moderate
Eco-friendly product safety (EFS)	**0.89**	**0.08**	**11.00****	**0.79**	**0.87**	**0.58**	**3.65**	**0.81**	**Most**
5. Eco-friendly food containers are safe (x5).	0.76	-	-	0.58			3.76	0.96	Most
6. Eco-friendly products are free from harmful chemicals (x6).	0.76	0.05	13.88**	0.58			3.67	1.02	Most
7. Eco-friendly products are reliable in their safety (x7).	0.85	0.06	14.71**	0.72			3.69	0.94	Most
8. Paper containers are just as safe as plastic containers (x8).	0.59	0.07	8.15**	0.35			3.41	1.03	Moderate
9. Eco-friendly products meet safety standards (x9).	0.82	0.07	11.54**	0.67			3.70	0.92	Most
Eco-friendly product image (EFI)	**0.98**	**0.09**	**11.00****	**0.96**	**0.74**	**0.48**	**3.81**	**0.75**	**Most**
10. Using products that reduce global warming shows social responsibility (x10).	0.71	-	-	0.51			4.07	0.95	Most
11. Eco-friendly products used in my university are attractive (x11).	0.63	0.07	8.55**	0.39			3.62	0.92	Most
12. Eco-friendly products have a functional design (x12).	0.74	0.07	9.92**	0.55			3.75	0.83	Most
Eco-friendly environment (EFE)	**0.84**	**0.08**	**10.64****	**0.70**	**0.88**	**0.66**	**3.95**	**0.81**	**Most**
13. Using eco-friendly food containers is good for environment (x13).	0.78	-	-	0.60			4.01	0.85	Most
14. Using eco-friendly products reduces environmental pollution (x14).	0.88	0.06	13.41**	0.77			4.00	0.91	Most
15. Using eco-friendly products helps reduce energy consumption (x15).	0.76	0.07	11.49**	0.58			3.84	0.99	Most
16. Using eco-friendly products helps reduce global warming (x16).	0.82	0.06	13.02**	0.70			3.97	0.95	Most
Eco-friendly product quality (EFQ)	**0.96**	**0.09**	**10.86****	**0.98**	**0.81**	**0.52**	**3.77**	**0.76**	**Most**
17. Bamboo food containers are not inferior to foam boxes (x17).	0.71	-	-	0.51			3.81	0.94	Most
18. Eco-friendly products are manufactured to a high standard (x18).	0.85	0.06	13.01**	0.73			3.87	0.85	Most
19. Paper straws are durable and suitable for use (x19).	0.63	0.07	8.51**	0.39			3.33	1.09	Moderate
20. Use of cloth bags is more environmentally friendly than plastic bags (x20).	0.69	0.07	9.39**	0.48			4.09	0.97	Most

Note. **p<.01; β: Standard component weight; SE: Standard error; t: t-statistic; R^2: Coefficient of determination; CR: Composite/construct reliability; AVE: Average variance extracted; $\overline{x}$: Mean; SD: Standard deviation; Most: Most agreement; & Moderate: Moderate agreement

that the PSTs believe that reusable cloth bags (x20) are more environmentally friendly than single-use plastic bags ($\overline{x}$=4.09, SD=0.97).

This is consistent with their opinions about the importance (x10) of using products that can potentially reduce global warming ($\overline{x}$=4.07, SD=0.95). However, when the PSTs were asked if eco-friendly product prices corresponded to their income (x4), most found that they did not ($\overline{x}$=3.24, SD=1.06). Therefore, the authors interpreted this as the Thai PSTs could not afford more expensive eco-friendly products but purchased them anyway because it was the right thing to do. This assumption has support from another study in which Zaremohzzabieh et al. (2021) indicated that green purchase intention is a specific kind of EFB in which consumers express their concern for the environment by purchasing eco-friendly products. This is also true for students in Thailand, as their attitude, conservation behavior, and awareness were obtained through education and increased media awareness efforts (Pimdee, 2020). Multiple scholars have also confirmed the essential nature of education in environmental education behavior, including how action determined impact and how specific actions reduce environmental problems (Frantz & Mayer, 2009; Pimdee, 2021; Steg & Vlek, 2009; Steg et al., 2016).

Finally, the CR (constructed reliability) and AVE (average variance extracted) values in **Table 6** represent the homogeneity of the items (Jan & Yeo, 2019; Kotler et al., 2019; Mahapatra. 2013). CFA is used to specify and test a measurement model for more concepts. CFA is a method used to model the extent to which multiple items measure an unobserved (latent) variable. Therefore, in research, we call the variables "observable variables" and "latent variables."

Final Second-Order Confirmatory Factor Analysis Model for Eco-Friendly Behavior

Figure 2 presents the details from the study's second-order CFA of EFB. Brown (2015) has stated that second-order CFAs can be used to test the assumption that the correlations among a set of first-order factors is accounted for one or more higher-order factors. Moreover, the second-order CFA is a statistical method employed by the researchers to confirm that the theorized EFB construct loads into the underlying sub-constructs from the measurement obtained from the questionnaire's items. Here, the main construct has become a second-order construct while the sub-constructs become the first order construct.

In **Figure 2**, the correlation coefficient values are shown between the first-order factor variables and their 20 observed variables from the student-teacher survey

questionnaire in the right column (x1-x20). Each variable is defined in **Table 6**.

CONCLUSION

The study revealed how a Thai PST's *eco-friendly (green) behavior* is influenced by *eco-friendly pricing*, the product's *eco-friendly safety*, its *eco-friendly image*, its *eco-friendly environment*, and the product's *eco-friendly quality*. From the use of the second-order CFA, it was determined that the product's image was most important to the PSTs. The product's quality followed this, its level of safety, how environmentally friendly the product was perceived, and finally, the product's pricing. It was also determined that all the variables were positively weighted (β), with values between 0.76 and 0.98.

The study revealed that the product price was the least important to a Thai PST. However, this was not due to the high economic status of each individual, but instead due to their perception that purchasing eco-friendly products were environmentally and socially correct behavior. This observation can find support from the study's data and external studies as when the PSTs were asked if eco-friendly product prices corresponded to their income (x4), most found that they did not ($\overline{x}$=3.24, SD=1.06). Also, the study determined that the product's price had the lowest weight (β=0.76) compared to the other four components. Considering the observed variables, two variables were relatively low weighted. These were the eco-friendly products are not too expensive (x1) (β=0.59) and eco-friendly product prices correspond to the PST's income (x4) (β=0.66), which focused on asking for product prices compared to economic conditions and income.

Therefore, the authors interpreted this data as Thai PSTs could not afford more expensive eco-friendly products but purchased them anyway because it was the right thing to do. This assumption has support from another study in which Zaremohzzabieh et al. (2021) indicated that green purchase intention is a specific kind of EFB in which consumers express their concern for the environment by purchasing eco-friendly products. This is also true for students in Thailand, as their attitude, conservation behavior, and awareness were obtained through education and increased media awareness efforts (Pimdee, 2020).

The study also noted that of the 20 items the PSTs were asked to voice their opinions on, the highest concern was for single-use plastic bags instead of multi-use cloth bags. This was also true for Styrofoam containers, which were perceived as environmentally degrading. Furthermore, the study makes practical contributions by identifying the image as crucial in Thailand for eco-friendly products. However, this is at odds with other regions where pricing plays a crucial role in new consumer eco-friendly product purchasing.

In developing countries, including Thailand, education plays a critical role in all aspects of the discussion on eco-friendly (green) behavior. However, as Husamah et al. (2022) noted, existing textbooks are significantly limited in their ability to promote sustainability education for prospective science teachers. Therefore, teachers must learn and consistently work on ways to improve their environmental learning management skills, where open environments are created, which today will most probably entail a social media group allowing teachers to participate in the learning management process and knowledge sharing (Kerdtip & Angkulwattanakit, in press).

Therefore, this study expanded on the literature on how education can and does play a critical role. One example of this was an examination of eco-friendly product purchasing decisions, especially in developing economies such as Vietnam, Indonesia, and Thailand. Also, from a review of the marketing mix theory and related studies, when the marketing mix is applied to eco-friendly products, the authors would suggest that '*education*' be added as an essential element within the mix (Warrink, 2018). Therefore, although the marketing mix theories support the study's findings, *education* is an added component. The authors feel it is essential to investigate future studies on eco-friendly products and new consumer ECB. This study might also be helpful to the Thai government and the Ministry of Education officials, educational institutions, and green marketers in fine-tuning their eco-friendly-related programs and products.

Limitations

This study aimed to obtain and assess Thai students' opinions concerning EFB within the university they were studying. Therefore, the research results may not apply to students in other disciplines and universities, both domestic and foreign. Moreover, the study is limited in that the population is industrial vocational education student teachers who, after graduation, will work as a teacher under Thailand's Vocational Education Office or pursue a career as a technician in an industrial organization.

Further Study Suggestions

Follow-on EFB studies might consider other groups of students who are not teacher candidates, including broad segments of individuals of different occupations and ages. It might also be interesting to compare students' EFB from other global regions in each world region. Moreover, to determine the causal factors of EFB, the causal relationship model (SEM) should be studied further.

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administration, & supervision; **PP & AS:** writing–original draft preparation; **SM & AS:** investigation; & **SB & AS:** data curation. All authors have agreed with the results and conclusions.

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APPENDIX A: RESEARCH QUESTIONNAIRE

Student's Perceived Behavior of Environmental Products

Statement

1. Environmental product awareness behavior (*eco-friendly behavior)* refers to the process by which students are exposed to information and how they understand the environmentally friendly value of products they use in their universities/institutions. Factors which should be considered also include the product's *eco-friendly price*, its *eco-friendly safety*, its *eco-friendly image*, its *eco-friendly environment*, and finally, the product's *eco-friendly quality*.
2. In order to save time in answering the questionnaire The researchers would like to suggest the following answering methods:
   a. Step 1: Read the text entirely to better understand it meaning.
   b. Step 2: Decide how "true" or "not true" it is for you.
   c. Step 3: If "true" or "not true", think about how true or not true using the following scale.
      1) Tick ✓ for a response of "not true at all".
      2) Tick ✓ for a response of "not true".
      3) Tick ✓ for a response of "not sure/I do not know".
      4) Tick ✓ for a response of "somewhat true".
      5) Tick ✓ for a response of "totally true".

Table A1. Example

Statement	5	4	3	2	1
1. I prefer to travel by public transport over private cars.	✓				

Note. 5: Totally true; 4: Somewhat true; 3: Not sure/I do not know; 2: Not true; & 1: Not true at all

By example (**Table A1**), this means that you have a strong preference to travel by public buses over private cars because it is more environmentally friendly.

Table A2. Student questionnaire about each student teacher's perception of environmental products & related information

Questionnaire statement item for EFB	5	4	3	2	1
Product price perception (*eco-friendly price)*					
1. Eco-friendly products are not too expensive.					
2. Eco-friendly product prices are appropriate for what is received.					
3. Eco-friendly products offer good value for the price.					
4. Eco-friendly product prices correspond to my income.					
Safety awareness *(eco-friendly safety)*					
5. Eco-friendly food containers are safe.					
6. Eco-friendly products are free from harmful chemicals.					
7. Eco-friendly products are reliable in their safety.					
8. Paper containers are just as safe as plastic containers.					
9. Eco-friendly products meet safety standards.					
Image perception (*eco-friendly image)*					
10. Using products to reduce global warming is a show of social responsibility.					
11. Environmentally friendly products used at my university have a beautiful appearance.					
12. Eco-friendly products design should be suitable for use.					
Eco-friendly awareness (*eco-friendly environment).*					
13. Using eco-friendly food containers is good for the environment.					
14. Using eco-friendly products reduces environmental pollution.					
15. Using eco-friendly products helps reduce energy consumption.					
16. Using eco-friendly products helps reduce global warming.					
Product quality awareness *(eco-friendly quality).*					
17. Food containers made from bamboo pulp are not inferior in quality to foam boxes.					
18. Environmentally friendly products should meet good production standards.					
19. Paper straws are durable and suitable for use.					
20. The use of cloth bags is safer for society than plastic bags.					

Note. 5: Totally true; 4: Somewhat true; 3: Not sure/I do not know; 2: Not true; & 1: Not true at all

Section 2. General Information

Instructions: Please fill in the word or mark the box ❒ with a ✓.

1. Gender

❒ 1. Male

❒ 2. Female

2. Universities/Institutions

❒ 1. Rajamangala University of Technology Thanyaburi

❒ 2. King Mongkut's University of Technology Thonburi

❒ 3. King Mongkut's University of Technology North Bangkok

❒ 4. King Mongkut's Institute of Technology Ladkrabang

3. Characteristics of student accommodation (while studying in your university/institution)

❒ 1. Own residence

❒ 2. Dormitory outside/institute

❒ 3. Relatives/acquaintances' houses

❒ 4. Others .....

4. Current cumulative GPA

❒ 1. Under 2.50

❒ 2. Between 2.50 & 3.00

❒ 3. More than 3.00

5. Student expenses per month (while studying in your university/institution)

❒ 1. Not over 3,000 baht

❒ 2. 3,001-5,000 baht

❒ 3. 5,001-10,000 baht

❒ 4. More than 10,000 baht

6. How often have you participated in a project or activity related to the use of eco-friendly products?

❒ 1. Always

❒ 2. Never

❒ 3. Not sure

7. What medium from your university has made you aware of environmentally friendly products?

❒ 1. Social media such as Facebook, Instagram, YouTube, etc.

❒ 2. Public relations signs

❒ 3. Friends and/or faculty members

❒ 4. Others (specify) .....

Section 3:

Suggestions……