Model Adopting Electric Motorcycle Based on Product Knowledge and Subjective Norms

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Abstract. The problem of global warming requires attention and solutions to support the sustainability of life. Therefore, steps are needed to overcome the negative effects of climate change, one of which is by adopting electric motorcycles. This study aims to analyze the effect of public knowledge about green products and subjective norms on the interest in adopting them. The population in this study is Z Generation in the industrial city of Karawang, with a sample size of 224 respondents selected using a purposive sampling technique. Data analysis was carried out using the Partial Least Square method using the SmartPLS3. The results showed that product knowledge and subjective norms partially and simultaneously affect the purchase intention of electric motorcycles. This finding confirms that increasing understanding of green products and social norms can encourage interest in electric vehicles. Therefore, collaboration between the government, manufacturers, and the public is needed in education, regulation, and marketing strategies to accelerate the adoption of environmentally friendly vehicles.

Keywords: Adoption Intention, Electric Motorcycles, Product Knowledge, Purchase Intention, Subjective Norms.

1 Introduction

The transition from fossil-fueled vehicles to electric vehicles (EVs) is crucial in reducing greenhouse gas emissions and tackling climate change. The transport sector is a major contributor to global GHG emissions due to its reliance on fossil fuels. Studies show that using EVs instead of internal combustion engine vehicles can significantly reduce emissions, potentially reducing more than 60 percent over their lifecycle if the entire energy supply chain is considered [1]. In addition, EVs contribute to reducing air pollution and improving air quality in densely populated urban areas [2]. While electricity for EVs can still come from fossil fuels, the shift to renewable energy sources will further increase their environmental benefits [3, 4]. On the other hand, rising oil prices make EVs more economical and attractive to consumers [5, 6]. Therefore, the transition to electric vehicles is not only a sustainable environmental solution but also an economically favorable option for the future of transport.

Previous research on electric vehicle (EV) adoption has identified various factors influencing consumer behavior. However, there are still gaps in understanding the role of knowledge about green products and subjective norms. While several studies have highlighted financial incentives, driving range, and charging infrastructure as key factors for EV adoption [7, 8], the impact of consumer understanding of the environmental benefits of EVs remains under-researched. However, it is known that individuals with higher green knowledge tend to adopt sustainable technologies [9, 10]. In addition, subjective norms that reflect social pressure on individual behavior also significantly affect EV adoption intention [11]. Still, the link between social norms and green product understanding is less explored, especially in shaping the social pressure that drives EV adoption [12]. Existing literature focuses more on individual factors, such as attitudes and perceived behavioral control, without considering how collective beliefs and people's understanding of green products can accelerate or hinder EV adoption [13]. Thus, further studies are needed to assist policymakers and marketers in designing more effective strategies.

Research on electric motorcycle adoption among Z Generation in Indonesian industrial cities such as Karawang emphasizes the importance of green product knowledge and subjective norms in influencing purchasing decisions. Z Generation, which is known to have higher environmental awareness, tends to understand the benefits of electric vehicles better, so their increased knowledge of green products contributes to an increased interest in adopting the technology [14, 15]. In addition, subjective norms play a significant role in adoption decisions, where social support from the surrounding environment can strengthen an individual's tendency to consider using an electric motorbike [16]. In the context of Indonesia, which has a culture with a strong social influence on consumer behavior, understanding the interaction between green product knowledge and subjective norms is crucial for manufacturers and policymakers in designing more targeted marketing strategies and policies [17]. Thus, this study contributes to the development of academic literature and offers practical implications for encouraging the adoption of electric vehicles in Indonesia.

2   Methods

This study uses quantitative methods to analyze the effect of Product Knowledge and Subjective Norms on Interest in Buying Electric Motorbikes by referring to the dimensions of previous research [18-20]. The study population was Z Generation in Karawang Regency, born between 1996-2006, with 224 respondents selected using purposive sampling based on age, domicile, and education level of at least high school or equivalent [21]. Data analysis was conducted using the Partial Least Squares (PLS) technique using SmartPLS3 to test the influence of indicators on research variables. [22]. The structural models in this study can be seen in Figure 1.

Hypotheses in this study

- H1= There is an effect of product knowledge on electric motorbike purchase intention.
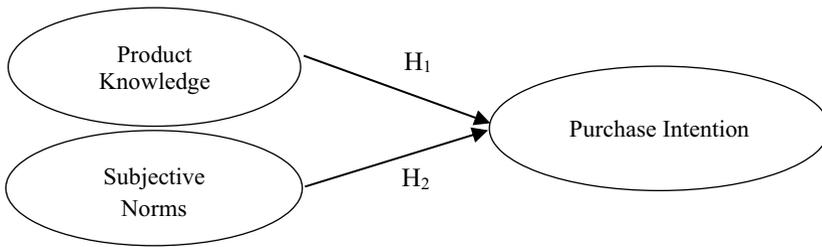- H2 = There is an effect of subjective norms on electric motorbike purchase intention.

Fig. 1. Structural models.

3   Results and Discussion

The following respondent profiles are presented in Table 1

Table 1. Respondent profiles.

	Description	Amount		Description	Amount
Age	17-20 Years Old	35	Occupation	Private Employee	78
	21-23 Years Old	104		Public Servant	30
	24-27 Years Old	85		Students	60
Gender	Male	80		Military/Police	1
	Female	144		Entrepreneur	55
Education	High school/equiva-lent	86	Residence	West Karawang	72
	College/Bachelor's degree	134		South Karawang	49
	Postgraduate	4		East Karawang	46
				North Karawang	57

3.1   Measurement Model Analysis (Outer Model).

There are several measurements for structural analysis of the model (outer model) to measure construct validity and reliability, namely Convergent Validity, Variance Extracted, Reliability, and Discriminant Validity [23].

This study uses 4 indicators to measure Product Knowledge, 5 to measure Subjective Norms, and 4 to measure Purchase Intention. The first convergent validity test shows that there is 1 indicator of the latent variable Product Knowledge, namely Product Knowledge.1, which is invalid. At the same time, the rest are as many as 1 indicator. The indicator for latent variable Purchase Intention has 1 indicator, namely Purchase Intention.2. The 2 indicators were removed, and the convergent validity test was carried out after improvement. The results of the validity and reliability tests after improving the latent construction are based on the test results that have been carried out previously.

Table 2. Structural model analysis (outer model).

Var	Item	Convergent Validity		Variance Extracted		Construct Reliability		
		Loading Factor	Desc	Average Variance Extracted (AVE)	Desc	Cronbach Alpha 0,6- 0,7	Composite Reliability > 0,7	Desc
Product Knowledge	Product Knowledge.2	0,811	Valid					
	Product Knowledge.3	0,752	Valid	0,602	Valid	0,668	0,819	Reliable
	Product Knowledge.4	0,762	Valid					
Subjective Norms	Subjective Norms.1	0,760	Valid					
	Subjective Norms.2	0,764	Valid					
	Subjective Norms.3	0,723	Valid	0,661	Valid	0,744	0,854	Reliable
	Subjective Norms.4	0,725	Valid					
	Subjective Norms.5	0,762	Valid					
Purchase Intention	Purchase Intention.1	0,791	Valid					
	Purchase Intention.3	0,819	Valid	0,558	Valid	0,802	0,863	Reliable
	Purchase Intention.4	0,829	Valid					

Source: Data processed by researchers.

Based on the results of convergent validity measurements, all indicators of latent variables Product Knowledge and Subjective Norms and latent variable Purchase Intention can be declared valid because the loading factor value is > 0,700. Based on Validity testing with Variance Extracted, all items or indicators of latent constructs are valid because all latent variables have an AVE value of more than 0,5. Construct reliability testing using Construct Reliability shows good reliability for all latent constructs.

Discriminant Validity is a validity test that measures how well a construct is truly different from others. A high Discriminant Validity value provides evidence that the latent construct is unique and can capture the measured phenomenon. The test is carried out by comparing the square root value of the AVE with the correlation value between constructs. Meanwhile, another method can be used to determine discriminant validity, namely cross-loading. The latent construct can be declared valid if the cross-loading value of each item against its construct is greater than the cross-loading value of each item with other constructs.

Table 3. Discriminant validity.

Var	Construct	Product Knowledge		Subjective Norms		Purchase Intention	
		Discriminant Validity	Cross Loading	Discriminant Validity	Cross Loading	Discriminant Validity	Cross Loading
Product Knowledge	Product Knowledge.2		0,811		0,415		0,530
	Product Knowledge.3	0,776	0,752		0,481		0,520
	Product Knowledge.4		0,762		0,531		0,534
Subjective Norms	Subjective Norms.1		0,468		0,760		0,570
	Subjective Norms.2		0,494		0,764		0,585
	Subjective Norms.3	0,681	0,452	0,813	0,723		0,493
	Subjective Norms.4		0,388		0,725		0,557
	Subjective Norms.5		0,490		0,762		0,524
Purchase Intention	Purchase Intention.1		0,492		0,561		0,791
	Purchase Intention 3	0,614	0,575	0,733	0,607	0,747	0,819
	Purchase Intention.4		0,588		0,617		0,829

Source: Data processed by researchers.

Table 3 shows that latent constructs Product Knowledge, Subjective Norms and Purchase Intention have a higher root AVE value than the correlation value between other constructs, so it can be concluded that latent constructs Product Knowledge, Subjective Norms, and Purchase Intention have good validity. The cross-loading value of each item on each construct is greater than the cross-loading value of the other variable construct items. It can be concluded that the latent constructs can be declared valid.

Furthermore, structural model analysis (Inner model) is carried out by testing the collinearity test on outer and inner values. The assumption or requirement that must be met in the inner model analysis is no multicollinearity problem; namely, there is a strong correlation between indicators, characterized by the Variance Inflating Factor (VIF) value at the indicator level greater than 5.

Table 4. Structural model analysis (inner model).

Variable	Indicator	Collinearity on Outer Values	Collinearity on Inner Values
		VIF	Y
Product Knowledge	Product Knowledge.2	1.419	1.604

	Product Knowledge.3	1.269	
	Product Knowledge.4	1.278	
Subjective Norms	Subjective Norms.1	1.622	1.604
	Subjective Norms.2	1.613	
	Subjective Norms.3	1.581	
	Subjective Norms.4	1.524	
	Subjective Norms.5	1.632	
Purchase Intention	Purchase Intention.1	1.456	
	Purchase Intention.3	1.479	
	Purchase Intention.4	1.509	

Source: Data processed by researchers

Based on Table 4, there are no indicators that have a VIF value greater than 5, so it can be stated that there is no multicollinearity problem. Thus, it can be noted that no multicollinearity occurs based on the collinearity test on both the inner and outer values.

The coefficient of determination (R-square) is useful in measuring how much diversity of endogenous variables can be explained by exogenous variables. A model can be said to be strong, medium, or weak by looking at the model's coefficient of determination. If the R^2 value ≥ 0.75, it can be considered a substantial or strong model. Then, if the value is $0.25 < R^2 < 0.75$, it can be said to be a moderate or moderate model. Furthermore, if the R^2 value ≤ 0.25, it can be said to be a weak or poor model. In the model formed, the coefficient of determination is 62.3%, so it can be stated that the SEM model formed is moderate or moderate.

Furthermore, a path coefficient test was conducted to test whether exogenous latent variables affect endogenous latent variables. Path coefficient testing can be carried out using the t-count test statistical value or the P-values on the path coefficient from the bootstrapping results. The test criteria are if the t-count value is greater than the t-table value of 1.984 or the P-values are less than the 5% significance level (α), it can be concluded that there is an effect of exogenous latent variables on endogenous latent variables. The results of the path coefficient test can be shown in Table 5.

Table 5. Path coefficient test.

Hypothesis	Path Coefficient	t-count	t-table	P_Values	Description
Product Knowledge →	0,371	4,884	1,984	0.000	Significant

Purchase Intention					
Subjective Norms → Purchase Intention	0,505	6,972	1,984	0.000	Significant

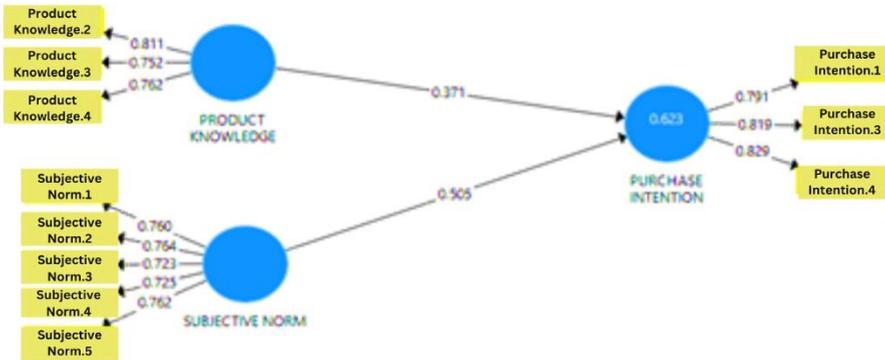Source: Data processed by researchers

Fig. 2. Path Coefficient

The path coefficient value can also be seen in Figure 2 of the path diagram, as shown in Figure 2. The table shows that latent variable Product Knowledge positively affects latent variable Purchase Intention by 0.371, and latent variable Subjective Norms positively impacts latent variable Purchase Intention by 0.505.

The research findings indicate that product knowledge and subjective norms significantly impact the purchase intention of electric motorcycles, both individually and simultaneously. Consumers who better understand the environmental benefits and efficiency of electric motors tend to be more interested in adopting them [24]. In addition, subjective norms that reflect social influence from family and friends also shape consumer attitudes towards electric vehicles. The greater the social support for using electric vehicles, the higher a person's interest in buying them [25, 26]. The combination of these two factors emphasizes the importance of education that raises awareness of the benefits of electric vehicles and creates a social environment conducive to adopting this technology. These strategies can be more effective in urban areas, where environmental awareness and social influence significantly drive the transition to greener transport [27].

4   Conclusions

This study concludes that product knowledge and subjective norms significantly influence the interest in buying an electric motorbike. Consumers who understand electric motorbikes' environmental and efficiency benefits tend to be more interested in adopting them, while social support from family and friends also strengthens purchase

intention. Therefore, education about electric vehicles and the creation of a supportive social environment can be effective strategies to increase the adoption of electric motorbikes, especially in urban areas. Future research could explore other factors, such as risk perception, price, and charging infrastructure, that influence the purchase intention of electric motorcycles. In addition, further studies can use qualitative or longitudinal methods to understand long-term changes in consumer attitudes.

References

1. Raugei, M., Kamran, M., Hutchinson, A. Environmental implications of the ongoing electrification of the UK light-duty vehicle fleet. *Resour. Conserv. Recycl.* **174**, 105818 (2021).
2. Aydogan, H. Electric Vehicles and Renewable Energy. *J. Phys. Conf. Ser.* **2777**, 012007 (2024).
3. Kurkin, A., Kryukov, E., Masleeva, O., Petukhov, Y., Gusev, D. Comparative Life Cycle Assessment of Electric and Internal Combustion Engine Vehicles. *Energies* **17**, 2747 (2024).
4. Knobloch, F. *et al.* Net emission reductions from electric cars and heat pumps in 59 world regions over time. *Nat. Sustain.* **3**, 437–447 (2020).
5. Wang, Z. The Growing Preference for Electric Vehicles from a Political and Economic Point of View. *J. Educ. Humanit. Soc. Sci.* **22**, 620–624 (2023).
6. Corderio, A. C. S., Losekann, L. The Economic Attractiveness of Electric Vehicles in Brazil: The Importance of Incentive Policies. *J. Appl. Bus. Econ.* **23**, (2021).
7. Toolib, S. N., Hanafi, W. N. W., Daud, S., Afsarizal, H. A. Factors Influencing Electric Vehicle Adoption: A Conceptual Paper. in *Int. Symp. Exhib. Bus. Account.* 849–857 (2023).
8. Saleh, H. N., Maupa, H. C., Sadat, A. M. The Impact of Price Value, Driving Range, Charging Station Availability, and Monetary Incentive Policy on Intention to Buy Electric Vehicles in Jabodetabek-Indonesia. *Int. J. Latest Eng. Manag. Res.* **9**, 49–56 (2024).
9. Mombeuil, C., Diunugala, H. P. Green brand awareness, green brand association, green perceived quality, and intention to purchase electric vehicles: The mediating effect of green trust. *In Review* (2023).
10. Zhao, H., Furuoka, F., Rasiah, R. A., Shen, E. Consumers' Purchase Intention toward Electric Vehicles from the Perspective of Perceived Green Value: An Empirical Survey from China. *World Electr. Veh. J.* **15**, 267 (2024).
11. Ray, D. R. M., Harito, C. Influential Factors Affecting the Adoption Intention of Electric Vehicles in Indonesia: An Extension of the Theory of Planned Behavior. *Eng. Math. Comput. Sci. J.* **5**, 117–128 (2023).
12. Erna, E., Setiawan, I., Aos, A. Investigating Individual's Energy Saving Behavior in Using Electric Vehicles: Extended Theory of Planned Behavior. *Int. J. Energy Econ. Policy* **14**, 517–523 (2024).
13. Purwanto, S., Rini, H. P. Analysis of Green Moral Obligation on Intention to Adopting Electric Vehicles (EV) with Openness to Changes and Self Enhancement as Moderating Variables. *East Asian J. Multidiscip. Res.* **2**, 5161–5174 (2024).
14. Balinado, J. R. O. Consumer Perception and Purchase Intention on the Transition to Hybrid and Electric Vehicles for Sustainable Mobility and Transportation in the Philippines. *J. Electr. Syst.* **20**, 1188–1195 (2024).
15. Choldiputri, N. T., Syafei, A. D., Assomadi, A. F., Febrianto, A., Hermana, J. Efficiency Study of Substitution of Official Vehicles in Banten Province with EVs (Electric Vehicle) To Reduce Carbon Emissions. *IOP Conf. Ser. Earth Environ. Sci.* **1307**, 012003 (2024).

16. Onat, N., Kucukvar, M., Tatari, O. Regional Well-to-Wheel Carbon, Energy, and Water Footprint Analysis of Electric Vehicles. in *Proc. 11th Asia Pacific Transp. Environ. Conf.* (APTE 2018), 23 (2019).
17. Pawenary, P., Azzahra, S., Azis, H., Prabuwono, A. S. Feasibility Study Designing Electric Motorcycles With Fossil Fuels Compared To Hybrid Systems On 150Cc Motorcycles. *J. Nas. Tek. Elektro* **10**, (2021).
18. Sun, Y., Wang, S. Understanding consumers' intentions to purchase green products in the social media marketing context. *Asia Pac. J. Mark. Logist.* **32**, 860–878 (2019).
19. Hamzah, M. I., Tanwir, N. S. Do pro-environmental factors lead to purchase intention of hybrid vehicles? The moderating effects of environmental knowledge. *J. Clean. Prod.* **279**, 123643 (2021).
20. Dutta, B., Hwang, H.-G. Consumers Purchase Intentions of Green Electric Vehicles: The Influence of Consumers Technological and Environmental Considerations. *Sustainability* **13**, 12025 (2021).
21. Sugiyono. *Metode Penelitian Kuantitatif, Kualitatif dan R&D*. 24th edn. (PT. Alfabeta, 2016).
22. David, G. G. *Partial Least Squares: Regression and Structural Equation Models*. (Statistical Associates Publishing, 2016).
23. Ghozali, I. *Aplikasi Analisis Multivariete Dengan Program IBM SPSS*. 8th edn. (Badan Penerbit Universitas Diponegoro, 2016).
24. Pramajaya, A., Haryanto, J. O. Tacit Knowledge and Product Information about the Environmental Impact towards the Purchase Intention of Electric Motorcycles. *J. Tek. Ind.* **23**, 149–160 (2021).
25. Masruroh, M., Nursanti, T. D., Irvianti, L. S. D., Limin, I. The Importance of Increasing Public Adoption of Electric Vehicles in Reducing Jakarta's Air Pollution. *IOP Conf. Ser. Earth Environ. Sci.* **1324**, 012042 (2024).
26. Dash, A. Determinants of EVs adoption: a study on green behavior of consumers. *Smart Sustain. Built Environ.* **10**, 125–137 (2020).
27. Jiang, Q., Wei, W., Guan, X., Yang, D. What Increases Consumers' Purchase Intention of Battery Electric Vehicles from Chinese Electric Vehicle Start-Ups? Taking NIO as an Example. *World Electr. Veh. J.* **12**, 71 (2021).