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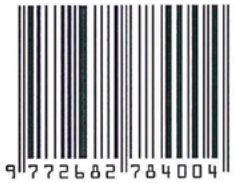

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EXAMINING THE IMPACT OF ENVIRONMENTAL EDUCATION, RELIGIOUSITY AND POLICY, RULES AND REGULATION ON BEHAVIOURAL CHANGE TOWARDS GREEN LIFESTYLE

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ABSTRACT

Environmental sustainability is an urgent global concern, necessitating significant behavioral changes at individual and societal levels which calls for conservation. These changes include adopting eco-friendly practices such as consuming green products, supporting the circular economy, reducing waste, and advocating clean energy. Achieving such transformations requires a multi-faceted approach that integrates knowledge dissemination, religious teachings, and policy interventions. This study explores the combined influence of these factors—mediated by subjective norms—on fostering behavioral changes toward environmental sustainability among university students. Based on the Theory of Planned Behavior and Norm Activation Theory, the study examines how knowledge equips individuals with critical awareness, how Islamic teachings promote values of stewardship and moderation, and how policy frameworks regulate and incentivize sustainable practices. It emphasizes the underexplored role of Islamic principles, which align spiritual values with ecological stewardship, advocating conservation as a sacred trust. Policies aimed at reducing pollution and promoting clean energy are evaluated for their effectiveness in driving behavioral change when aligned with cultural and spiritual dimensions. The study uses PLS-SEM as the tool for analysis. Results conform to the hypotheses where knowledge, religiousity, and policy, rules and regulation with the mediating effect of subjective norms have significant impact on behavioural changes toward environmental sustainability. The study offers theoretical, empirical, and practical contributions by developing an integrative conceptual model, shedding light on youth engagement in

sustainability, and informing educational, religious, and policy initiatives. This approach underscores the importance of value-driven, culturally relevant strategies for achieving environmental sustainability.

1. Introduction

Environmental sustainability has emerged as a critical concern in light of escalating challenges such as climate change, biodiversity loss, and resource depletion. Addressing these issues requires profound behavioral changes at both individual and societal levels. These changes encompass adopting environmentally friendly practices, such as consuming green products, purchasing from sustainable producers, practicing waste reduction through reuse and recycling, supporting the circular economy, and advocating for clean energy. Achieving this transformation necessitates a multi-faceted approach incorporating knowledge dissemination, religious teachings, and policy interventions. This study explores how knowledge, religiosity, and policies—mediated by subjective norms—can collectively influence behavioral changes toward environmental sustainability.

Despite growing awareness of environmental issues, behavioral inertia persists, impeding the adoption of sustainable lifestyles. Existing approaches to environmental sustainability often fail to address the interplay of cultural, spiritual, and regulatory influences that shape individual and collective behaviors. Religious teachings, particularly within Islam, offer profound ethical frameworks emphasizing stewardship, moderation, and conservation. However, these teachings remain underutilized in fostering pro-environmental behaviors. Furthermore, while environmental policies and regulations aim to mitigate pollution and promote clean energy, their effectiveness is contingent upon public compliance and attitudinal alignment. Knowledge dissemination, though a critical enabler, often lacks the contextual integration needed to resonate with diverse populations, particularly university students, who represent future leaders and change-makers.

Environmental education is pivotal in equipping individuals with the knowledge and skills required to address environmental challenges. It fosters awareness, critical thinking, and collective action aimed at conserving natural resources and mitigating environmental degradation. By promoting informed decision-making, environmental education serves as a foundation for sustainable behavior. However, knowledge alone is insufficient; it must be complemented by cultural and spiritual dimensions to inspire deeper, value-driven commitments to environmental stewardship.

Islam, as a comprehensive way of life, provides a robust ethical framework for environmental sustainability. Hundreds of Qur'anic verses emphasize humanity's responsibility as stewards of the Earth, advocating for the preservation of God's creation. Core Islamic principles such as *Tawheed* (unity of creation), moderation (*wasatiyyah*), and the prohibition of wastefulness (*isrāf*) align closely with sustainability goals. For instance, Qur'an 7:31 warns against excessive consumption, and Qur'an 17:37 cautions against arrogance and destruction of the Earth. These teachings not only promote ecological balance but also imbue environmental actions with spiritual significance. The Islamic Climate Change Symposium's 2015 declaration underscores the role of Islam in addressing global environmental challenges. Islamic organizations and scholars increasingly highlight the compatibility of Islamic teachings with sustainability, advocating for conservation practices that resonate with religious communities. Nevertheless, the potential of Islamic principles to drive behavioral change remains underexplored, particularly in the context

of youth and university students. Religion profoundly shapes values related to nature through personal, social, and more-than-human processes. Personal transformation often arises from religious practices such as prayer and meditation, fostering gratitude, humility, and relational values toward nature. Socially, religious teachings are transmitted through family traditions, educational institutions, and community activities, embedding pro-environmental norms within cultural contexts. Religious rituals frequently incorporate natural elements, enhancing ecological awareness and inspiring conservation efforts. More-than-human processes emphasize divine and supernatural connections, aligning with Indigenous and animistic traditions that integrate nature into spiritual frameworks. This perspective broadens the scope of environmental ethics, viewing nature not merely as a resource but as a sacred trust. Together, these dimensions illustrate religion's multifaceted role in shaping environmental values and actions.

Policy interventions are critical for mitigating environmental degradation by regulating behaviors and promoting sustainable practices. Governments employ a combination of punitive and incentivizing measures, such as taxing polluters, subsidizing clean energy, and enforcing environmental standards. These mechanisms aim to internalize environmental costs and encourage the adoption of green technologies. For instance, Neves et al. found that market-based regulations effectively reduce CO2 emissions over the long term.

However, the success of environmental policies depends on societal compliance and attitudinal shifts. Policies alone cannot drive change unless they resonate with individual values and subjective norms. Integrating policy frameworks with cultural and spiritual dimensions could enhance their acceptability and effectiveness. As such, this study integrates the Theory of Planned Behavior (TPB) and Norm Activation Theory (NAT) to examine the factors influencing behavioral changes toward environmental sustainability. TPB posits that behavioral intentions are shaped by attitudes, subjective norms, and perceived behavioral control. NAT complements this by emphasizing the activation of personal norms through awareness of consequences and ascription of responsibility.

The conceptual model developed in this study incorporates knowledge, religiosity, and policy frameworks as antecedents of subjective norms, which in turn mediate their influence on pro-environmental behaviors. This integrative approach allows for a holistic understanding of the factors driving sustainable behaviors among university students.

The primary objective of this study is to examine how knowledge, religiosity, and policy interventions—mediated by subjective norms—contribute to behavioral changes toward environmental sustainability. This study makes several key contributions: Theoretical Contribution - By integrating TPB and NAT, the study provides a comprehensive framework for understanding the interplay of knowledge, religiosity, and policies in shaping pro-environmental behaviors. Empirical Contribution - The focus on university students offers insights into the factors influencing behavioral changes in a critical demographic that will shape future sustainability initiatives. Practical Contribution - The findings can inform the design of educational programs, religious outreach initiatives, and policy interventions aimed at fostering environmental sustainability. Cultural Relevance - By emphasizing Islamic teachings, the study highlights the potential of culturally and spiritually aligned approaches to drive behavioral change in predominantly Muslim contexts.

Addressing environmental challenges requires a multi-dimensional approach that integrates knowledge, spiritual values, and policy interventions. This study bridges these domains by examining how environmental education, Islamic teachings, and regulatory frameworks influence pro-environmental behaviors. By focusing on university students, the study contributes to

the growing body of literature on youth engagement in sustainability and offers practical recommendations for fostering behavioral change. The proposed conceptual model provides a robust foundation for future research and policy development aimed at achieving environmental sustainability through value-driven actions

The following sections are organized as follows. The next secton narrates the theory, conceptual framework along with the relevant review of literature. Section 3 explains the methodological approach followed by presentation of the results. The penultimate section discuses the results and limitation of the study, and the final section concludes.

2. Literature Review, Theory and Conceptual Framework

The Norm Activation Theory (NAT), introduced by Schwartz in 1977, provides a theoretical framework for understanding altruistic and environmentally conscious behaviors that arise from internalized norms. Schwartz posited that NAT establishes a relationship between personal norms (PN), activators, and behaviors (Schwartz, 1977; Schwartz and Howard, 1984; Harland et al., 2007). According to Schwartz, personal norms require activators, such as specific triggers or situational cues, to motivate individuals toward pro-social behaviors (Schwartz, 1977).

To enhance the predictive capabilities of the NAT model, researchers have incorporated additional variables, such as social norms (SN), which represent the influence of societal expectations, alongside awareness of consequences (AC), ascription of responsibility (AR), and efficacy (Bamberg et al., 2007; Onwezen et al., 2014; Han, 2014). These extensions have strengthened the utility of NAT in explaining and predicting environmentally friendly behaviors. Several empirical studies have validated the effectiveness of NAT in this context (Ebreo et al., 2003; Zhang et al., 2013; Van der Werff and Steg, 2015). Green Purchase Intention (Green PI) is one application of NAT, referring to the likelihood and motivation to purchase products with environmentally friendly features (Yusof et al., 2013). The connection between NAT and Green PI underscores the importance of internalized values in promoting sustainable consumer choices.

In the current study, we hypothesized that anticipated pride and guilt play a critical role in driving behaviors aligned with personal norms. Anticipated emotions, such as pride and guilt, act as self-regulatory mechanisms that mediate the relationship between personal norms and actual behavior. Our findings support this hypothesis, demonstrating that anticipated emotions effectively mediate the influence of personal norms on pro-environmental behaviors. Further analysis revealed that these relationships persisted even when the Theory of Planned Behavior (TPB) was integrated into the Norm Activation Model (NAM). In the combined NAM-TPB framework, anticipated emotions influenced behavior indirectly through behavioral intentions. This finding highlights the complex interplay between emotional, normative, and intentional factors in shaping environmentally responsible actions.

The implications of these findings suggest that fostering positive anticipated emotions, such as pride, while mitigating negative ones, like guilt, could strengthen the effectiveness of interventions designed to promote pro-environmental behaviors. By integrating both NAT and TPB perspectives, this study contributes to a more nuanced understanding of the psychological mechanisms underpinning sustainable behavior, offering valuable insights for policymakers and practitioners aiming to encourage environmentally conscious actions.

The Theory of Planned Behavior (TPB) by Ajzen (2011) is essentially an extension of the Theory of Reasoned Action, provides a comprehensive framework for understanding the factors influencing an individual's intention to engage in a specific behavior. This theory delineates three distinct categories of beliefs that collectively shape behavioral intentions and, ultimately, behavior itself.

Firstly, behavioral beliefs refer to an individual's perceptions of the likely outcomes or consequences of performing a behavior. These beliefs form the foundation of attitudes toward the behavior, which can be positive or negative depending on whether the expected outcomes are deemed favorable or unfavorable. For instance, if an individual believes that adopting environmentally friendly practices will lead to significant benefits, such as reduced pollution, they are more likely to develop a positive attitude toward these practices.

Secondly, normative beliefs pertain to the perceived social pressures or expectations from influential figures, peers, or societal norms regarding the behavior in question. These beliefs shape subjective norms, which reflect the degree to which individuals feel compelled to conform to others' expectations. For example, if a student perceives that their friends and mentors value environmental sustainability, they may feel motivated to align their behavior accordingly.

Lastly, control beliefs are concerned with an individual's perception of their ability or resources to execute the behavior successfully. These beliefs influence perceived behavioral control, which encompasses the ease or difficulty of performing the behavior. Factors such as access to resources, knowledge, and external barriers play a critical role in shaping this perception.

Together, these three belief systems – behavioral, normative, and control – form the theoretical underpinnings of the TPB, offering valuable insights into the cognitive processes that drive intentional behavior. By understanding these components, researchers and practitioners can better design interventions to foster positive behavioral changes in diverse contexts, including health promotion, environmental sustainability, and social responsibility. Based on the foregoing discussion, the following hypotheses were developed:

H1: Knowledge lead to behavioural changes towards environmental sustainability through the mediation effect of subjective norms.

H2: Religiousity lead to behavioural changes towards environmental sustainability through the mediation effect of subjective norms.

H3: Policy, rules and regulation lead to behavioural changes towards environmental sustainability through the mediation effect of subjective norms.

H4: Subjective norms leads to behavioural changes towards environmental sustainability since individuals tend to behave in a manner that is in line with social norms.

The conceptual framework is illustrated in Figure 1.

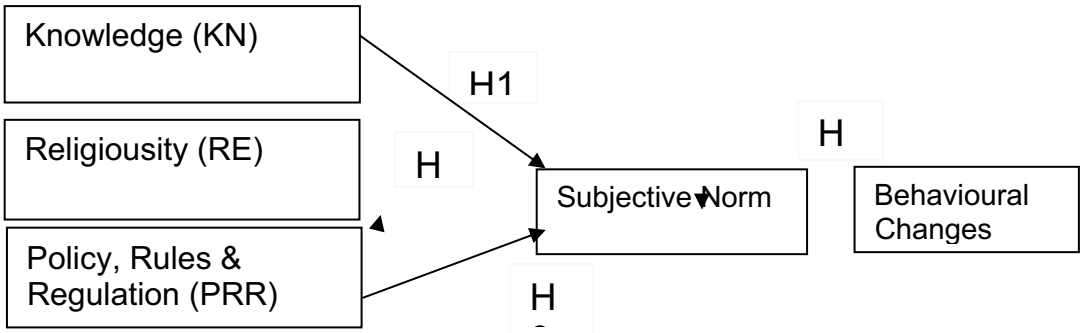

Figure 1. Conceptual Framework (xxx et al. 2021)

3. Methodology

This study employs Partial Least Squares Structural Equation Modelling (PLS-SEM) to investigate the complex interrelationships among knowledge, reasons for usage, attitude, willingness, and digital hesitancy. PLS-SEM is a robust multivariate analysis technique that offers several significant advantages, making it particularly suitable for this research. It is highly flexible in handling non-normal data distributions, which are common in social science research. Additionally, it is well-suited for small sample sizes and is particularly effective for exploratory studies, where the objective is to identify and test theoretical relationships.

Following the methodological guidelines proposed by Anderson and Gerbing (1988), this study adopts a two-step analytical approach using PLS-SEM. The first step involves evaluating the measurement model to ensure the reliability and validity of the constructs. This includes assessing the internal consistency, convergent validity, and discriminant validity of the measurement items. The second step focuses on analyzing the structural model, which tests the hypothesized relationships between latent variables and evaluates the model's predictive relevance and overall fit. This systematic approach ensures a rigorous examination of the theoretical framework and enhances the reliability of the findings.

3.1 Sample and procedure

This research adopts a quantitative methodology, utilizing a survey questionnaire as its primary tool for data collection. The design of the questionnaire was carefully constructed to align with the research objectives and to be comprehensible to students, who form the study's primary respondents. The diverse demographic and educational backgrounds of the students, as well as their varying levels of understanding regarding environmental sustainability, necessitated a thorough review process to ensure clarity and relevance. To this end, the questionnaire was rigorously verified by three internal experts. These experts, all seasoned economics lecturers with over a decade of teaching experience, provided valuable insights to ensure that the questions accurately captured the essence of the research objectives while being accessible to respondents.

Recognizing the potential influence of diversity on the respondents' engagement with environmental sustainability issues, particular emphasis was placed on refining the questionnaire for clarity and contextual appropriateness. This iterative refinement process aimed to minimize ambiguities and ensure that the questions were both inclusive and representative of the target population's perspectives. To further enhance the reliability and validity of the survey instruments, a pilot survey was conducted. The pilot study involved the distribution of 30 questionnaires to a sample group of students. Additionally, follow-up interviews were conducted with 10 respondents from this pilot group to gather detailed feedback on their experience with the questionnaire. These interviews were instrumental in identifying and addressing any issues related to the wording, structure, and interpretability of the questions.

The feedback obtained from the pilot survey and interviews informed the refinement of the questionnaire, ensuring it was optimized for the larger-scale survey. To assess the reliability of the survey instruments, Cronbach's alpha was employed. This statistical measure evaluates the internal consistency of the constructs, providing a reliable gauge of the instruments' robustness. The pilot study's results demonstrated Cronbach's alpha values exceeding 0.6 for all constructs, which is widely regarded as the threshold for acceptable reliability. This affirmed that the survey instruments were well-suited for capturing the data required for this research.

The sampling frame for this study comprised students enrolled in environmental-related economics courses, specifically "Environmental Economics" (ECO646) and "Economic Policies and Issues" (ECO649), within the Business Economics (BA250) bachelor degree program at Universiti Teknologi MARA (UiTM) Cawangan Kedah. These courses were selected because they provide a direct connection to the research theme of environmental sustainability, ensuring that the respondents have at least some foundational exposure to the concepts under investigation. The total student population at UiTM Kedah in 2024 stood at 8,224, offering a broad and diverse pool of potential respondents.

The data collection process spanned three academic semesters from 2023 to 2024, during which a total of 256 questionnaires were distributed to students enrolled in the targeted courses. This approach allowed the research to capture a more representative sample across different cohorts, minimizing potential biases associated with semester-specific factors. Out of the 256 distributed questionnaires, 198 were returned with complete responses, yielding a valid response rate of approximately 77.3%. This robust response rate underscores the students' engagement with the research and provides a solid foundation for the subsequent analysis.

The unit of analysis for this study is the individual student, with each respondent providing unique insights into their knowledge, attitudes, and behaviors related to environmental sustainability. By focusing on individual-level data, the study is able to explore the nuanced relationships between the variables of interest, such as knowledge, reasons for engaging in environmental sustainability, attitudes, willingness to act, and potential hesitancies.

The research design also incorporated strategies to ensure data quality and mitigate potential biases. For instance, the questionnaire's structure was carefully organized to facilitate ease of understanding and prevent respondent fatigue. Questions were grouped thematically, with clear instructions provided for each section. Additionally, the use of both close-ended and Likert-scale questions allowed for the collection of quantitative data while also capturing the respondents' perceptions and attitudes in a structured manner.

The demographic diversity of the respondents added depth to the study, as it included students from various socioeconomic and cultural backgrounds. This diversity is particularly relevant given the study's focus on environmental sustainability, a topic influenced by individual values, cultural norms, and prior exposure to environmental issues. By sampling from a population with such varied perspectives, the study ensures a more comprehensive understanding of the factors driving or hindering engagement in environmental sustainability among students. Moreover, the inclusion of a pilot study and the iterative refinement of the questionnaire demonstrate the research's commitment to methodological rigor. These steps not only enhanced the reliability of the data collection instruments but also ensured that the questions were contextually relevant and resonated with the respondents. The pilot study served as a critical testing ground, allowing the researchers to identify and address potential issues before the full-scale survey was launched. The use of Cronbach's alpha to assess the reliability of the constructs further underscores the methodological robustness of the study.

In summary, the quantitative approach in this study, centered on a meticulously designed and validated survey questionnaire, provides a solid foundation for exploring the factors influencing environmental sustainability among students. The rigorous verification process, involving expert review, pilot testing, and iterative refinement, ensures the reliability and validity of the survey instruments. The thoughtful sampling strategy, combined with the focus on individual-level analysis, enables the study to capture diverse perspectives and contribute valuable insights to the discourse on environmental sustainability in higher education. By leveraging a systematic and

methodologically sound approach, this research offers a comprehensive examination of the complex interplay between knowledge, religiousity, and policies on the changes in behaviour in the context of environmental sustainability.

3.2 Measures

This study investigates the factors contributing to behavioral changes toward environmental sustainability by examining the roles of knowledge, religiosity, and policies, rules, and regulations. These factors are mediated by subjective norms, which reflect the social pressures and expectations influencing individual behaviors. To capture respondents' perceptions accurately, all constructs utilize a uniform response format: a 5-point Likert scale ranging from strongly disagree (1) to strongly agree (5). This standardized approach ensures consistency and comparability across constructs. The constructs themselves were carefully adapted and consolidated to align with the study's objectives, providing a comprehensive framework for understanding behavioral changes within the university context.

Behavioural changes toward environmental sustainability, is loosely based on the theory of norm activation, theory of social change and theory of planned behaviour. By integrating established theoretical underpinnings with tailored measures, the research aims to provide new insights into how university students' attitudes and external influences shape their engagement with environmental sustainability efforts.

4. Results

For the measurement model, internal consistency was rigorously assessed using Cronbach's alpha and composite reliability. Table 1 illustrates that the Cronbach's alpha and composite reliability values for all constructs exceed the recommended threshold of 0.8, as suggested by Nunnally (1978), thus affirming internal consistency. To establish convergent validity, two key criteria were examined: the outer loadings of the indicators, which should be greater than 0.7, and the average variance extracted (AVE), which should exceed 0.5, as per the guidelines provided by Hair et al. (2017). Table 1 confirms that all constructs meet these criteria, with outer loadings surpassing the 0.7 threshold and AVE values ranging from 0.869 to 0.979, providing robust evidence of convergent validity. Constructs with outer loadings below the acceptable limit, such as BE2 and SN5, were excluded from the model to ensure precision. Figure 2 further supports these findings by showcasing the measurement model, where all factor loadings are above 0.819, corroborating the constructs' internal consistency and validity.

Based on Table 2, discriminant validity was evaluated using two complementary methods: the Fornell-Larcker criterion and the Heterotrait-Monotrait ratio (HTMT). The HTMT criterion, grounded in the work of Henseler et al. (2015), stipulates that the value between two constructs should remain below 0.85, while Kline (2011) recommends a stricter threshold of 0.5. Table 2 demonstrates that the HTMT values for all constructs fall between 0.142 and 0.726, well within the acceptable range, thereby fulfilling the discriminant validity requirement. Additionally, the Fornell-Larcker criterion asserts that the square root of the AVE for each construct should exceed the inter-construct correlations. Table 2 shows values ranging from 0.40 to 0.949, consistently meeting this standard. Together, these results confirm that the measurement model satisfies all discriminant validity concerns, ensuring the reliability and robustness of the constructs used in this study.

Table 1
Measurement Model

Constructs	Items	Outer Loadings	Cronbach's Alpha	Composite Reliability	AVE	f^2
Behavioural Change	BE1	0.965	0.963	0.964	0.973	*0.900*
	BE3	0.939				
	BE4	0.936				
	BE5	0.955				
Knowledge	KN1	0.876	0.915	0.924	0.940	*0.798*
	KN2	0.928				
	KN3	0.926				
	KN4	0.840				
Policy, Rules & Regulations	PRR1	0.848	0.773	0.775	0.869	*0.688*
	PRR2	0.821				
	PRR3	0.819				
Religiousity	RE1	0.912	0.92	0.936	0.943	*0.805*
	RE2	0.906				
	RE3	0.880				
	RE4	0.890				
Subjective Norms	SN1	0.983	0.972	0.974	0.979	*0.923*
	SN2	0.961				
	SN3	0.955				
	SN4	0.942				

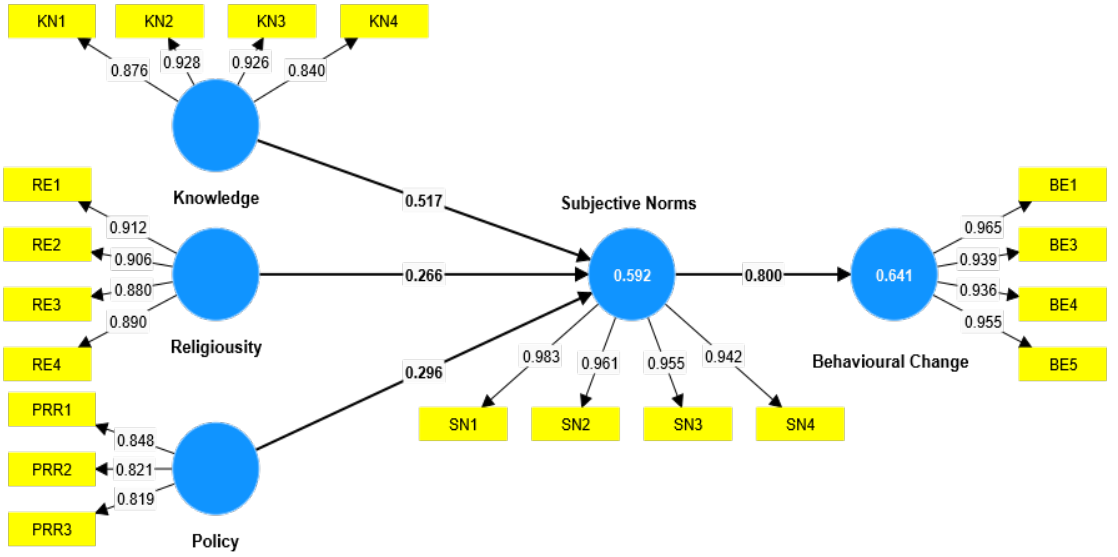

Figure 2. Measurement Model

Table 2
Discriminant Analysis

HTMT	Behavioural Change	Knowledge	Policy	Religiousity	Subjective Norms
Behavioural Change					
Knowledge	0.697				
Policy	0.649	0.654			
Religiousity	0.305	0.071	0.142		
Subjective Norms	0.726	0.707	0.686	0.270	

Fornell-Larcker	Behavioural Change	Knowledge	Policy	Religiousity	Subjective Norms
Behavioural Change	0.949				
Knowledge	0.658	0.893			
Policy	0.819	0.555	0.830		
Religiousity	0.291	0.040	0.049	0.897	
Subjective Norms	0.800	0.671	0.596	0.260	0.961

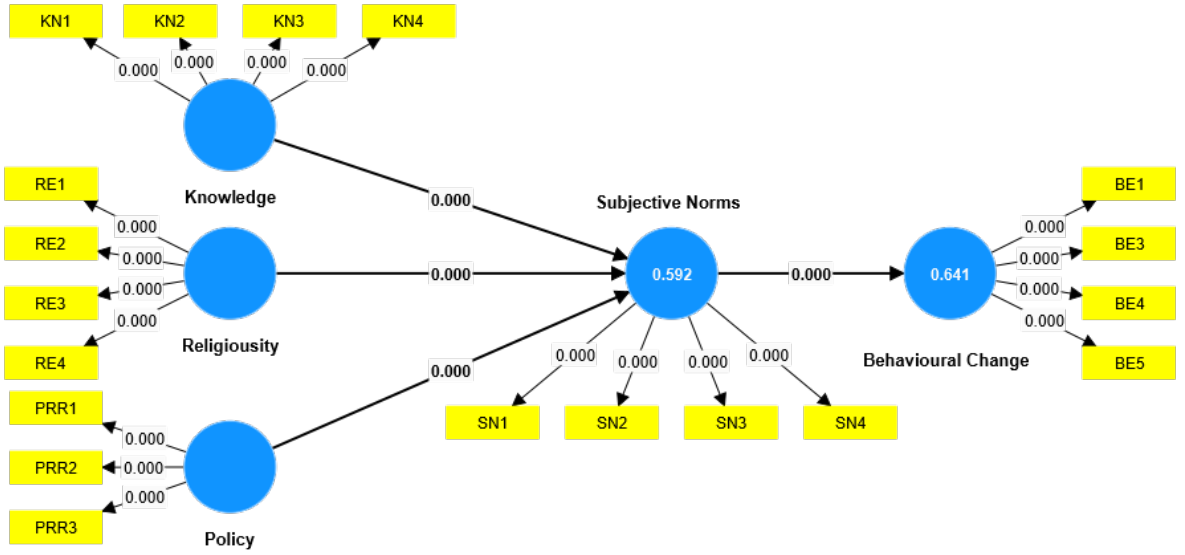

Figure 3. Structural Model

To evaluate the significance of the coefficient paths within the structural model, a bootstrapping technique with 10,000 resamples was applied. This robust statistical method enhances the reliability of the results by generating a distribution of estimates to test the significance of relationships. Table 3 presents the findings for both direct and total effects, highlighting how each construct influences behavioral changes toward environmental sustainability.

For the direct effects, the results reveal that knowledge, religiosity, policies, rules, and regulations, as well as subjective norms, all have a significant positive impact on behavioral changes toward environmental sustainability. These findings underscore the importance of these constructs as direct predictors of pro-environmental behavior. When examining the total effects, the results indicate that subjective norms play a crucial mediating role, reinforcing the direct effect findings. Subjective norms serve as an intermediary through which other constructs exert their influence on behavioral change. Specifically, knowledge, religiosity, and policies, rules, and regulations significantly affect subjective norms, which, in turn, positively impact behavioral changes toward environmental sustainability. This mediating role highlights the importance of social and cultural pressures in shaping individual behavior.

Overall, the results emphasize the interconnectedness of these constructs, demonstrating a holistic framework for understanding the drivers of environmental sustainability behaviors. These insights provide actionable pathways for designing interventions and policies aimed at fostering environmental stewardship. Figure 3 illustrates the structural model.

Table 3
Structural Model

Direct Effect	Coefficient	Standard Error	t-stats	p-values
Knowledge -> Subjective Norms	0.515	0.077	6.678	0.000
Policy -> Subjective Norms	0.298	0.077	3.824	0.000
Religiousity -> Subjective Norms	0.264	0.056	4.761	0.000
Subjective Norms -> Behavioural Change	0.799	0.047	17.006	0.000

Total Effect	Coefficient	Standard Error	t-stats	p-values
Knowledge -> Behavioural Change	0.412	0.068	6.059	0.000
Knowledge -> Subjective Norms	0.515	0.077	6.678	0.000
Policy -> Behavioural Change	0.240	0.069	3.457	0.000
Policy -> Subjective Norms	0.298	0.077	3.824	0.000
Religiousity -> Behavioural Change	0.211	0.046	4.636	0.000
Religiousity -> Subjective Norms	0.264	0.056	4.761	0.000
Subjective Norms -> Behavioural Change	0.799	0.047	17.006	0.000

To evaluate the causal-predictive ability of the constructs, a PLS Predict analysis was conducted. Alongside assessing the significance of path coefficients, the predictive power of the model was examined by analyzing the coefficient of determination (R^2) values of the endogenous constructs, as recommended by Hair et al. (2017). The results demonstrated that the model accounted for 64.1% of the variance in BE and 59.2% of the variance in SN, indicating substantial explanatory power.

Additionally, a blindfolding procedure with an omission distance of k=10 was performed to calculate the Stone-Geisser's Q^2 values. The Q^2 values for BE and SN were found to be 0.668 and 0.57, respectively. Since both values exceed zero, the research model was confirmed to possess predictive relevance.

Furthermore, a detailed PLS Predict analysis, as outlined by Shmueli et al. (2016), was carried out. Table 4 illustrates that the Q^2 predict values for BE and SN are greater than zero, indicating that the prediction error in the PLS-SEM results is lower than that of the mean values. When compared to a naive linear regression model (LM), the PLS benchmark demonstrated lower prediction errors, as measured by RMSE or MAE, across most indicators. These findings suggest that the model exhibits medium predictive power, further validating its utility in understanding and predicting behavioral outcomes.

Table 4
PLS Predict

	Q^2predict	PLS-SEM_RMSE	PLS-SEM_MAE	LM_RMSE	LM_MAE
BE1	0.630	0.404	0.286	0.302	0.225
BE3	0.616	0.436	0.312	0.339	0.248
BE4	0.556	0.452	0.327	0.389	0.282
BE5	0.602	0.456	0.327	0.41	0.297
SN1	0.576	0.435	0.284	0.439	0.293
SN2	0.548	0.481	0.316	0.489	0.329
SN3	0.506	0.448	0.303	0.453	0.317
SN4	0.461	0.499	0.336	0.506	0.352

Robustness Check

To ensure the robustness and validity of the results, three diagnostic tests were performed. Firstly, a Confirmatory Tetrad Analysis (CTA) was conducted to determine whether the constructs were reflective or formative in nature. The findings, as presented in Table 5, indicate that the majority of the results are statistically insignificant, thereby confirming the reflective nature of the items used in the model.
Secondly, to assess the potential issue of endogeneity within the model, the Gaussian Copula method was employed. The results, illustrated in Figure 4, reveal no significant effects, thereby indicating the absence of endogeneity problems in the data. This finding supports the reliability of the model's estimations and causal inferences.
Lastly, the issue of nonlinearity was examined using the Quadratic Effect Test. As depicted in Figure 5, the results indicate that the constructs of knowledge (KE) and religiosity (RE) exhibit nonlinearity. This observation suggests that the relationships involving these variables may not follow a strictly linear pattern, warranting further investigation or potential model adjustments to address these nonlinear effects effectively.

Table 5
Confirmatory Tetrad Analysis

Construct	**Coefficient**	**Standard Error**	***p*-values**	**Bias**	**CI low**	**CI up**
Knowledge						
1: KN1,KN2,KN3,KN4	0.021	0.01	0.025	0.000	0.003	0.041
2: KN1,KN2,KN4,KN3	0.037	0.009	0.136	-0.001	0.019	0.056
Behavioural Change						
1: BE1,BE3,BE4,BE5	0.011	0.007	0.149	0.000	-0.004	0.025
2: BE1,BE3,BE5,BE4	0.013	0.008	0.088	0.000	-0.002	0.028
Religiousity						
1: RE1,RE2,RE3,RE4	0.101	0.02	0.251	-0.001	0.066	0.143

2: RE1,RE2,RE4,RE3	0.076	0.022	0.232	-0.001	0.036	0.121
Subjective Norms						
1: SN1,SN2,SN3,SN4	-0.006	0.003	0.112	0.000	-0.012	0.000
2: SN1,SN2,SN4,SN3	-0.006	0.003	0.069	0.000	-0.012	0.000

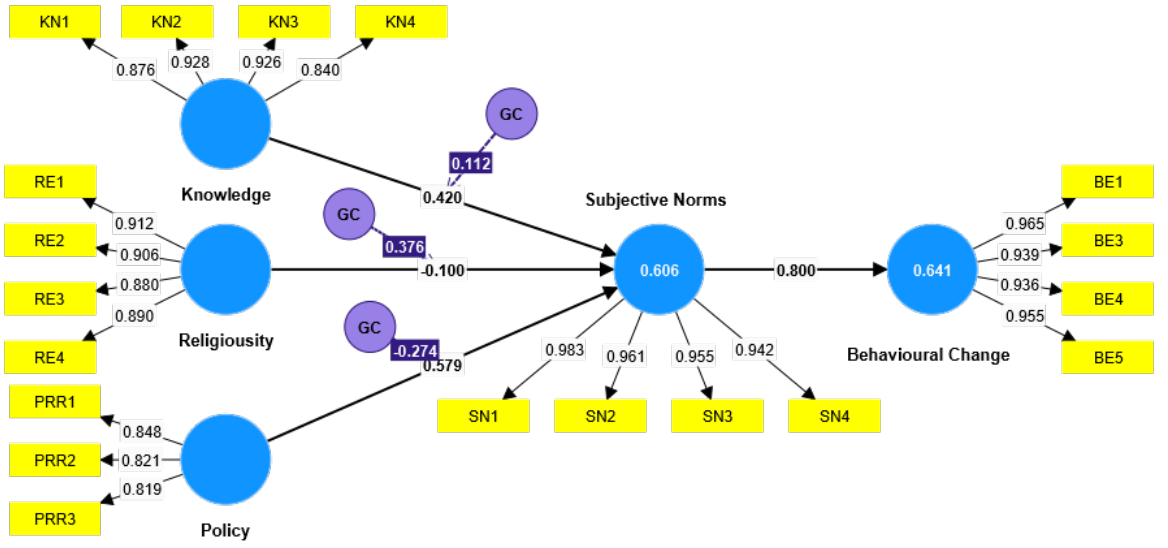

Figure 4. Test for Endogeneity – Gaussian Copula

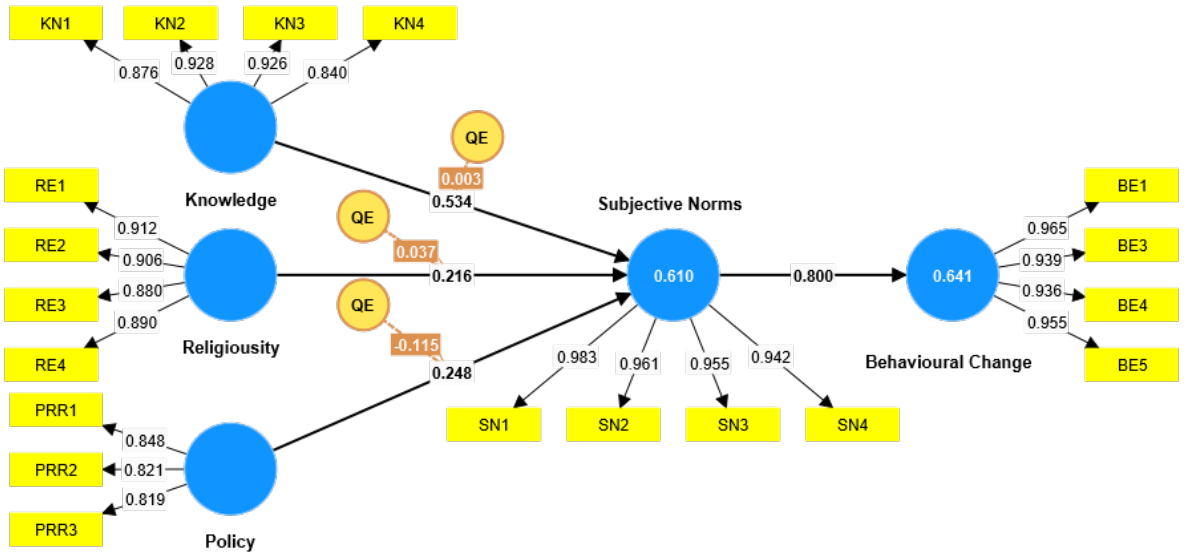

Figure 5. Test for Nonlinearity – Quadratic Effect

5. Discussion

The findings of this study highlight the significant positive effect of knowledge on behavioral changes toward environmental sustainability. Specifically, students who are aware of the detrimental effects of environmental pollution and degradation are more likely to modify their behavior in favor of conservation efforts. This result aligns with prior studies, which have consistently demonstrated that knowledge plays an important role in fostering green behavioral changes. Contextually, the more individuals are exposed to information about the severity of environmental degradation, the greater their propensity to engage in environmentally responsible actions, such as recycling or purchasing green products. The observed positive relationship between knowledge and behavioral change also extends to its connection with subjective norms. Awareness of the adverse consequences of environmental degradation not only influences intrinsic motivation but also shapes societal expectations, thereby fostering collective action.

Religiosity emerged as another significant factor influencing behavioral changes toward environmental sustainability. As the respondents in this study were all Muslim, their understanding of environmental stewardship, as emphasized in the Quran, likely motivated their pro-environmental behaviors. This sense of moral and spiritual responsibility translated into concrete actions such as recycling, reducing food waste, and conserving energy by switching off unused lights. These findings align with existing literature suggesting that religious teachings often instill a sense of duty toward environmental preservation. The role of religiosity in shaping behavior underscores the importance of integrating spiritual and ethical dimensions into environmental education and advocacy efforts.

The study also underscores the role of social norms as a mediating variable in promoting behavioral changes. Social norms favouring environmental sustainability were found to significantly influence students' actions. This finding is supported by De Groot and Steg (2009), who identified that individuals who perceive a sense of responsibility in challenging situations often experience feelings of guilt, which, in turn, drive their actions. The interplay between social norms and intrinsic motivation highlights the importance of community-driven initiatives in fostering pro-environmental behavior.

Policies, rules, and regulations constitute the third factor examined in this study and were shown to significantly impact both subjective norms and behavioral changes. Efforts such as awareness campaigns, regulations mandating waste recycling, the establishment of more recycling centers, and the availability of affordable green product alternatives have collectively enhanced accessibility and choice for environmentally responsible actions. These measures not only facilitate ethical consumer behavior but also create social pressures that compel individuals to adopt conservation-oriented practices. The increased availability and affordability of green products, coupled with regulatory support, amplify consumers' ethical obligations and translate into tangible behavioral changes.

Additionally, the mediating role of subjective norms was assessed, revealing that subjective norms effectively mediate the relationships between knowledge, religiosity, and policies, rules, and regulations with behavioral changes. While all three factors independently influence behavioral changes, the inclusion of subjective norms as a mediating variable further accentuates their effects, illustrating the interconnectedness of individual, societal, and institutional influences on environmental behavior.

Despite these insights, the study has a few limitations. Firstly, the sample was confined to students enrolled in environmental-related courses within the Faculty of Business Management at Universiti

Teknologi MARA Cawangan Kedah only. Future research should consider expanding the sample to include the general public to enhance the generalizability of the findings. Secondly, the use of cross-sectional data, albeit collected over three semesters, limits the ability to draw causal inferences. Longitudinal studies are recommended for future research to better capture the dynamics of behavioral changes over time. Addressing these limitations will provide a more comprehensive understanding of the factors driving environmental sustainability behaviors and strengthen the applicability of the findings to broader contexts.

6. Conclusion

This study has highlighted the intricate interplay of knowledge, religiosity, and policy frameworks, mediated by subjective norms, in influencing behavioral changes toward environmental sustainability. The findings emphasize that fostering environmentally responsible behaviors requires a multi-dimensional approach that integrates education, cultural values, and regulatory mechanisms.

Knowledge emerged as a critical driver of pro-environmental behaviors, reinforcing the idea that individuals equipped with an understanding of the adverse effects of environmental degradation are more likely to adopt sustainable practices. This underscores the importance of comprehensive environmental education programs that not only disseminate information but also inspire action through critical awareness and decision-making skills.

Religiosity, particularly within the context of Islamic teachings, was found to significantly influence environmental behaviors. Core principles such as stewardship, moderation, and the prohibition of wastefulness serve as moral imperatives that resonate with sustainable living. The study highlights the underexplored potential of integrating religious values into environmental advocacy, demonstrating how spiritual teachings can inspire practical actions such as recycling, energy conservation, and reduced consumption. This finding calls for a greater emphasis on leveraging cultural and spiritual dimensions in environmental initiatives, particularly in Muslim-majority contexts.

Policy interventions, including regulations, awareness campaigns, and incentives for sustainable practices, were shown to play a pivotal role in shaping behaviors. The study reaffirms that well-structured policies, when aligned with societal norms and cultural values, can enhance accessibility and motivation for adopting green practices. For instance, making green products affordable and available while enforcing waste recycling policies creates an enabling environment for behavioral change.

The mediating role of subjective norms was also significant, demonstrating the power of social expectations and community-driven initiatives in promoting pro-environmental actions. This finding suggests that collective action and societal pressures can amplify the effects of individual knowledge and values, creating a ripple effect that drives broader behavioral shifts.

While the study offers valuable insights, its scope is limited to university students enrolled in environmental-related courses at Universiti Teknologi MARA Cawangan Kedah. Future research should expand to include diverse demographic groups to enhance the generalizability of findings. Additionally, the cross-sectional design limits causal inferences; longitudinal studies are recommended to capture the evolving dynamics of behavioral change over time.

In conclusion, this study provides a comprehensive framework for understanding the drivers of behavioral changes toward environmental sustainability. By integrating theoretical insights from the Theory of Planned Behavior and Norm Activation Theory, it offers a robust model for designing

interventions that leverage education, religiosity, and policy frameworks. These findings contribute to the growing discourse on sustainability and provide actionable recommendations for policymakers, educators, and community leaders seeking to foster a green lifestyle. Addressing environmental challenges requires a holistic approach that aligns individual values with societal norms and institutional support, paving the way for a sustainable future.

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