THE INFLUENCE OF ENVIRONMENTAL FACTORS ON ECOLOGICAL BELIEFS AND ECOLOGICAL BEHAVIOUR OF ENERGY-EFFICIENT APPLIANCE PURCHASE

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ABSTRACT

Previous ecological behaviour studies have focused on personal factors only, and thus ignored the impact of environmental factors on ecological behaviour. In addition, there are criticism on the complexity of belief component in the value-belief-norm theory. Hence, this study aims to investigate the effect of environmental factors and to assess the mediating role of ecological beliefs on energy-efficient appliance purchasing. This study utilised a questionnaire survey among 592 Malaysian consumers. The partial least squares technique was utilised to analyse the data and to test the study hypotheses. The findings show that environmental factors have a positive influence on both ecological beliefs and ecological behaviour; ecological beliefs are positively related to ecological behaviour. Additionally, ecological beliefs mediate the relationship between environmental factors and ecological behaviour. This holistic research framework helps to elaborate on the existing knowledge of environmental factors and an individual's belief, in the context of energy-efficient appliance purchase.

Keywords: ecological behaviour, ecological beliefs, social influences, facilitating conditions, energy-efficient appliances

INTRODUCTION

The use of electricity is increasing day by day and the demand is rising faster than the overall global electricity generation rate (Energy Information Administration, 2021). As such, many government agencies, non-profit organisations, and industries are researching this issue, in hopes of formulating an effective solution that can overcome this problem (Waris & Hameed, 2020a). One solution is to encourage consumers to purchase and use energy-efficient household appliances due to the difficulties to execute energy efficiency programme at the industry level (Cherry et al., 2017). Compared to traditional appliances, energy-efficient appliances can reduce electricity consumption and utility expenses as well as conserve electrical energy that is in a depletion status (Hernandez et al., 2017).

In recent years, "ecological behaviour" has become a global phenomenon due to the rising awareness of environmentalism – an ideology that evokes the necessity and responsibility of human to respect, protect, and preserve the natural environment (Chan et al., 2021). This field of study has received considerable attention from both academic and industry experts that focus on behaviours such as recycling, waste reduction, conservation of energy, and even green consumerism. As a consumer, efforts can be made to purchase "green" household appliances. Such wise decisions can help to minimise negative impacts towards the natural environment (Guckian et al., 2017). Through human behaviour change interventions, it helps in reducing the environmental problems that attributed to the human actions or activities (Chan & Lee, 2016; Hameed & Khan, 2020).

Individual behaviour change is a necessary condition for making a positive societal transition (Guckian et al., 2017). Several theories suggested that positive attitudes are closely related to human behaviour (Hagger et al., 2016; Paul et al., 2016; Teo, 2016). Thus, if a consumer believes that energy-efficient appliances can reduce their utility expenses while protecting the environment, they are likely to purchase them without any hesitation (Venkatesh et al., 2003). Nevertheless, the use of energy-efficient appliances in Malaysia is still at an unsatisfactory level as many consumers are not replacing their household appliances with energy-efficient ones (Tan et al., 2017a). Thus, this study examined the factors that influenced the purchase of energy-efficient appliances. This is an important issue to be researched because the Malaysian government had invested resources in promoting the adoption of energy-efficient appliances among the consumers since 2005.

The value-belief-norm (VBN) theory (Stern, 2002) is developed specifically for ecological behaviour studies. It postulates a causal chain of seven antecedent variables of ecological behaviour: three value orientations, three belief components,

and personal norms. The VBN theory has been applied and proven to be useful in studying many pro-environmental behaviour studies (Carfora et al., 2021; Hwang et al., 2020; Liu et al., 2018; Sanchez et al., 2016).

Currently, ecological behaviour studies have explored that ecological behaviour is shaped by the individual's values and beliefs (Liu et al., 2020). The VBN theory focuses solely on internal (individual) factors such as attitudes, personalities, knowledge, and intentions (Fraj & Martinez, 2007; Wu et al., 2013). It makes sense that a study on human behaviour requires a multi-dimensional view which incorporates both internal and external elements (Devi et al., 2017). Environmental factors that a person encounters significantly influence its perception and behaviour, including purchase behaviour (Young et al., 2017). In short, consumers are surrounded by environmental factors that influence their purchase decisions (Bues et al., 2017). Thus, the question whether environmental factors influencing the ecological behaviour has to be addressed. In this study, the effects of social influences and facilitating conditions on both ecological beliefs and ecological behaviour are investigated.

Environmental attitudes or beliefs can be considered an important antecedent of environmental behaviour (Ghazali et al., 2019). In the VBN theory, the belief component is represented by three variables, such as ecological worldview (NEP), adverse consequences for valued objects (AC), and perceived ability to reduce threat (AR). This makes the value-belief relationship in the VBN theory is not being measured and tested directly (Steg et al., 2005). Similarly, such situation causes the complexity in measuring a person's belief (Chan et al., 2021). Even Stern et al. (1995) concluded that NEP, AC, and AR measure only a single belief construct. This issue needs to be addressed with the adoption of a simpler and straightforward approach in dealing with the belief construct. Therefore, this study adopted a new and single ecological beliefs variable in measuring and dealing with the belief component in the research model. With that, the mediating role of ecological beliefs were also investigated.

Based on the above discussion, this study investigated the phenomenon through the inclusion of environmental variables and the modification of measurement approach on ecological beliefs component. Specifically, this study aims to: (1) investigate the effect of social influences and facilitating conditions on ecological beliefs and ecological behaviour; (2) investigate the effect of ecological beliefs on ecological behaviour, and (3) assess the mediating role of ecological beliefs on the relationship between environmental factors and ecological behaviour.

This study sets out to make the following contributions: First, the inclusion of environmental factors that have been ignored in previous studies. Second, adopting a simpler and straightforward measurement approach on ecological belief variable. Third, testing the mediating effect of ecological beliefs, which seems to be very rare in pro-environmental studies. Findings from this study can help the government and industry to formulate appropriate strategies in promoting the adoption of energy-efficient appliances. The insights generated can be served as the input for the energy efficiency plans where the government is actively seeking research collaborations via The Association of Water and Energy Research Malaysia (AWER) (Tan et al., 2017a). Useful marketing information such as purchase pattern, purchase motivation and purchasers' profile will help marketers to develop a better product positioning and promotion plan in facilitating the adoption process.

LITERATURE REVIEW

Underpinning Theories

There are theories developed and tested in studying the general human behaviour (Teo, 2016). In the pro-environmental related studies, the VBN theory is commonly used for investigating various issues (Canlas et al., 2022). The VBN theory posits that personal values and beliefs towards the environment are found to be influencing pro-environmental behaviours (Chua et al., 2016). Thus, belief is considered an important antecedent of ecological behaviour (Han, 2021). There are researchers adopted and tested the whole model (Li et al., 2018), and also only some components of the model (Carfora et al., 2021). Many previous studies adopted and validated the VBN theory in different study contexts. For instance, Ananno et al.'s (2021) study related to e-waste management; Chan et al.'s (2021) study pertaining to energy-efficient appliances purchase; Wang et al.'s (2021) study pertaining to green hotels adoption; and Zhang et al.'s (2020) study related to acceptance of green transport and so on. Since the present study is related to ecological behaviour, it is appropriate to build the foundation of the research framework by using this prominent and same-context theory (Levit & Cismaru, 2020). The above assertions justified the resources used to form the founding theories for this study in explaining the ecological behaviour of energy-efficient purchase.

Ecological Beliefs and Behaviour

Belief is considered as one of the important factors for understanding human behaviour (Zhang et al., 2021). Previous ecological behaviour studies are focused on

the belief components, understanding these as the result of a rational costs-benefits analysis derived from environmental behaviour (Chan et al., 2018; Venugopal & Shukla, 2019). Han (2021) explained that ecological beliefs refer to the beliefs about the relationship between human beings and the natural environment as well as the consequences of ecological protection or deterioration, based on personally valued aspects. It is clearly evident that ecological beliefs are referring to the human-environmental relationship which refers to a sense of awareness and obligation that provides cues for appropriate environmental behaviour (Quoquab et al., 2020).

On the other hand, ecological behaviour is observed in many societies which intends to protect and to reduce negative impacts on the environment. Ecological behaviour basically refers to those actions which contribute towards environmental preservation and/or conservation (Bennett et al., 2018). According to Kothe et al. (2019), ecological behaviour refers to the activities that intend to protect the environment or to reduce the deterioration of the environment. Ecological behaviour seeks to minimise the negative impact of one's actions on the natural and built world (Rausch & Kopplin, 2021).

The terminology of ecological behaviour has been conceptualised in different ways throughout the decades (Han, 2021; Sanchez et al., 2016). For instance, Chan (2001) explained this term from the consumerism perspective which refers to a specific kind of eco-friendly behaviour that consumers perform to express their concern over the environment. From the same perspective, Rashid (2009) described it as the willingness of individuals who give preference to products that contain features that are environmentally friendly when compared to the purchase of other traditional products. Thus, the operational definition of ecological behaviour in this study refers to those actions by individual consumers in purchasing household appliances that are equipped with energy saving feature.

A direct consequence of overusing electricity is an increase in utility expenses. However, conserving electricity is not just about cost saving; there are more important issues that are at hand. The Organisation for Economic Co-operation and Development (OECD) warns that energy-related emissions will increase by 70% by 2050 (Energy Information Administration, 2021). Most electricity is produced by burning coal and oil. Such generation processes not only cause air pollution due to emission of carbon dioxide, but also cause a decline in the availability of input minerals for the near future (Chen et al., 2021). Furthermore, those emissions can accelerate the negative consequences of climate change including higher temperatures and extreme weather events (Rehman et al., 2021).

Environmental Factors

Consumers are surrounded by environmental factors that influence their purchase decisions (Bues et al., 2017). Some of these factors are constants, while some are more situational in nature. For instance, shopping with someone else can definitely affect the types of products that a person will look at or even the price level of the products that may consider purchasing. As such, the consumer behaviour is not solely based on internal factors (e.g., personality, culture, and social influences); the external factors have to be taken into consideration as well (Kimiagari & Malafe, 2021). In technology acceptance context, both social influences and facilitating conditions are the environmental factors that significantly influence the adoption decision (Feng et al., 2021).

Social influences relate to the degree to which an individual perceives the importance of others believing he or she should or should not perform the behaviour in question (Venkatesh et al., 2003). Social factors such as religion, family, and friends, are constantly affecting human beings' decisions and lifestyles. Every individual belongs to a group and has someone around influencing their decision and behaviour (Trudel, 2019). Hence, social influence is the change in behaviour that one person causes in another (Yuen et al., 2021).

Facilitating conditions relates to the degree to which an individual believes that an organisational and technical infrastructure exists to support the use of the system (Venkatesh et al., 2003). It is the belief of the existence of resources, such as training support, special discounts, and free installations that will assist users in using a new system. It refers to the users' perception of the presence of control factors that might facilitate or hinder the performance of a behaviour (Momani, 2021).

External environmental factors have a significant effect on technology acceptance (Atulkar & Kesari, 2018). The influence of social influences and facilitating conditions on the adoption of new system have been examined in the literature in different contexts such as electronic train tickets (Park & Ahn, 2021), social media adoption (Puriwat & Tripopsakul, 2021), e-learning system (Abbad, 2021), and mobile banking (Chee et al., 2021).

RESEARCH FRAMEWORK AND HYPOTHESES DEVELOPMENT

Social influences are having an impact on various behaviours, as found in many previous studies. For instance, Harman and Koivisto (2015) studied the social

influences on exercise practice; Smyth et al. (2017) studied the social influences on learning behaviour; Previte et al. (2015) studied the social influences on drinking behaviour; and also Cruwys et al. (2015) that studied the social influences on food choice. Even in the ecological behaviour context, social influences are an important driver of these behaviours. Johnstone and Hooper (2016) reveal that social influence factors are influencing the green product consumption decisions. Gifford and Nilsson (2014) found that the relationship between social influence and environmental concern and behaviour is significant.

Prior studies that tested the relationship between facilitating conditions and the system usage intention or actual usage proved to be significant and positive. In Tarhini et al.'s (2013) cross-sectional study on 604 British university students, facilitating conditions are found to having a positive influence on the adoption and usage of the Blackboard system. In explaining the teachers' intentions to continue using ICT in arts classrooms, Rahmat and Au (2013) found a significant correlation between the relationship of facilitating conditions and teachers' intentions to use ICT.

Bakar and Abdul Razak (2014) prove that the relationship between the facilitating conditions and continuance intention is significant and positive among the Malaysia public higher education students. For the e-banking context, Ghalandari (2012) did a survey on 310 customers of Bank Melli, Iran, and found that all four predictors in the study (including facilitating conditions), had a positive and significant effect on users' behaviour and intention to use e-banking services. Yu (2014) concluded that the individual intention to adopt mobile banking is influenced by facilitating conditions. Yang and Forney (2013) found that facilitating conditions were significantly influencing the adoption of mobile shopping.

The above discussion shown that environmental factors are influencing human behaviour including ecological behaviour. Both social influences and facilitating conditions are common environmental variables found to have direct effects on behaviour (Venkatesh et al., 2003). These relationships, between environmental factors and behaviour are well-documented (Chin et al., 2016; Muti Altalhi, 2021). But in pro-environmental action studies, limited research is adopting or adapting environmental factors in explaining this issue (Lee, 2010). Obviously, this is a shortcoming in the literature. Hence, considering this gap, the following hypotheses are proposed:

H1:   Social influences positively affect ecological behaviour.

H2:   Facilitating conditions positively affect ecological behaviour.

Situational factors will influence human's belief, and in turn, affect the human behaviour (Beck et al., 1979). In other words, a belief that is held by a person (self-concept) is subject to external influences in the environment (Tchetchik et al., 2021). This relationship was tested mainly in technology adoption and acceptance field. However, there is a dearth of research that examines this relationship in an ecological behaviour context.

Mazzarolo et al. (2021) did a study that aimed to explain the user satisfaction on Instagram and found that social influence is noted as the one of the factors influencing the users' attitude. Yoo et al.'s (2021) study suggested that social influences are likely to be important influences on the adoption of smartphones in South Korea. Yu (2014) also found that the adoption of mobile banking among the 441 consumers was significantly related to social influence. From the adoption of the Moodle context, Hsu (2012) found that social influence is significantly related to students' behavioural intentions. Sumak et al. (2010) found that social influence has a significant impact on students' behavioural intention to use Moodle, and that students' behavioural intentions are a powerful predictor of the use of the e-learning system.

Boca (2021), in the study of online education among the 300 college students in Romania, found that a supportive environment affects the college students' attitude towards online learning. Whereas in Abu et al.'s (2015) study that focused on the adoption of technology for Malaysian small-medium enterprises (SMEs) in the food industry, they found that available training and support from others could influence their usage intention. This is because these SMEs are not having the knowledge and skill in operating some of the advanced technologies. There is another cross-cultural study conducted by Tarhini et al. (2013) that found that the facilitating condition influences the students' belief about the potential benefits of using educational technology in their learning process. This result is similar as compared with the British and Lebanese university students. Also, Wu and Ho (2021) found that facilitating condition is affecting the user attitude for live chat usage in mobile banking.

There are many studies prove that external environmental factors are influencing a person's perception, and subsequently their actual behaviour (Maartensson & Loi, 2021). However, in pro-environmental action research, researchers are only focusing on internal (individual) factors in studying the ecological behaviour such as attitudes, personalities, knowledge, and intentions (Wu et al., 2013). Limited study is focusing on external factors. The internal and external factors should be included in studying technology acceptance and adoption issues (Venkatesh et al., 2003). Both social influences and facilitating conditions are common predictors

in many behavioural studies. Since the present study is looking into the issue of energy-efficient appliances purchase behaviour, these variables are appropriately to be applied and extended here as well. Hence, the following hypotheses are proposed:

H3: Social influences positively affect ecological beliefs.

H4: Facilitating conditions positively affect ecological beliefs.

According to Stern (2002), environmental beliefs may indicate how people relate to the environment and their willingness to act so more or less environmentally-friendly and may contribute to the understanding of ecological behaviour and its various manifestations. Thus, researchers began to present specific items on the characteristics of natural and environmental problems faced and general items on man's relationship to the environment. Lopez and Arango (2008) believe that the environment can be understood as social beliefs about the relationship between the human being and the environment ranging from an anthropocentric to an ecocentric perspective.

There are many theories that found the relationship between attitude/belief and behaviour is correlated (Topal et al., 2021). A study conducted by Ihemezie et al. (2021) focused on the forest conservation found that the positive attitudes and human behaviours were linked. Another study that was conducted by Han (2015) by looking at the green lodging behaviour among the travellers found that the attitude element is linked with the intention and actual behaviour of adoption of green lodging. However, these attitude formations are more on the positive and negative perceptions of that particular behaviour, but not the actual belief of such behaviour.

The VBN theory that is specifically developed for the ecological behaviour study context is widely used in handling many environmental studies (Hiratsuka et al., 2018; Poortvliet et al., 2018). However, the belief element in this theory is not measured directly as the belief towards the given situation or phenomena (Waris & Hameed, 2020b). The three belief components (NEP, AC, and AR) are looking into the consequences of the action and the control level of the person on such behaviour. As such, there is limited study that examining the specific beliefs on energy efficiency issues.

There are behavioural theories that posit that a human's behaviour is influenced by their belief system (Hagger et al., 2016; Paul et al., 2016; Teo, 2016). In ecological behaviour research, even the ecological beliefs were not measured and tested

directly towards ecological behaviour, but it is still found that ecological beliefs have a relationship to various environmental actions or behaviours (Han, 2021). Hence, the following hypothesis is proposed:

H5: Ecological beliefs positively affect ecological behaviour.

Anything happens in an individual's environment or the feeling about a situation will influence a human's belief and such belief in turn will affect the human's behaviour (Beck et al., 1979). The belief component in this context refers to as how the individual interprets an event that subsequently affecting how an individual thinks or believes about a situation. Hence, a human's belief is mediating between the environment and behaviour (Nair & Little, 2016). This helps in explaining the mediating effect of ecological beliefs towards the relationship between the environment and behaviour. For instance, a person will find using a new software or application difficult if it is without any support of training provided. But once those external supports given, it might change their perception of using such new software or application.

Jagers and Matti (2010) suggested the need for further study into environmental belief components so that to address the new measures and analyses this variable. Although the literature points out the environmental beliefs refers to the perception about human-environmental relationship but this topic is still quite hazy and confusing.

The individual personal norms basically are influenced by the awareness of consequences (AC) and ascription of responsibility (AR). If a person is aware on the negative consequences of his or her actions towards the environment and he or she could avert those consequences, the person will likely perform in a more ecological way in their daily life. There are results from previous studies that supporting this relationship such as in Carfora et al. (2021), Han (2021), and Liu et al. (2018) studies.

However, the mediating effect of ecological beliefs between environmental factors and ecological behaviour is still neglected in academic research. As explained earlier that the easier and simpler form of ecological beliefs measurement was designed and included in the research model, its relationships with other study variables need to be re-evaluated in this new ground. This is because with this new measurement approach, those tested relationships using old method or approach are no longer valid. Hence, the following hypotheses are proposed:

H6: Ecological belief mediates the relationship between social influences and ecological behaviour.

H7: Ecological belief mediates the relationship between facilitating conditions and ecological behaviour.

Thus, this study proposes the following research model that presents ecological behaviour as a consequence of direct and indirect relationships with ecological belief and environmental factors (social influences and facilitating conditions) (see Figure 1).
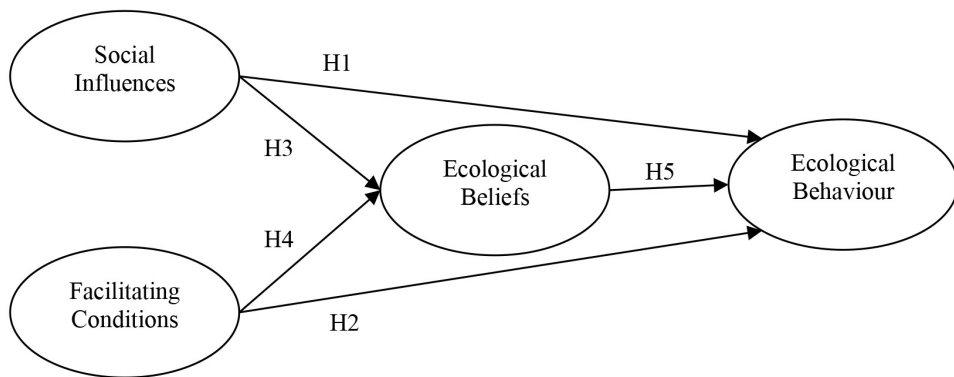

Figure 1. Research framework

METHODOLOGY

Population and Sample

The target population was Malaysian consumers who bought green household appliances within the last six months (July–December 2018). Sampling area was Klang Valley, due to the fact that it is the highest populated state (40.2% of population) in Malaysia (Department of Statistics Malaysia, 2010). Non-probability judgmental sampling method was employed to gather the required data from respondents. The use of judgmental sampling was to ensure that participants are in the best position to provide the necessary information by outlining the criteria that need to be fulfilled (Sekaran, 2003). Since the respondents are required to make the actual green household appliances purchase within the last six months, a filtering question was included in the questionnaire to differentiate the "green" and "traditional" appliances purchase.

Three electrical shops in Kuala Lumpur collaborated with the researcher in collecting the required data between March and May 2019. Those shops helped to send the online survey to their existing customers and allowed the research assistants to collect the required information in their shops for two months. Since this study adopted the non-probability sampling method, non-response bias might occur (Yuksel, 2017). The measurement accuracy of respondents' perceptions and behaviours is vital for all researches. Therefore, a combination of self-administered and online survey methods were employed in minimising such issues. It helps to capture more respondents by using more than one survey method due to each method has its own strengths and weaknesses (Dalecki et al., 1993). This is a simple and common solution to reduce the high rate of non-response bias (Whitehead et al., 1993).

The sample size was decided based on Hair et al.'s (2014) rule of thumb – to have 20 times observations as the number of items to be analysed. The present study has 22 items, hence the minimum collection of 440 (22 × 20) usable questionnaires was required.

Measurement Instrument

All measurement items for the present study were adopted from existing literature (see Table 1). Ecological behaviour was measured by using nine items adopted from Fraj and Martinez (2007), ecological beliefs were measured with six items adopted from Singh (2011), and both the measures of social influences (three items) and facilitating conditions (four items) were adopted from Venkatesh et al. (2012). These are the unobserved variables that cannot be measured directly and are considered as the nature in the management field of study (Borsboom et al., 2003).

A 5-point Likert scale ranging from 1= strongly disagree to 5 = strongly agree was used to measure each item. The survey questionnaire comprised three sections: Section A contained 3 questions pertaining to the respondents' household purchase experience, Section B contained 22 items to measure the study variables, and Section C contained 8 questions pertaining to the respondents' demographic information.

It is important to make sure that the developed instrument is accurate. Hence, the "goodness" of the measures developed need to be assessed. Changes or rewording of all the adapted questionnaire items for this study were kept at a minimum. As suggested by Davis and Venkatesh (1996), this method maintains the questionnaire items as in the original form and helps to reduce the measurement bias. Content

or face validity is considered as a very minimal index of validity (Sekaran, 2003). For this reason, panels (academic or industry experts in that particular field or the actual respondents) are invited to check through the developed questionnaire. The purpose of such an activity is to check on the face level that the items are clear and are measuring the right concept.

Table 1
Measurement items

Variable	Item	Measurement item	Source
Ecological behaviour	EB1	I guess I have never actually bought any energy-efficient appliances because it can save my electricity cost. (R)	Fraj and Martinez (2007)
	EB2	I keep track on how government is handling the energy efficiency issues.	
	EB3	I have communicated with other users to find out about energy-efficient appliances.	
	EB4	I make a special effort to buy energy-efficient appliances.	
	EB5	I have attended an event that specifically concerned with bettering the environment.	
	EB6	I have switched to use energy-efficient appliances for ecological reasons.	
	EB7	I have never joined a clean-up drive (e.g., *gotong-royong*). (R)	
	EB8	I have never attended a meeting related to ecology. (R)	
	EB9	I read materials pertaining to ecological issues.	
Ecological beliefs	EF1	It frightens me that the electricity production process bringing negative impacts to the environment.	Singh (2011)
	EF2	It makes me angry that some people do not care about conserving electricity.	
	EF3	It makes me angry that industries are causing the waste of electricity.	
	EF4	I am open to the idea of energy conservation in improving the environmental quality.	
	EF5	I am concerned about the usage of electrical energy in my city.	
	EF6	I rarely worry about the effects of excessive usage of electrical energy on me and my family. (R)	

Table 1 (*Continued*)

Variable	Item	Measurement item	Source
Social influences	SI1	People who are important to me think I should use energy-efficient appliances.	Venkatesh et al. (2003)
	SI2	People who influence my behaviour think that I should use energy-efficient appliances.	
	SI3	People who opinions that I value prefer that I use energy-efficient appliances.	
Facilitating conditions	FC1	I have the resources (e.g., money) necessary to purchase energy-efficient appliances.	Venkatesh et al. (2003)
	FC2	I have the necessary knowledge to use energy-efficient appliances.	
	FC3	The use of energy-efficient appliances is compatible with other technologies that I use.	
	FC4	I can get help from others when I have difficulties using energy-efficient appliances.	

Note: R = reverse worded items

Demographic Profile

Of the 700 distributed questionnaires, 592 (355 online and 237 self-administered surveys) were returned and found usable for further analysis, representing a response rate of 84.6%. The majority of the respondents were male (56.3%), and in the age group between 20 to 30 years (52.7%). Most participants were Malay (50.5%) and with single (56.3%) marital status. In terms of respondents' religion, majority were Muslim (51.4%). Most respondents had a bachelor degree (47.3%) qualification and income level of RM2,001 to RM3,999 (33.1%) per month.

DATA ANALYSIS AND DISCUSSION

The presence of common method bias (CMB) needs to be checked when data is collected from the same respondents for both predictors and criterion (Podsakoff et al., 2003). CMB exists when one variable explains more than 50% of the total variance. As suggested by Kock (2015), full collinearity test was used to check the presence of CMB. Through this procedure, variance inflation factor (VIF) for all study variables are generated. If the VIF value is greater than 3.3, it is as an indication of the occurrence of CMB in the model (Kock & Lynn, 2012). The output of this analysis revealed that none of the VIF are greater than 3.3, and it can be concluded that the model is free of CMB.

To assess the model, this study used SmartPLS 3.0 software for variance-based partial least square-structural equation modelling (PLS-SEM) method (Ringle et al., 2015) to estimate the parameters in the measurement model and structural model. PLS-SEM is a variance approach that tries to maximise the explained variance in the endogenous variables, and has proven to be substantially better than numerous statistical methods (Astrachan et al., 2014; Hair et al., 2017). Moreover, this study is an attempt to test a modified theory that focuses on the relationship prediction among the study variables, therefore the PLS-SEM is much more suitable (Hair et al., 2017). Additionally, it can handle complicated research models that have both reflective and formative constructs. PLS path modelling with path weighting scheme for the inside approximation was applied (Quoquab et al., 2017; Wetzels et al., 2009), followed by non-parametric bootstrapping approximation with 5,000 resampling to obtain the standard error of the estimate (Chin, 1998).

Measurement Model

Since the present study is to test the structural relationships among unobserved variables, the relationship between construct and indicator is reflective (Coltman et al., 2008). With a reflective measurement model, causality flows from the construct to the indicator (Coltman et al., 2008). The measurement model represents the relationship between construct and its relevant indicators was estimated in terms of validity and reliability (Hair et al., 2011). The reliability was assessed based on factor loading, composite reliability, and Cronbach's alpha values (Hair et al., 2014). There are 16 items used for the evaluation of measurement model analysis, instead of 22 items. One item (EF6) from ecological beliefs construct was dropped and five items (EB1, EB5, EB7, EB8 and EB9) from ecological behaviour construct were dropped. The above items that contained large measurement error variance (factor loading less than 0.5) were dropped as to produce the average variance extracted (AVE) improvement (Henseler et al., 2009). Table 2 reveals that factor loading for all items surpassed the threshold value of 0.60 (Chin, 1998), composite reliability for all constructs exceeded the cut-off point value of 0.70 (Henseler et al., 2009), and Cronbach's alpha values for all constructs exceeded the cut-off point of 0.70 (Pallant, 2013). As such, the reliability of the measurement model reached satisfactory level.

Table 2
Evaluation of the measurement model

Construct	Item	Loadings	Composite	AVE	Cronbach's alpha
EB	EB2	0.653	0.796	0.512	0.721
	EB3	0.777			
	EB4	0.701			
	EB6	0.678			
EF	EF1	0.724	0.842	0.517	0.766
	EF2	0.737			
	EF3	0.746			
	EF4	0.737			
	EF5	0.647			
FC	FC1	0.684	0.843	0.574	0.753
	FC2	0.784			
	FC3	0.798			
	FC4	0.760			
SI	SI1	0.850	0.908	0.766	0.847
	SI2	0.885			
	SI3	0.890			

Note: EB = ecological behaviour; EF = ecological beliefs; FC = facilitating conditions; SI = social influences. EB1, EB5, EB7, EB8, EB9, and EF6 were deleted to improve the AVE.

Next, the validity of the model was estimated based on convergent validity and discriminant validity. Convergent validity was assessed based on the values of AVE and composite reliability (Tan et al., 2017b). Table 2 demonstrates that both values, i.e., AVE and composite reliability, for all constructs exceeded the satisfactory level of 0.50 and 0.70, respectively (Fornell & Larcker, 1981; Henseler et al., 2009). Thus, indicating that the convergent validity was established.

To evaluate the discriminant validity, two methods were used. First, Fornell and Larcker's (1981) criterion method, which required the square root of the AVE of a construct to be greater than the correlation between other constructs in the row and columns. The analysis result shows that this condition was met. Thus, the discriminant validity at construct level was ascertained.

Next, Henseler et al.'s (2015) heterotrait-monotrait (HTMT) method, was used. It represents the ratio between construct correlations to within the construct correlation. HTMT values less than 0.90 for constructs that are conceptually similar

and less than 0.85 for constructs that are conceptually different is a necessary condition to establish convergent validly (Henseler et al., 2015; Kline, 2011). As shown in Table 3, all HTMT values were less than the cut-off point of 0.85, thus indicating that discriminant validity was established.

Table 3
Discriminant validity via HTMT method

	EB	EF	FC	SI
EB				
EF	0.375			
	95% CI (0.067, 0.262)			
FC	0.351	0.492		
	95% CI (0.030, 0.232)	95% CI (0.199, 0.378)		
SI	0.357	0.437	0.485	
	95% CI (0.066, 0.260)	95% CI (0.146, 0.339)	95% CI (0.144, 0.325)	

Assessment of Structural Model

This analysis procedure aims to evaluate the causal relationships among the constructs in a hypothetical model (see Figure 2). The assessment of the structural model was based on the criteria suggested by Hair et al. (2014), i.e., significant of path coefficient, coefficient of determination (R^2), effect size (F^2), and predictive relevance (Q^2) values. First, a PLS algorithm followed by bootstrapping procedures with 5,000 resamples were executed in order to generate R^2, F^2, the path coefficient, and their corresponding *t*-values.
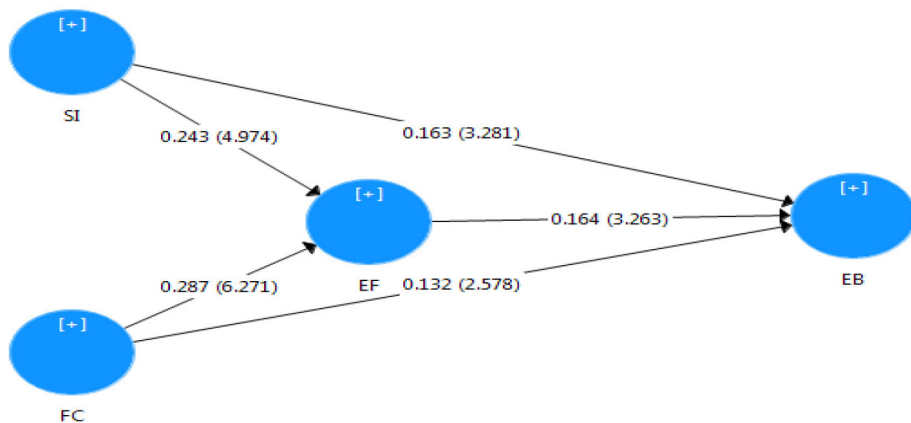

Figure 2. PLS path model

In order to conclude that a relationship is significant, the *t*-value of that path must be greater than 1.645 (Hair et al., 2014). As shown in Table 5, SI (B = 0.163, $p < 0.01$) and FC (B = 0.131, $p < 0.05$) were positively related to the ecological behaviour, thus H1 and H2 were supported. Additionally, SI (B = 0.243, $p < 0.01$) and FC (B = 0.287, $p < 0.01$) were positively related to ecological beliefs, thus H3 and H4 were supported as well. For the relationship between ecological beliefs and ecological behaviour, EF (B = 0.164, $p < 0.01$) exerted positive and significant effect on EB, which provided support for H5.

Next, this study assessed the effect size f^2, which represents the individual effect of exogenous variables in explaining the variance in the endogenous variable (Mohammad et al., 2016). To measure the effect size, Cohen's (1988) equation was used:

$$f^2 = \frac{R^2}{1 - R^2}$$

Values of 0.02, 0.15, and 0.35 represent small, moderate, and substantial effect, respectively. From Table 4, it can be observed that the effect size of FC on EF and the effect of FC on EF were substantial. On the other hand, the effect sizes of other exogenous variables were moderate.

Table 4
Evaluation of structural model

Hypothesis	Path	Coefficient	SD	*t*-value	*p*-value	f^2	Supported
H1	SI→EB	0.163	0.050	3.281	0.001	0.024	Yes
H2	FC→EB	0.131	0.051	2.578	0.014	0.016	Yes
H3	SI→EF	0.243	0.049	4.974	0.000	0.062	Yes
H4	FC→EF	0.287	0.046	6.271	0.000	0.087	Yes
H5	EF→EB	0.164	0.050	3.263	0.001	0.025	Yes

Next, this study examined the presence of a mediation effect by using the bootstrapping procedure as suggested by Preacher and Hayes (2004; 2008). In order to conclude that a mediation relationship is significant, the *t*-value of that indirect path must be greater than 1.96 (Hair et al., 2014). The results in Table 5 show that the indirect effect of β1 = 0.040 (95% CI: 0.019, 0.083) was significant with a *t*-value of 2.665 and the indirect effect of β2 = 0.047 (95% CI: 0.015–0.072) was significant with a *t*-value of 2.845. Hence, ecological beliefs were able to mediate the relationship between social influences and ecological behaviour, and the relationship between facilitating conditions and ecological behaviour.

Table 5
Hypotheses test for indirect effect

Path	Indirect effect	SD	95% CI	*t*-value	*p*-value	Supported
β1: SI→EF→EB	0.040	0.015	0.019–0.083	2.665	0.018	Yes
β2: FC→EF→EB	0.047	0.017	0.015–0.072	2.845	0.015	Yes

To assess the overall model, the R^2 and Q^2 values for the endogenous variables were obtained via the PLS algorithm and blindfolding procedures (Hair et al., 2014). The R^2 recorded was 0.195 which indicated that environmental factors had explained 19.5% of the variance in ecological beliefs, and 0.123 which indicated that ecological beliefs had explained 12.3% of the variance in the ecological behaviour.

The Stone-Geisser's Q^2 value is used to assess the predictive relevance of the PLS path model (Henseler et al., 2009) which represents a measure of how well the observed values are reconstructed by the model and its parameter estimates. Q^2 values recorded in this study are 0.092 for ecological beliefs and 0.051 for ecological behaviour. The Q^2 value being larger than zero indicates the predictive relevance of the PLS path model (Hair et al., 2011). As such, the exogenous variables are capable of predicting the endogenous variables in this model.

Research Findings

This study aimed to examine the direct and indirect influences of environmental factors and ecological belief towards ecological behaviour in the Malaysian consumer context. The research results reveal that social influences and facilitating conditions are positively related to both ecological beliefs and ecological behaviour.

The findings from this study on the significant environmental factor-ecological behaviour relationship are aligned with previous studies. For example, the relationship between social influences and behaviour has been tested in Johnstone and Hooper's (2016) study in green product consumption context, and Muti Altalhi's (2021) study in environmental concern context. Whereas, the relationship between facilitating conditions and behaviour is found to be valid in both Khorasanizadeh et al.'s (2016) and Wang et al.'s (2017) studies that focused in energy-efficient appliances purchase context. The result is consistent with the connecting condition between environmental influences and human behaviour (Feng et al., 2021).

The relationship between environmental factors and ecological beliefs is found to be valid in this study as well. These findings are aligned with previous studies. For example, Boca (2021), Fornara et al. (2016) and Yoo et al. (2021) found that social influences are significantly related to ecological beliefs. On the other hand, Moser's (2015) study that investigated 12,113 German households pertaining to their green product purchase found that facilitating conditions are significantly related to ecological beliefs. This result is consistent with the previous findings on situational factors influenced human beliefs (Maartensson & Loi, 2021).

Additionally, the relationship between ecological beliefs and ecological behaviour is also found to be significant. Stanes et al. (2015) found that ecological beliefs are significantly influence the young household consumers in energy conservation behaviour. Han (2015) found that travellers' attitudes are linked with the behaviour of green lodging adoption. This result comes in line with VBN theory which state that a person's belief or attitude shapes the individual's behaviour (Ihemezie et al., 2021).

Furthermore, ecological beliefs were found to be mediating the relationship between social influences and ecological behaviours, and the relationship between facilitating conditions and ecological behaviour. There are results from previous pro-environmental studies that support this relationship such as in Carfora et al. (2021), Han (2021), and Liu et al. (2018) studies. This result is line with prior findings where situational factors will influence human belief and subsequently their behaviour (Atulkar & Kesari, 2018). Such findings also simplify the measure of ecological belief, while also validating this relatively new variable in another study.

CONCLUSION

Theoretical and Practical Contributions

This study utilises VBN theory as the basic foundation for the conceptual framework. Without such initiative, what causes the ecological behaviour cannot be fully explained. Insights from this study underline the significant influences of environmental factors on ecological beliefs and ecological behaviour of energy-efficient appliances purchase. This adds value to the existing literature that focused only on personal factors. Hence, the industry and the government can plan to use external forces in disseminating this new technology among the members of the community.

Social influences are a common influencing factor found in retail studies. A consumer may ask opinion or seek assistance from the expert in their decision making process. As a result, marketers should engage opinion leaders or innovators in their promotion programs. Rewards can be given to encourage product recommendations. In the same way, facilitating factors can be utilised as well. Due to the low earning power among Malaysian consumers, price factor could be an obstacle towards the purchase of energy-efficient appliances. Thus, government and also industry can plan activities or incentive programs as the push factor to encourage the purchase of energy-efficient appliances. For instance, subsidy or rebate can be given to households which purchase an energy-efficient appliance. Therefore, third party forces or external motivation/rewards can effectively help to initiate and sustain human behaviour including ecological behaviour.

In addition, ecological beliefs are exerting influence on the adoption of energy-efficient appliances. This study introduces a simpler and straightforward approach in dealing with this construct. Apart from that, it is found that ecological beliefs are mediating the relationship between social influences and ecological behaviour, and the relationship between facilitating conditions and behaviour. This new and direct relationship is very limited in the literature as majority of the previous studies used old measurement approaches (NEP, AC, and AR used to measure the ecological beliefs in VBN theory). The research results indicated that ecological beliefs are considered as an important antecedent to ecological behaviour. Thus, environmental education can be executed for cultivating the appropriate ecological perceptions which ultimately bring implications or contributions for the betterment of the environment. In Japan, environmental education started in 1960s and now Japanese develop the skills to make informed and responsible decisions in protecting the environment.

In 2005, energy efficiency labelling programme started in Malaysia. After 15 years, there has been no follow up study to measure whether this programme was effective or successful. With this study, it is hoped that it will contribute to a wider understanding pertaining to the acceptance and purchase of energy-efficient appliances in Malaysia. There is a section in the questionnaire to record the purchase motivation and usage pattern on such appliances. In addition, the respondents' demographic information is very useful for marketers in profiling and segmenting the customers. This information is not easily available in the market where substantial resources are needed in collecting and gathering the data. Such information helps marketers to study the consumers, and to formulate effective strategies for further actions.

Furthermore, this study provides insights on the influence of environmental factors in adopting energy-efficient appliances. This reveals that the quality of the product is not the only factor that affecting the consumers' decision. External factors such as family and peer influence, or support given by industry and government, can exert influence on the consumers' purchase decision. In the retail industry, external factors, especially environmental factors, are recognised as a common tool in stimulating the required consumers' action. Thus, different forms of incentive strategies can be designed by the industry and government in cultivating the purchase and usage of energy-efficient appliances. For instance, the government can offer tax exemptions to the manufacturers who produce energy-efficient appliances as a support in the betterment of the environment and also to make the selling price more competitive.

Insights from this study can be used as an input in the subsequent planning for similar or different programmes by the government and industry. It is hoped that the results from this study might be useful to refer to in the strategic planning in promoting the adoption and acceptance of energy-efficient appliances in the community.

Limitation and Future Research Direction

The present study confirms the direct and indirect influences of environmental factors and ecological beliefs towards ecological behaviour. However, there are several research limitations that could provide research directions for future researchers. This study is a cross-sectional study where the data was collected once, in a specific point in time. The environmental factors affecting the consumers could be changed or different over time, thus a longitudinal approach might be an interesting method to be used to observe the consumers' perception over time. The general ecological behaviour consists of diverse actions, but the present study only focused on the purchase dimension. In the future, maybe this research model can be applied to different contexts of study such as recycling, waste reduction, energy conservation, and so on. In addition, more cross-cultural research is needed to compare whether those factors in the present study will have similar results with different segments and cultural groupings.

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