RESEARCH ARTICLE

Investigating Relationship between Environmental Knowledge and Attitudes towards Electric Vehicles: An Emerging Economy Context

Vikas Gautam

Department of Marketing & Business Strategy, ICFAI Business School Hyderabad, Survey No. 156/157, IFHE-IBS Campus, Donthanapally Shankarapalli Road, Hyderabad, Telangana 501203, India

*Correspondence Author: Vikas Gautam; vgautam78@gmail.com

Abstract: In order to investigate the impact of environmental information on the purchase of electric automobiles, the present research applied the Theory of Planned Behavior. Using primary data (n = 214), the proposed research model was validated using covariance-based structural equation modelling. The findings confirmed a positive relationship between attitudes towards electric vehicles and environmental knowledge. It was discovered that purchase intentions and perceived consumer effectiveness were significantly related. Control over availability also has a significant impact on buyers' intentions. The study's findings were unable to show a significant indirect relationship between environmental knowledge and purchase intentions. However, in this study, purchase behavior was significantly predicted by individuals' purchase intentions. In particular, females were found to have stronger buy intentions than their male counterparts when it came to the effects of consumer perceived efficacy and control over availability (significant moderation of gender). The study's empirical findings had a variety of theoretical and practical ramifications.

***Keywords*:** Theory of Planned Behavior; Electric vehicles; Environmental knowledge; Primary data; Structural equation modeling

1. Introduction

Every government in the world finds it challenging to promote resource efficiency among the populace in order to promote sustainability. Media from both the traditional and modern eras can aid in raising awareness of the importance of a clean and hygienic environment. Furthermore, the government urgently needs severe laws and rules to deal with people like these who endanger sustainability. Every person has the right to breathe in clean,

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fresh air regardless of where they reside (rural region or urban region of a country). According to Michelsen and Fischer[1], every stakeholder in natural eco-system must be educated about the importance of environment and this knowledge plays a significant role as an antecedent to natural consumption and eco-friendly friendly conduct. The main objective of environmentally education must focus on encouraging individuals' understanding and knowledge about environment[2]. Based on this premise, environmental knowledge is considered to be including environmentally information and education as its main determinants.

The highest priority of the 21st century should be provided to sustainable environment across globe[3]. This declaration was made in Conference on Environment and Development by United Nations in 1992. This conference was held at Rio de Janeiro, Brazil (second most populous city of the country). Fundamentally, environmental issues and human behavior are interrelated[4]. Authors further argued that the entire world is witnessing degradation of the environment at a very fast pace along with huge losses to flora and fauna (biodiversity). The possible reasons are such as: extreme pollution (water, air, sound, etc.), global warming due to high greenhouse gases, and changes in climatic conditions. It is the need of hour that entire humanity must come forward to modify or change human behavior towards upliftment of environment which leads to sustainability[5].

According to Agarwal[6], fossil fuels based vehicles are posing a big threat to the safety of environment. The author argued that primary mode of transportation is majorly dependent of these types of vehicles. Automobile industry must work on fixing two major problems namely less carbon emissions and reduction in energy consumption[7]. Authors further demanded collective interventions by government agencies, automobile manufacturers, and policy makers for widespread use of electric vehicles. According to Parvatha Vardhini[8], it is expected that number of electric vehicles can cross 220 million by 2030. This transformation can only be possible with strict environmental laws, sincere efforts towards restricting carbon emissions, etc., specifically in case of India where vehicular carbon emission accounts for more than 51% of total carbon emissions[9]. This carbon emission is recorded even up to 80% across urban areas.

Electric vehicles (zero carbon emissions) may help the world in fighting with monster environment related problems like greenhouse effect, air pollution, and high use of non-renewable energy resources[10]. Due to the urgency of creating a sustainable ecosystem and the significance of sustainable consumption, there are more and more environmental challenges[11]. Due to their significant potential to meet environmental and energy security goals, electric vehicles have attracted a lot of attention globally[12]. Electric vehicles (EVs) are paving the way for sustainable mobility because of their decreased greenhouse gas (GHG) emissions and dependency on fossil fuels. It could boost fuel economy by 40%–60% on average while lowering carbon footprint by 30%–50%[13]. EVs are also environmentally friendly because they produce almost no carbon dioxide or other hazardous gases. EVs emit less noise and vibration, which makes for a more comfortable ride for the passenger.

Modern age marketers have started showing concerns about the environment and its sustainability[14]. These concerns are not voluntary; the author argued and listed some reasons like organizational image makeover, value addition in offering, point-of-parity to combat competition, compliance to governments' strict regulations, and caring for environment strategy to enter new markets. Typically, the majority of the research in the allied part engrossed on deciphering the eco-friendly approach of people and its character in displaying apprehension for climate. There was lack of focus on the research which helped in understanding the process of developing favorable attitudes towards electric vehicles.

Current study intends to contribute to the literature in this area by investigating individuals' intentional behavior towards protecting surroundings and also identifying determinants of this kind of behavior. Furthermore, the present study will use Theory of Planned Behavior to understand varied roles of predictors in exhibiting

consumers' intentional behavior. A unique facet of this method is that the intentional behavior underlying in nature and not-so visible characteristics of the human behavior that can only be projected by a few stated procedures.

This study looked at consumers' intentions to protect the environment and the variables that affect how they approach sustainability. Because environmentally responsible transportation is a profitable business strategy. There are many ways to capitalize on this trait, such as getting the attention of a bigger audience by employing an effective advertising channel to achieve the aims and being environmentally conscious. Also, it will assist automakers in understanding how potential buyers see electric vehicles. Also, the current research effort has given automakers a very strong understanding of how to better realize the intentions of potential customers.

This paper is organized as follows: literature review on environmental sensitivity and its relationship with Theory of Planned Behavior is presented in the next section of the paper. Next to this section, research methodology and interpretation of the study findings are presented. In the last, discussion, implications, limitations, avenues for further research, conclusion and references are presented.

2. Literature review

There is a continuous discussion about the care towards environment by every stakeholder. Showing concern for saving environment is considered a wise step for achieving sustainable development and saving natural environment without compromising on quality of life can only be possible with wholesome efforts of all stakeholders[15]. Governing bodies along with environmental policy makers can help in achieving environmental sustainability[16]. This research used Theory of Planned Behavior to examine intentions and buying behavior of users towards environmentally friendly electric vehicles. Ajzen[17] proposed Theory of Planned Behavior. Theory of Planned Behavior based its theoretical underpinnings from Theory of Reasoned Action proposed by Ajzen and Fishbein[18]. The framework suggested by Theory of Planned Behavior explains thoroughly about the consumer buying procedure involved in purchase of environmentally friendly products[19]. Although it is evident that actions result in reactions, perceived behavior control refers to a person's ability to adopt the considered comportment in a reasonable manner[20].

Theory of Planned Behavior consists of three constructs such as: attitude, subjective norm and Perceived Behavioral Control (PBC). Ajzen[17] defined attitudes as "a function of a person's salient behavioral beliefs; which represent perceived likely consequences of the behavior, and subjective norms as a function of normative beliefs, which represent perceptions of specific salient others' preferences about whether one should or should not engage in a behavior". According to Ramayah *et al.*[21], PBC refers to "an individual's ability to undertake the behavior under consideration rationally while clearly understanding that it is the outcome of the actions performed by him or her". TRA postulates that intention is an antecedent to the actual behavior and it is determined by one's actions while appraising performance of behavior. Attitude, PBC, and subjective norm led collectively to intentional behavior of an individual. A person is at liberty to take decision about his/her archetypal behavior[17]. Factors namely self-identity and PBC lead towards sustainable consumption[22]. Two key characteristics that help explain sustainable consumption are self-identity and perceived behavioral control[23].

2.1. Attitudes towards electric vehicles and environmental knowledge

Elaboration Likelihood Model (ELM) recognized relationship between environmental knowledge and attitudes in communication research. According to the ELM[24], user association during the decision-making process may be augmented through central and peripheral routes. Central and peripheral routes of persuasion are

modeled against high verses low involvement products. Authors of ELM proposed that both routes of persuasion led to form attitudes (positive/negative). Whether to purchase or not environmentally friendly products, this purchase decision is a function of attitudes towards environmental awareness. Individuals having more information about the environment will purchase more environmentally friendly products in comparison to the individuals who have less environmental information. Therefore, their adoption behavior will get influenced by the quantum of information they possess. This leads to the argument that individuals' consumption experience may not be static with reference to intensity of environmental attitudes. With reference to this study, customers who are planning to purchase environmentally friendly products like electric vehicles will definitely get influenced greatly by the knowledge about the environment they possess. This type of behavior and approach would surely lead them to exhibit great sensibility towards environment. Consumers will form positive attitudes towards environmentally friendly products[24]. Individuals' concern for environment promotes the creation of attitudes towards environmentally friendly products like electric vehicles[25]. Environmental knowledge and attitudes are positively associated[26,27]. Therefore, it is hypothesized that:

H1: Environmental knowledge and attitudes towards environmentally friendly products are positively associated.

2.2. Purchase intentions and attitudes

Ajzen[17] defined attitudes as "a function of a person's salient behavioral beliefs; which represent perceived likely consequences of the behavior". During conflicting situations, states of mind play critical roles and subsequently influence people while choosing right alternatives. According to Vermeir and Verbeke[28], "An individual's sustainable consumption behavior is a function of a favorable attitude towards environment friendly products". Besides, Zeleny *et al.*[29] explained attitude as "a deep rooted concept in a person's self with a perception of the degree of bonding between self and the environment". An individual's sustainable consumption behavior is influenced by how satisfied they are with eco-friendly goods and services[30].

Affirmative attitudes towards a specific conduct reinforce the intent to realize that actions and environmental attitudes of an individual predict purchase intentions[17]. Users make use of cost to benefit ratio for calculating perceived value for demonstrating their categorical behavior and wanted to be perceived as individuals with objective orientation[31]. To exhibit their categorization behavior and desire to appear impartial, people use the cost-benefit ratio to measure perceived value[32]. This leads to confirm the fact that affirmative attitudes are concomitant with constructive valuation of the act. Thus, in this background, the hypothesis is proposed as:

H2: Attitudes and purchase intentions are positively associated.

2.3. Purchase intentions and subjective norms

Ajzen[17] defined subjective norms as "a function of normative beliefs, which represent perceptions of specific salient others' preferences about whether one should or should not engage in a behavior". It may also be understood as perceived social pressure to carry out or not to carry out a particular behavior. According to Jäger[33], subjective norms point towards the depth of understanding related to behavior of individuals and how they think about others in a given situation. Numerous researchers investigated relationships between subjective norms and purchase intentions across multiple product contexts like green products, organic products, sustainable products, and environmentally friendly products. Subjective norms strongly predicted individuals' purchase intentions[34]. For a range of product contexts, including green, organic, sustainable, and environmentally friendly products, the literature has examined the relationship between people's purchasing intentions and subjective norms. Intentions to buy are significantly correlated with subjective norms[20]. Socially desirable behavior and positive attitudes are interlinked and individuals start volunteering to participate in various activities such as showing concern for

environment through various methods of reuse, recycling, etc.[35]. Hence, it is hypothesized that:
H3: Subjective norms and purchase intentions are positively associated.

2.4. PBC and purchase intentions

According to Ramayah *et al.*[21], PBC refers to "an individual's ability to undertake the behavior under consideration rationally while clearly understanding that it is the outcome of the actions performed by him or her". According to Atkinson[36], PBC may be defined as "hope of success by relating with the theory of achievement". Situational factors like attitude and PBS impact decisions of individuals to a large extent[33]. An explicit conduct of a person is shaped by PBC and purchase intentions collectively[17]. In this research, PBC is explained with the help of two sub-dimensions. Control on availability is one of the sub-dimensions of PBC and other sub-dimension is perceived consumer effectiveness

2.4.1. Purchase intentions and control on availability

The absence of easy availability of environmentally friendly products will work as a big constraint for those individuals who wish to buy these kinds of offerings. Ease in locating and ordering the desired products is interpreted as product availability. An individual who possesses positive attitudes will certainly get demotivated in case of product unavailability. Research conducted by Baker *et al.*[37] contended that self-assurance in capability to restrict and thus establish the conduct has progressive relationships with the intentional behavior and/or the buying behavior. Self-control with confidence and buying behavior are closely related[38]. Purchase intentions won't materialize into actual purchasing behavior when desired things are not easily available[23]. So, it is hypothesized that:
H4: Control on availability impacts purchase intentions positively.

2.4.2. Purchase intentions and perceived consumer effectiveness

Straughan and Roberts[39] defined perceived consumer effectiveness as "the belief that people have the capability to influence the consequence in a positive manner". Authors further confirmed positive association between perceived consumer effectiveness and apprehensive behavior towards environment. Individual actions have a huge impact on future decisions and, ultimately, how people respond[40]. Therefore, a positive approach as an individual with reference to own behavior puts forward the claim for better environmental understanding and it leads to alter their purchase intentions in a positive way. Thus, it is hypothesized that:
H5: Perceived consumer effectiveness and purchase intentions are positively related.

2.5. Purchase behavior and purchase intentions

Literature has inconclusive evidence for positive association of purchase intentions with purchase behavior[41,42]. Intentions with great meticulousness may predict actual buying behavior of individuals[17]. A study by Venkatesh *et al.*[43] confirmed a small to medium effect size in the relationship between intentions to use and actual behavior. Authors confirmed these findings in the information technology use context. Earlier, in case of the organic food context, purchase intentions and purchase behavior are positively related[44]. In the light of the above background, it is hypothesized that:
H6: Purchase intentions and purchase behavior are positively related.

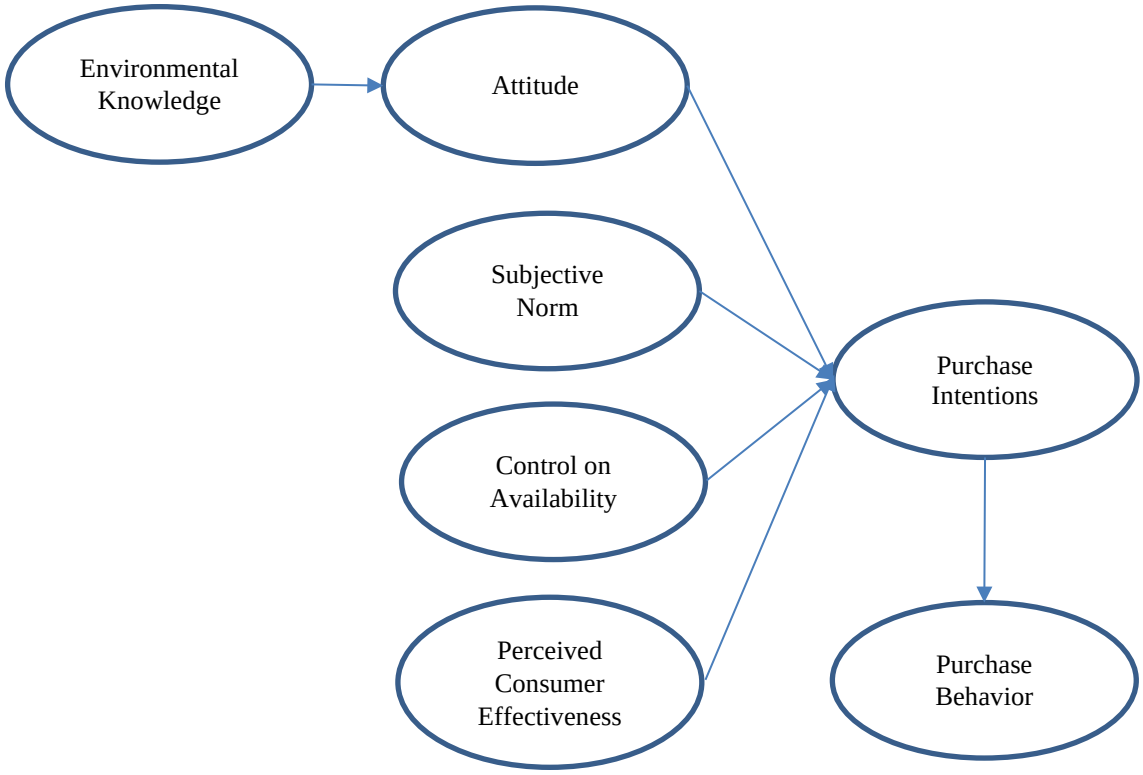

Figure 1. Conceptual research model of the study.

3. Research methodology

This section of the article includes the methodology used to achieve research objectives.

3.1. Data collection

The population under this study includes people who intend to purchase personal cars in the near future. Primary data were collected from the target respondents located across various places in Hyderabad (Capital city of Telangana, a state in southern part of India) during December 2020 to February 2021. As per rule of thumb, a representative sample size can be determined based on the number of variables multiplied by responses in range of 5–10[45].

3.2. Measurement scales

A cross-sectional survey-based research design was employed in this study. To measure variables under the study, standardized measurement scales were borrowed (see **Table 1**).

Additionally, the structured questionnaire had questions based on demography such as: age of the respondent, respondent's gender, education levels of respondents, monthly household income, and type of occupation. Respondents were briefed about the requirements and categorically told that there is no wrong or right answer to the statements in the survey. They need to record their responses on a seven-point Likert's scale (wherein 1 = strongly disagree; 7 = strongly agree). All the doubts (if any) of the respondents were cleared during the process of responding to the questions in the data collection process.

Table 1. Constructs of the study

S.N.	Name of construct	Source	No. of items
1	Environmental knowledge	Sidique *et al.*[46]	3
2	Attitude	do Valle *et al.*[47]	4
3	Subjective norm	Vermeir and Verbeke[48]	4
4	Control on availability	Sparks and Shepherd[49]	3
5	Perceived consumer effectiveness	Straughan and Roberts[39]	4
6	Purchase intentions	Baker and Churchill[50]	4
7	Purchase behavior	Schlegelmilch *et al.*[51]	6

Source: Author's compilation.

3.3. Data analysis

In this study, data analyses were conducted in multiple stages. In the first stage, a demographic profile of respondents was made with the help of descriptive statistics. The data preparation stage found 39 incomplete questionnaires. In order to get robust model fit, these missing data were deleted from the study. Then, a sample size of 214 responses was used for further analysis (n = 214). Since, the underlying factor structure was known; therefore, model fit was ascertained with the help of the measurement model of Structural Equation Modeling. Study hypotheses were tested with the help of the structural model. Fits of the measurement and the structural models were assessed by using multiple goodness-of-fit indices as recommended by Hair *et al.*[52].

4. Results

4.1. Demographic profile

Table 2 provided detailed the demographic profile of respondents. Majority of the respondents were below the age group of 30 years, and a small percent of respondents (01.40%) were above 60 years of age. There were 59.80% males and 40.20% female respondents in the sample.

Table 2. Demographic profile

S.N.	Variable	Levels	Number	Percentage
1	Age (in years)	Below 30	151	70.60
		30–45	42	19.60
		46–60	18	8.40
		60 & higher	3	1.40
2	Gender	Male	128	59.80
		Female	86	40.20
3	Educational qualification	Under graduate	41	19.20
		Graduate	84	39.30
		Post graduate	80	37.40
		Others	9	4.20
4	Monthly household income (in Rs.)	Below 100,000	66	30.80
		100,000–300,000	32	15.00
		300,000–500,000	40	18.70
		500,000 & higher	76	35.50

Source: Author's compilation.

There was an analogous combination of undergraduates to post-graduate respondents in the empirical data. Sample represented respondents coming from diverse financial backgrounds (54.30% had monthly household income of greater than Rs. 300,000).

4.2. Descriptive analysis

Table 3. Descriptive and reliability analyses results

Variable	Mean	Std. Dev.	Cronbach's alpha
Environmental knowledge (EK)			
EK 1	4.77	1.405	0.897
EK 2	4.32	1.505	
EK 3	4.63	1.495	
Attitude (AT)			
AT 1	4.35	1.564	0.882
AT 2	4.19	1.533	
AT 3	3.49	1.496	
AT 4	3.70	1.570	
Subjective norm (SN)			
SN 1	4.03	1.499	0.882
SN 2	3.94	1.561	
SN 3	4.15	1.469	
SN 4	4.08	1.631	
Perceived consumer effectiveness (PC)			
PC 1	3.67	1.534	0.916
PC 2	3.57	1.575	
PC 3	3.64	1.647	
PC 4	3.99	1.537	
Control on availability (CO)			
CO 1	5.01	1.493	0.636
CO 2	4.76	1.534	
CO 3	4.82	1.481	
Purchase intentions (PI)			
PI 1	4.20	1.489	0.898
PI 2	4.13	1.460	
PI 3	4.56	1.509	
PI 4	4.37	1.437	
Purchase behavior (PB)			
PB 1	4.82	1.498	0.847
PB 2	4.49	1.516	
PB 3	4.25	1.479	
PB 4	4.56	1.372	
PB 5	4.50	1.488	
PB 6	4.56	1.448	
Overall scale	0.959		

Source: Author's compilation.

The average of variables under study ranged from 3.49 to 5.01. Whereas, the dispersion measure showed a range from 1.372 to 1.647 for standard deviation. In order to assess the reliability of the measurement scale,

Cronbach's alpha values for all study constructs were calculated with the help of IBS SPSS 2.0. All values ranged from 0.636 to 0.916 in case of constructs. Pallant[53] states Cronbach's alpha value above 0.6 is considered high reliability and acceptable index[54]. Cronbach's alpha values in the range of 0.60 to 0.80 are considered moderate, but acceptable. Hence reliability was ascertained.

The fundamental assumption of normality was met prior to final data analysis. Skewness and kurtosis values were calculated for assessment of normality. The maximum skewness value was −0.528, and the maximum value for kurtosis was −1.103. When the numerical values of univariate skewness and kurtosis do not cross 2 and 7, respectively, normality assumption will be met[55].

In a survey-based study, when all indicators of study constructs are measured at the same time with the help of a single structured questionnaire, there are ample chances that the established relationships amongst the constructs might be biased by the effect of common method variance[56]. It questions the validity of study results by generating a methodical covariation above the accurate relationship between the scale items. Finally, it provides wrong estimates for reliability and convergent validity or even inflated path coefficients for study constructs[57].

Since there is no mechanism in place to completely remove any type of bias in responses, efforts were made to reduce the biasness to the manageable level. Harman's single factor test[58] was performed to sense Common Method Variance (CMV). In this test, the CMV problem will exist in case one single factor accounts for more than half of the total variance explained[57]. In the data analysis, none of the dimensions explicated more than 50% of the variance. Hence, this dataset didn't show any problem related to CMV.

4.3. Confirmatory factor analysis

The present research adopted measurement scales from the past literature for all study constructs. In order to confirm the underlying factor structure, a measurement model was estimated.

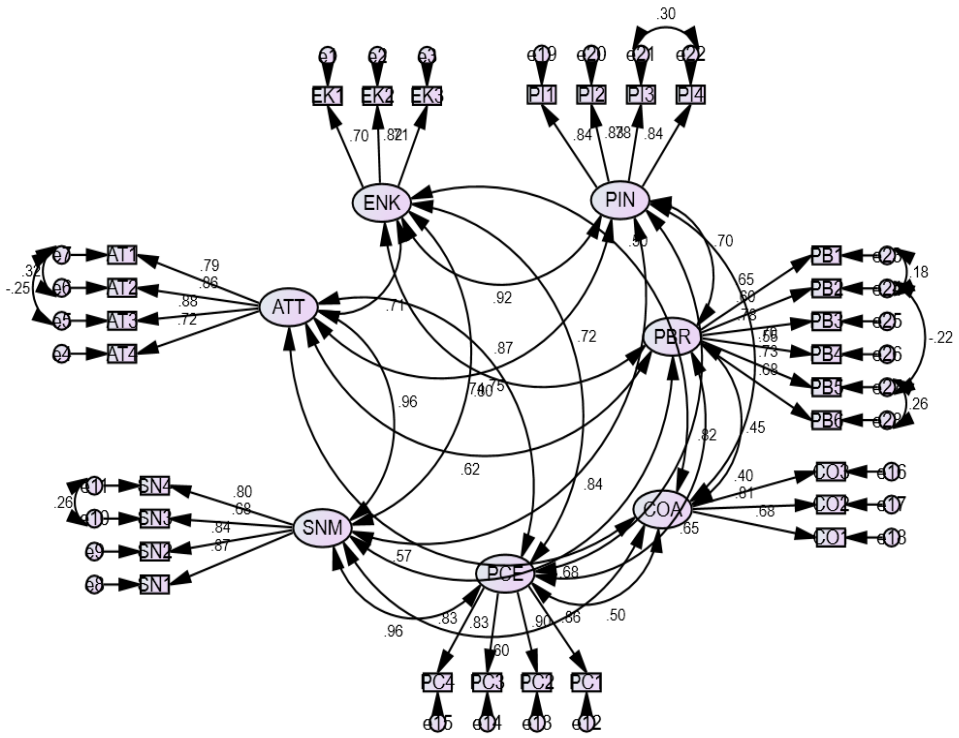

Figure 2. Confirmatory factor analysis.

All the study constraints were workable and standard errors in adequate limits. Statistical significance of parameter estimates was established as critical ratio in each case was greater than permitted boundary of 2.58 (0.05 significance level).

Table 4. Model fit indices

S.N.	Measure	Study results	Threshold
1	Chi-square	544.041	-
2	DF	322	-
3	Chi-square/DF (CMIN/DF)	544.041/322 = 1.690	<3 good; <5 sometimes permissible
4	p-value for the model	<0.000	>0.05
6	IFI (Incremental Fit Index)	0.948	>0.90
7	TLI (Tucker-Lewis Index)	0.938	>0.90
8	CFI (Comparative Fit Index)	0.947	>0.90
9	SRMR	0.046	<0.09
10	RMSEA	0.057	<0.05 good; 0.05–0.10 moderate; >0.10 bad
11	PCLOSE	0.86	>0.05
	ECVI (Expected Cross Validation Index)	Default model = 3.343; Saturated model = 3.812; Independence model = 21.879	ECVI value of the default model should be least among all

Source: Hu and Bentler[59].

Measurement model results confirmed that all major fit indices comfortably crossed the threshold suggested by Hu and Bentler[59]. Hence, the present study model was found fit.

4.4. Convergent and discriminant validity

Construct validity of a measurement scale can be established in two parts namely convergent validity and discriminant validity[60]. Convergent validity is established when all the indicators of a construct load to their respective constructs. On the other hand, discriminant validity can be achieved when constructs are clearly discriminated.

Table 5. Convergent and discriminant validity results

	CR	AVE	ASV	PIN	ENK	ATT	SNM	PCE	COA	PBR
PIN	0.893	0.676	0.599	0.822						
ENK	0.790	0.557	0.552	0.420	0.746					
ATT	0.886	0.662	0.576	0.454	0.312	0.814				
SNM	0.877	0.641	0.667	0.403	0.496	0.357	0.801			
PCE	0.917	0.735	0.592	0.318	0.424	0.471	0.459	0.857		
COA	0.716	0.527	0.283	0.455	0.504	0.470	0.296	0.303	0.654	
PBR	0.846	0.579	0.420	0.301	0.740	0.319	0.382	0.455	0.453	0.692

Source: Author's compilation.

The results of a sample-based study can only be generalized to the entire population if measurement scales are valid. Bagozzi and Yi[61] and Fornell and Larcker[62] recommended two criteria for attaining convergent validity of a scale such as Composite Reliability and the Average Variance Extracted with thresholds of ≥0.70 and ≥0.50 respectively. Measurement model results confirmed meeting of these two criteria. Thus, convergent

validity was achieved. Additionally, Hair *et al.*[52] recommended the procedure to establish discriminant validity; according to the authors, the square root of Average Variance Extracted must be higher than correlation among the respective constructs. This condition was met in this study (c.f. **Table 5**). Therefore, discriminant validity was ascertained.

4.5. Hypotheses testing

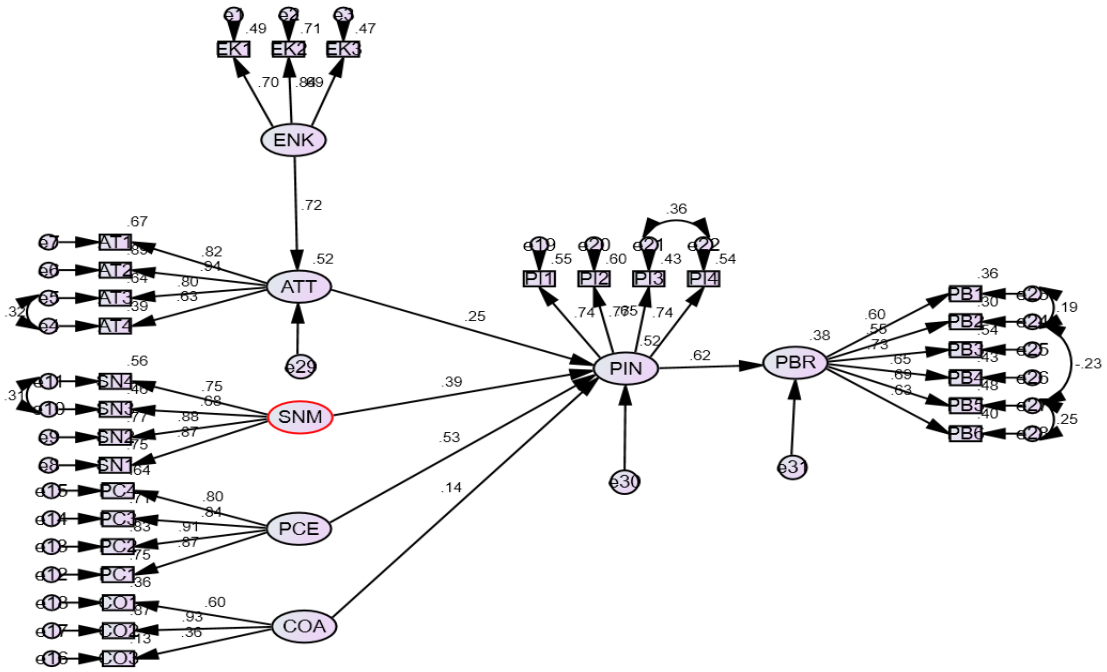

Figure 3. The structural equation model for hypothesis testing.

Table 6. Model fit indices

S.N.	Measure	Study results	Threshold
1	Chi-square	596.304	-
2	DF	338	-
3	Chi-square/DF (CMIN/DF)	596.304/338 = 1.764	<3 good; <5 sometimes permissible
4	p-value for the model	<0.000	>0.05
6	IFI (Incremental Fit Index)	0.917	>0.90
7	TLI (Tucker-Lewis Index)	0.906	>0.90
8	CFI (Comparative Fit Index)	0.923	>0.90
9	SRMR	0.039	<0.09
10	RMSEA	0.048	<0.05 good; 0.05–0.10 moderate; >0.10 bad
11	PCLOSE	0.76	>0.05
	ECVI (Expected Cross Validation Index)	Default model = 2.056; Saturated model = 2.671; Independence model = 19.458	ECVI value of the default model should be least among all

Source: Hu and Bentler[59].

The results confirmed that all major fit indices comfortably crossed the threshold suggested by Hu and Bentler[59]. Hence, the structural model was found fit.

Table 7. Hypotheses testing results

S.N.	Relationship	Unstandardized coefficient	Standardized coefficient	S.E.	C.R.	p-value	R^2 value	Decision
1	ATT <--- ENK	0.727	0.724	0.113	6.451	<0.000	0.525	Supported
2	PIN <--- ATT	0.238	0.254	0.062	2.891	<0.000	0.518	Supported
3	PIN <--- SNM	0.279	0.393	0.054	6.379	<0.000		Supported
4	PIN <--- PCE	0.368	0.529	0.052	6.540	<0.000		Supported
5	PIN <--- COA	0.231	0.135	0.125	1.203	0.048		Supported
6	PBR <--- PIN	0.568	0.617	0.090	5.677	<0.000	0.380	Supported

Source: Author's compilation.

The structural model helped to test the study hypotheses. There were a total six hypotheses in this study. All study hypotheses found support based on structural equation modeling results. With reference to **Table 6**, significant positive association between environmental knowledge and attitudes was found ($\beta = 0.724$, $p < 0.000$). Empirical results confirmed perceived consumer effectiveness as the most significant predictor of purchase intentions ($\beta = 0.529$, $p < 0.000$) followed by subjective norms ($\beta = 0.393$, $p < 0.000$), attitudes ($\beta = 0.254$, $p < 0.000$), and control on availability ($\beta = 0.135$, $p < 0.048$). Moreover, purchase intentions and purchase behavior were significantly associated ($\beta = 0.568$, $p < 0.000$).

4.6. Mediation analysis

In order to test the mediating effect of attitudes, a technique proposed by Baron and Kenny[63] was used.

Table 8. Mediation analysis results

Relationship	Direct without mediator	Direct with mediator	Indirect
PIN <--- ENK	0.883 (0.000)	0.773 (0.000)	Not significant No mediation

Source: Author's compilation.

Study results could not establish significant meditating impact of attitudes in the relationship between environmental knowledge and purchase intentions in electric vehicles context.

4.7. Moderation analysis

There was a significant moderating effect of gender in the relationship between perceived consumer effectiveness and purchase intentions. In addition, the path from control on availability to purchase intentions was also moderated significantly by gender (c.f. **Table 9**).

Table 9. Moderation analysis results

S.N.	Relationship	Standardized coefficient			
		Male	p-value	Female	p-value
1	ATT <--- ENK	0.759	0.000	0.930	0.000
2	PIN <--- ATT	0.179	0.067	0.201	0.322
3	PIN <--- SNM	0.283	0.000	0.316	0.000
4	PIN <--- PCE	0.090	0.055	0.241	0.000
5	PIN <--- COA	−0.005	0.953	−0.394	0.016
6	PBR <--- PIN	0.837	0.000	0.956	0.000

Source: Author's compilation.

5. Discussion of results

This study intended to extend the Theory of Planned Behavior in the environmentally friendly products context with reference to electric vehicles. This study modeled the predictors and outcomes of intentional behavior of individuals in the electric vehicles context. Additionally, TPB was extended by including environmental knowledge construct in order to assess its impact on attitudes and purchase intentions. Extended Theory of Planned Behavior[17] was used to assess fit for the study model and related hypotheses. A total of 51.80% of variance in purchase intentions (R^2 = 0.518) was explained by four predictors (attitudes, subjective norms, perceived consumer effectiveness, and control on availability). This finding validates the use of Theory of Planned Behavior as variance explained crossed the 50% threshold. Whereas, the model helped in explaining 38% variance in purchase behavior (R^2 = 0.380).

The findings of this investigation supported hypotheses 1 and 2. These hypotheses investigated, respectively, the influence of attitudes on purchase intentions and the influence of environmental knowledge on attitudes. By adopting efficient communication methods, the need of a pollution-free environment can be brought to people's attention. These efforts will ensure sustainability for the society. These findings were echoed by the past studies by Dash[25], Ramayah *et al.*[21], Sidique *et al.*[46], and Chan and Lau[64].

Empirical results of the study found evidence for most significant effect of consumer perceived effectiveness on purchase intentions. Further, control on availability and attitudes towards electric vehicles were also found positively associated. These findings are in accordance with the results of past studies by Tuwanku *et al.*[65], Straughan and Roberts[39], and Webster[66].

This study found subjective norms as the second most important predictor of purchase intentions for electric vehicles after perceived consumer effectiveness in importance hierarchy. Chan and Lau[64] confirmed the similar results. Whereas, subjective norms were not proved as the strong determinant of purchase intentions in the electric vehicle context. Subjective norms focus on an explicit behavior by individuals within the ambit of society. In the context of India, social behavior is embedded strongly in the culture and people take pride being socially active through various deeds. The whole society works always for welfare of environment as an inclusive approach. Hence, positive influence of subjective norms on purchase intentions will surely lead towards better environmental care through judicious use of natural resources.

Indian culture places a strong emphasis on community, and those who are involved in it are given greater consideration. In our society, natural resources are revered on a par with God. As a result, people behave as socially responsible citizens and demonstrate their favorable intents towards ecologically friendly items. The study's findings demonstrated a strong correlation between purchasing intentions and actual actions. This finding justified suitability of TPB[17] in the electric vehicles context. Awareness about environment and positive attitudes towards eco-friendly products headed to buy these products[67]. Authors further argued that even product disposal behavior is also significantly influenced. Individuals, who experience higher pressure from society for purchasing environmentally friendly products, have higher purchase intentions towards purchasing types of products[48]. The present study findings gel closely with these previous research works.

Factors like attitudes, awareness of consequences, ascription of responsibility, personal norms, perceived value, perceived consumer effectiveness, and subjective norms direct intentional behavior of individuals in case of electric vehicles[68]. Studies investigating relationships by extending Theory of Planned Behavior by environmental knowledge with reference to electric vehicles in the Indian context are not in abundance.

5.1. Implications of the study

What motivates people to show concern for environment is very important to understand for solving the mystery behind positive attitudes towards environmentally friendly products including electric vehicles. Significant positive association was confirmed between purchase intentions and purchase behavior. In order to achieve sustainable growth without harming much of environment, it is vital to spread wakefulness about environmentally friendly products and never-ending focus on increasing environmental knowledge. The study results provided evidence of positive significant association among environmental knowledge, attitudes, and purchase intentions.

As a result, managers of automobile companies can design better and effective communications which help individuals in understanding positive effects of using environmentally friendly electric vehicles for their various commuting/transportation requirements. This type of interventions will lead to pollution and hazard free environment and certainly be a special gift for future generations. Further, it is strongly suggested that marketers in mobility space can contribute significantly towards efficient and sustainable environment.

All six paths in TPB were found significant. Hence, it is intended that these constituents of TPB explicate share of individuals' pro-environment behavior. Spash *et al.*[69] proposed that understanding the pro-environmental behavior of individuals will empower practitioners to formulate better environment management policies and procedures which subsequently align with individual preferences in taking care of environment and its various functions.

5.2. Study limitations and future scope

The study results should be interpreted with a caution due to limitations. The current study also confronts with multiple limitations. The first limitation is about self-reported responses by the survey participants. This method has its own limitations. It is strongly recommended to include personal interviews and dedicated dynamic focus group discussions to gain useful insights.

The current research included sample respondents from one geographical location Hyderabad. It is possible to get better insights in case the study is expanded to other geographical locations. Further scholars can consider dividing India into 5 regions namely East, West, North, South, and Central. Then, the stratified sampling method may be used to collect data from all these 5 regions to conduct a country level study. Future studies can also consider situational variables as moderating variables in the TPB model.

6. Conclusion

Present research intended to investigate the role of environmental knowledge in forming attitudes towards environmentally friendly electric vehicles. A research model was proposed by extending Theory of Planned Behavior by environmental knowledge and tested with the help of the maximum likelihood estimation method. All six study hypotheses found support in the empirical results. Environmental knowledge and attitudes were found positively associated. In terms of importance hierarchy, consumer perceived effectiveness was found as the strongest determinant purchase intentions followed by subjective norms, attitudes towards environmentally friendly electric vehicles, and control on availability. More specifically, effects of consumer perceived effectiveness, and control on availability on purchase intentions were found higher in case of females in comparison to male counterparts. Empirical findings of the study confirmed positive significant association between purchase intentions and purchase behavior in the electric vehicles context. On the other hand, mediation

effect of attitudes in relationship between environmental knowledge and purchase intentions could not be established. Finally, it is concluded that a recurrent use of TPB across environment related research works is desirable to validate outcomes from the past studies and to better label psychosomatic roles on notions, perceptions, motives, attitudes, performances, and preferences.

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Conflict of interest

It is declared that there is no potential conflict of interest.

Author contribution

The corresponding author has contributed all the parts of the manuscript.

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Appendix 1

Study Questionnaire

COVER LETTER

Dear Respondent,

I am seeking your assistance in the regard of research project. Kindly take a few minutes to answer the below mentioned questions. Please respond to each question based on how it relates to you personally when you visit a place as a tourist. You are not required to give your identity, and thus be assured that complete anonymity will be maintained. Please return the completed questionnaire.

Thank you for your help.

Part I: Respondent' response

On a scale of "strongly disagree" (1) to "strongly agree" (7), please circle the appropriate rating. (1 = Strongly Disagree, 2 = Disagree; 3 = Somewhat Disagree; 4 = Undecided; 5 = Somewhat Agree; 6 = Agree; 7 = Strongly Agree)	
Statement	**Response**
Environmental Knowledge	
Using electric vehicles is a primary means to reduce pollution	1 2 3 4 5 6 7
Using electric vehicles is a substantial approach to reduce wasteful use of natural resources	1 2 3 4 5 6 7
Using electric vehicles is one great approach to conserve natural resources	1 2 3 4 5 6 7
Attitude	
I believe that use of electric vehicles by me will help in reducing pollution and also help in improving the environment	1 2 3 4 5 6 7
I believe that use of electric vehicles by me will help in reducing wasteful use of natural resources	1 2 3 4 5 6 7
I believe that use of electric vehicles by me will help in conserving natural resources	1 2 3 4 5 6 7
I feel good about myself when I use electric vehicles	1 2 3 4 5 6 7
Subjective Norm	
My friends expect me to engage electric vehicle usage behavior	1 2 3 4 5 6 7
My family expects me to engage in electric vehicle usage behavior	1 2 3 4 5 6 7
My society expects me to engage in electric vehicle usage behavior	1 2 3 4 5 6 7
People can rely on me to make a positive contribution to the society due to my electric vehicle usage behavior	1 2 3 4 5 6 7
Control on Availability	
I am familiar with the availability of electric vehicles in my locality	1 2 3 4 5 6 7
I can easily get electric vehicles whenever I need them	1 2 3 4 5 6 7
I have complete control over the number of electric vehicles that I need to buy for personal use	1 2 3 4 5 6 7
Perceived Consumer Effectiveness	
It is worthless for the individual consumer to do anything about pollution	1 2 3 4 5 6 7
When I buy environmentally sustainable products, I try to understand how its use will affect the environment and other consumers	1 2 3 4 5 6 7
Since one person cannot have any effect upon pollution and natural resource problems, it doesn't make any difference what I do	1 2 3 4 5 6 7
Each consumer's behavior can have a positive effect on society by purchasing products sold by socially and environmentally responsible companies	1 2 3 4 5 6 7
Purchase Intentions	
I would like to use electric vehicles	1 2 3 4 5 6 7
I would buy electric vehicles if I happen to see them in a store	1 2 3 4 5 6 7
I would actively seek out electric vehicles in a store in order to purchase it	1 2 3 4 5 6 7
I would patronize and recommend the use of electric vehicles	1 2 3 4 5 6 7
Purchase Behavior	
I choose the electric vehicles if another non- electric vehicle with a similar price is available	1 2 3 4 5 6 7
I choose the electric vehicles regardless of their price	1 2 3 4 5 6 7
I try to discover the environmental effects of electric vehicles prior to purchase	1 2 3 4 5 6 7
I bring my own shopping bag at store in order to reduce the use of plastic bags	1 2 3 4 5 6 7
If I understand the potential damage to the environment that some products can cause, I do not purchase those products	1 2 3 4 5 6 7
I don't buy a product if the company which sells it is environmentally irresponsible	1 2 3 4 5 6 7

Part II: Demographic profile

Please Mark (√) your responses to the following:

Factor	**Category**	
Age	a. Below 30	[ ]
	b. 30–45	[ ]
	c. 46–60	[ ]
	d. 60 & above	[ ]
Gender	a. Male	[ ]
	b. Female	[ ]
Educational Qualification	a. Under graduate	[ ]
	b. Graduate	[ ]
	c. Post-graduate	[ ]
	d. Others	[ ]
Monthly Household Income (in Rs.)	a. Below 100,000	[ ]
	b. 100,000–300,000	[ ]
	c. 300,000–500,000	[ ]
	d. 500,000 & above	[ ]

******* Thank You Very Much for Your Cooperation *******