



Original article

Determinants of environmental awareness toward the green living behaviour of students: the role of family, university and social environmental factors in Hanoi, Vietnam

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ABSTRACT

The environment has been deteriorating, due to global warming, deforestation and pollution which have been happening increasingly often. As a result, green behavior has become increasingly important, and people are more aware of the environment and are conscious of the need to change their behaviour in order to protect the environment. This study investigated the factors influencing green living behaviours of students in Hanoi and the level of their environmental awareness including family, university, and social environmental related factors. Quantitative research using a purposive sampling technique was undertaken on 1295 students who were studying in eight universities in Hanoi, Vietnam. The data was collected through online surveys which were posted on social media platforms. The data was analysed using PLS SEM (Partial Least Square, Structural Equation Modelling) with the assistance of SmartPLS 4.0.9.2 software. The research results not only disclose which family, university and social environmental factors have positive and direct effects on green living behaviours, but also provide insights into the mediation effects of environmental awareness influencing students' green living behaviours. University related factors were shown to have the most positive influence on the environmental awareness of the students and their green living behaviours. The practical implications of this research suggest actionable strategies for higher education institutions, families, and society to improve green living behaviour among students.

KEY WORDS: environmental awareness, green, environmental protection

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1. Introduction

Green living behaviour and a responsibility towards society and ecology, has become a worldwide trend. Despite all economic dilemmas, global climate change

and environmental pollution are one of the most significant anxieties of the modern world. "Going green" is encouraging more people to help protect the environment and alleviate the effects of global climate change. Green living behaviour is a desired response

from individuals to the challenge posed by increasing global temperatures, greenhouse emissions and carbon footprints. Studies in the past reviewed many factors that affect green behaviour (LI ET AL., 2019; ANWAR ET AL., 2020; AL-ALAWNEH ET AL., 2023). These review helped shed light on why some people engage in green behaviour and why others pursue non-green behaviour amid increasing global climate problems.

Higher education students are expected to make considerable contributions to the future state of the environment; as they have been well educated, possessing information and knowledge related to our environment. This study adds to the number of green skills acquired by university students, to prepare them for green jobs. The Global Green Skills Report by LinkedIn Economic Graph (2023) reveals that seven out of eight workers lack a single green living skill, "at a time when the future of our planet depends on them." Students need these green skills to apply for the increasing number of green jobs available to them as countries transition to an economy that reduces greenhouse gas emissions across industries. About 254 million students are enrolled in universities across the world (UNESCO, 2024). On the practical side, students with green skills can use these skills in their everyday lives, to help in arresting the current climate crisis, and to teach them to their families, friends and their future family. According to the recommendations of numerous researchers, higher educated individuals are more likely to be anxious about the environment and more inspired to involve themselves in behaviours associated with environmental protection because of their awareness of possible environmental harm (LOZANO ET AL., 2013). Many universities have decided to become green but, their academic courses and disciplines, have not yet become accustomed to the fundamental concept of being green. Consequently, universities are challenged to discover active ways to encourage learners to involve in suitable green living behaviours. Innovative approaches to and a more holistic educational mind-set to enhancing learners' environmental awareness are therefore warranted.

Green living behaviour refers to an individual's efforts to diminish environmental influences and lessen resource consumption. To nurture effective environmental education strategies for learners, the factors that influence students' behaviours to be involved in green living should be thoroughly explored. This study examines the factors related to family, university, social environment which influence

environmental awareness and green living behaviours among students in Vietnam.

Vietnam has been facing distinct challenges concerning environmental pollution. THE ENVIRONMENTAL PERFORMANCE INDEX - EPI (2024) demonstrates that Vietnam is ranked 180/180 among countries for its environmental performance. Over the last decade, environmental pollution has increased sharply in Vietnam and is registered in the top 22 countries of the world that are effected by air pollution (according to IQAir.com). Hanoi, the capital and the largest cultural, economic, and educational centre of Vietnam, has numerous leading universities, creating various educational networks and the largest concentration of students with a total of 628,981 (GENERAL STATISTICS OFFICE OF VIETNAM, 2020). This creates a young, dynamic community, which has a great influence on society. Therefore, students in Hanoi have the potential to become the main force in spreading the ethos and implementing green living and environmental protection actions, which could serve as inspiration for other universities in Vietnam and around the world.

This study examines the factors which impact environmental awareness and green living behaviours among university students in Hanoi, Vietnam. Specifically, the research investigates whether factors that are linked to family, university, and social environment affect their green living behaviour and environmental awareness. It aims to answer the following research questions (RQ):

RQ1: Do family, university and social environment factors positively influence environmental awareness among students?

RQ2: Does environmental awareness have a mediating effect on family, university and social environmental factors and green living behaviours of students?

RQ3: Does the environmental awareness of students positively influence their green living behaviours?

The theory of planned behaviour is the underlying theory used in this research, postulating that the individual behaviour is motivated by the intent to do it. The aim of this research was to examine and analyse the factors influencing environmental awareness and green living behaviours of Hanoi students. The study used a quantitative method with structural equation modelling, with three independent variables including family related factors, university related factors and social environment factors, one mediation variable which is environment awareness and one dependent variable which is green living behaviours.

2. Literature review

2.1. Underpinning theory

The Theory of Planned Behaviour (TPB), developed by [AJZEN \(1985\)](#), posits that a person's behaviour is driven by their intention to accomplish the behaviour and is affected by three main factors: subjective norms, attitude and perceived behavioural control towards the behaviour. In the context of green behaviour, attitude involves a person's positive, or negative, evaluations of actions such as recycling or conserving energy, which are shaped by environmental awareness. Subjective norms pertain to the social pressure individuals feel to engage in green behaviours, which are influenced by the behaviour and values of family, peers, and community. Perceived behavioural control replicates a person's perception of the difficulty, or ease, of performing green behaviours, which can be enhanced by increased environmental awareness through knowledge and understanding of sustainable practices ([AJZEN, 1991](#)). Environmental awareness acts as a mediator in this relationship by shaping attitudes and enhancing perceived behavioural control, thereby influencing the intention to perform green behaviours. By applying TPB, researchers can systematically examine how social influence and environmental awareness interact to shape intentions and actual green behaviours, providing a comprehensive approach to understanding the psychological mechanisms behind sustainable practices.

2.2. The affect of family related factors on a student's environmental awareness and their green living behaviours

The relationship between family influence and green behaviour, with environmental awareness acting as a mediator, emphasises the family's pivotal role in shaping sustainable practices. [OH ET AL. \(2021\)](#) attested that families are the primary social units where values, attitudes, and behaviours are first developed. When families emphasise the importance of environmental awareness, they create a foundational understanding of ecological issues and the necessity for sustainable living. Environmental awareness, fostered by family influence, serves as a crucial mediator in promoting green behaviour ([PIYAPONG, 2020](#)). This awareness involves recognizing the influence of individual and cooperative actions on the environment and understanding the importance

of conservation and sustainability ([LIU ET AL., 2020](#)). Families that prioritise environmental discussion and demonstrate eco-friendly practices instil this awareness in their members. This, in turn, influences the implementation of green behaviours such as energy conservation, recycling and reducing waste ([AL-ALAWNEH ET AL., 2023](#)). For example, children who grow up in households where parents actively engage in and discuss sustainable practices are more likely to grow up with a solid grounding in environmental responsibility ([SUÁREZ-PERALES ET AL., 2021](#)). This awareness mediates their behaviour, leading them to make independent environmentally conscious choices. Additionally, family traditions and practices that highlight environmental sustainability further reinforce this cycle, ensuring that green behaviours are consistently practised and passed onto future generations ([LING ET AL., 2023](#)). Thus, family influence, through the lens of environmental awareness, significantly drives the adoption of green behaviours ([KHAN, 2024](#)). Therefore, the following hypotheses were proposed for this study:

H_{1a}: Family related factors (FA) positively influence environmental awareness (EA) among students.

H_{1b}: Environmental awareness (EA) has the mediating effect between the effect of family related factors (FA) and green living behaviours (GB).

2.3. The affect of university related factors on a student's environmental awareness and their green living behaviours

The relationship between university influence and green behaviours, with environmental awareness as a mediator, highlights the critical role educational institutions play in fostering sustainable practices among students ([AKHTAR ET AL., 2022](#)). Universities are unique environments where individuals are exposed to new ideas, research, and diverse perspectives, creating fertile ground for cultivating environmental consciousness ([ANWAR ET AL., 2020](#)). Universities influence students' environmental awareness through various means, including coursework, campus initiatives, and extracurricular activities. Courses in environmental science, sustainability, and related fields provide students with a deep understanding of ecological issues and the importance of sustainable living ([FAWEHINMI ET AL., 2020](#)). Additionally, universities often promote green initiatives such as recycling programs, energy conservation efforts, and sustainable campus operations, which visibly demonstrate the principles

of environmental stewardship (CHOONG ET AL., 2019). Environmental awareness, nurtured in the academic setting, serves as a mediator for green behaviour. Students who gain knowledge about environmental issues and witness sustainable activities first-hand are more likely to internalise these values (HAMEED ET AL., 2021). This awareness encourages them to adopt green behaviours such as reducing waste, conserving energy, and participating in environmental advocacy. Moreover, university-led campaigns and student organisations focused on sustainability can reinforce this awareness, creating a community culture that prioritises environmental responsibility (LAU & HASHIM, 2020). As students carry these values into their personal and professional lives, the impact of university influence extends beyond campus, promoting broader societal shifts towards sustainability. Therefore, universities perform a pivotal role in producing environmentally conscious individuals through education and demonstration of green practices (SALEEM ET AL., 2020). Thus, the following hypotheses were proposed for this study:

H_{2a}: University related factors (UN) positively influence environmental awareness (EA) among students.

H_{2b}: Environmental awareness (EA) has a mediating effect between the effect of university related factors (UN) and green living behaviours (GB).

2.4. The affect of social environmental factors on a student's environment awareness and their green living behaviours

SH. AHMAD ET AL. (2022) suggested that the relationship between social influence and green behaviours, with environmental awareness as a mediator, underscores the impact of societal norms and interactions on sustainable practices. Social influence encompasses the effects of peers, community, media, and cultural norms on an individual's attitudes and behaviours. When environmentally conscious behaviours are prevalent and valued within a society, they exert a powerful influence on individuals to adopt similar practices (SIMIYU & KARIUKI, 2024). Environmental awareness acts as a critical mediator in this relationship. Social interactions often provide information about environmental issues, whether through direct conversation, social media, or community activities (BEGUM ET AL., 2021). When individuals are consistently exposed to messages and behaviours that emphasise the importance of sustainability, their environmental awareness increases. This heightened

awareness involves understanding the ecological impact of everyday actions and recognizing the collective benefits of green behaviour (LING ET AL., 2023). For example, in a community where recycling, using public transportation, and conserving energy are common practices, people are more likely to be aware of, and engage in, these behaviours. Social norms and the desire to conform to community standards can drive individuals to adopt green practices. Moreover, influential figures such as celebrities, community leaders, and social media influencers perform a significant role in shaping environmental awareness and promoting sustainable behaviours (KOUSAR ET AL., 2022).

As environmental awareness increases, it mediates the relationship between social influence and green behaviour, leading individuals to make environmentally conscious choices. This dynamic demonstrates how societal norms and interactions can significantly impact individual and collective efforts towards sustainability. Hence, the following hypotheses were proposed for this study:

H_{3a}: Social environment factors (SO) positively influence environmental awareness (EA) among students.

H_{3b}: Environmental awareness (EA) has a mediating effect between the effect of social environmental factors (SO) and green living behaviours (GB).

2.5. The affect of a student's environmental awareness on their green living behaviours

Environmental awareness (EA) was defined as involving environmental knowledge qualified by emotions, individuals, symbolic denotations and social groups (HIRSH, 2014). ALTIN ET AL. (2014) suggested that EA is the awareness of environmental dilemmas and involves the dynamic participation of somebody in environmental establishments. EA is considered an important factor that influence individuals practising environmental behaviours (SI ET AL., 2022). People who are aware of environmental problems and the causes and effects of behavior are more likely to take protective actions toward the environment (MEI ET AL., 2016). Similarly, HANISCH ET AL. (2014) stated that EA is vigorous for humans to protect the environment. TÜRKOĞLU (2019) states that the task of environmental protection requires humans to work hard to minimize pollution as well as other harmful human impacts on the environment. The research of PENG KUAI ET AL. (2022) showed that development of environmental awareness is more

likely to encourage energy saving among young people in rural households. The effects of climate change not only affect the present generation but also those of the future, and the young are now experiencing the impacts of this global situation. Are they aware of the changing environment around them? Would their behaviour change to a green one with greater environmental awareness? OGIEMWONYI (2024) revealed that the green behaviours of the consumers they studied were not influenced by environmental awareness.

H4: Environmental awareness (EA) positively influences green living behaviours (GB) among students.

3. Methods

3.1. Research design

The study used a quantitative method with structural equation modelling. The purpose of the research was to examine and analyse the factors that affect awareness toward the green living behaviours of Hanoi students. There are 05 variables employed in this research as presented in Fig. 1, with the independent variables being family related factors, university related factors and social environmental factors. In this research, the dependent variable was awareness as the mediating constant. The research scrutinized 21 observed variables, encompassing independent variables such as social

environment factors (SO1, SO2, SO3, SO4, SO5), family related factors (FA1, FA2, FA3, FA4), university related factors (UN1, UN2, UN3, UN4), environment awareness (SA1, SA2, SA3, SA4), and green living behaviour (GB1, GB2, GB3, GB4).

3.2. Sampling method and data collection

This research's aim was to test the theoretical framework from a predictive perspective and was concerned with spreading existing theories, employing purposive sampling method. In the research, students who studied in Hanoi were chosen as the population. The sampling was undertaken purposefully throughout July 2023. Respondents took part voluntarily and were anonymous, with data secrecy guaranteed through consent. Quantitative data was collected through the use of an online questionnaire, which proposed to measure the constructs in the beforehand outlined model. The survey was constructed using variables gained from earlier studies and other information. This was translated into Vietnamese and reviewed by environmental education experts to ensure comprehensibility and accuracy. A total of 21 questions were gained from various literature and restated. Each variable was measured using a five-point Likert scale to measure agreement, fluctuating from strongly disagree to strongly agree (respectively from 1 to 5).

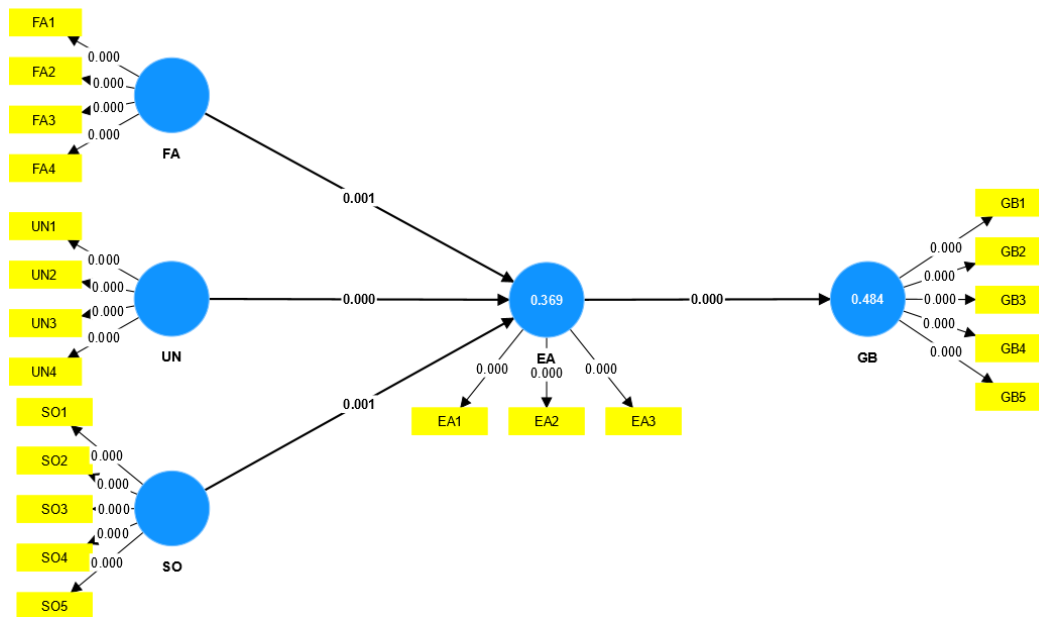


Fig. 1. Proposed research model

FA: Family related factors; UN: University related factors; SO: Social Environmental factors; EA: Environmental awareness; GB: Green living behaviours

The survey was modified from previous literature was adapted for the purpose of novelty and understanding concepts. Prior to the main research, the survey underwent a pilot test among students who gave feedback to enhance the questions and the general questionnaire. The pretest sample of 25 random students was carried out in Hanoi (the survey was distributed in a supermarket nearby an area with a number of universities. The pilot test results were accepted for the main research. An online survey was produced using Google Forms then disseminated through the most broadly used social media platforms in Vietnam such as Gmail, Zalo, Instagram and Facebook. A total of 1314 students in different universities in Hanoi, participated in the study. However, 1295 valid answers were used for the analysis. The sample size met the required conditions for analysis using Partial Least Square-Structural Equation Modelling (PLS-SEM) (MEMON ET AL., 2020; HAIR ET AL., 2019). PLS-SEM is often preferred over other SEM techniques, such as CB-SEM, even when the model is theoretically well-defined and examines existing relationships based on the Theory of Planned Behaviour due to its emphasis on prediction and its ability to handle complex, predictive models with smaller sample sizes and non-normal data. While CB-SEM is ideal for theory testing and assessing model fit, PLS-SEM focuses on maximising the

explained variance in dependent variables, making it more suitable for behavioural research aiming to predict outcomes like intentions and behaviours. Furthermore, PLS-SEM can handle formative constructs and complex hierarchical models, providing greater flexibility for real-world data and practical applications.

Table 1 shows the demographic characteristics of the correspondents. More female students answered the questionnaire than male (70.12% and 29.88% respectively). The research obtained answers from students on various majors, the largest sample was from economics students with 32.05%, the second largest was from jurisprudence students with 25.71%, then technology students with 17.30% and the remainder were students of pedagogy and educational science, tourism and culture, language and linguistics, environmental science, construction industry and architect, art and medicine. Among 1295 respondents, 25.71% were first year students, 24.79% were second year students, 28.57% were third year students, 18.15% fourth year students and only 2.78% were fifth year students. The majority of correspondents had part-time jobs, accounting for 61.93% and 38.07% indicated that they did not have part-time jobs. Referring to the household income, 75.44% live in an average income household, 19.08% in a high income household and only 5.48% in low income one.

Table 1. Demographic characteristics

Item	Category	Frequency	Percentage [%]
Gender	Male	387	29.88
	Female	908	70.12
Major	Pedagogy and educational science	65	5.02
	Economics	415	32.05
	Jurisprudence	333	25.71
	Technology	224	17.30
	Tourism and culture	53	4.09
	Language and Linguistics	36	2.78
	Environmental Science	29	2.24
	Construction Industry and Architect	98	7.57
	Art	23	1.78
	Medicine	19	1.47
Year of study	1 st year student	333	25.71
	2 nd year student	321	24.79
	3 rd year student	370	28.57
	4 th year student	235	18.15
	5 th year student	36	2.78
Part-time job	Yes	802	61.93
	No	493	38.07
Household income	Low income	71	5.48
	Average income	977	75.44
	High income	247	19.08

3.3. Operational definition of variables

In the research, family related factors, university related factors, social environmental factors were selected as the main indicators affecting the green living behaviour of students, with environmental awareness as a mediating variable. The operational definitions of the variables are shown in Table 2.

4. Data analysis

HAIR ET AL. (2019) assisted that PLS-SEM was employed in this study as it is appropriate for explanatory research. Additionally, this research explores the theoretical framework of existing established theories which are suitable for PLS-SEM analysis (MEMON ET AL., 2017; HAIR ET AL., 2019). As PLS-SEM displays the direct and indirect influence of independent variables, RAMLI ET AL. (2018) asserted that it is considered more useful than regression analysis, and it also provides fewer contradictory results when determining the mediation effect.

RINGLE ET AL. (2015) suggested that SmartPLS software should be used for PLS-SEM analysis. Two models are attained from the PLS-SEM testing results, which are the measurement model and the structural model. The measurement model tests the validity and reliability of the variable constructs. Outer loading is used to test reliability, and Cronbach's alpha (CA) and composite reliability (CR) were employed to measure construct reliability.

Validity testing was done by construct validity (AVE - average variance extracted) and discriminant validity through use of the heterotrait-monotrait (HTMT) ratio. Subsequently satisfying the reliability and validity tests, the next stage was to conduct the structural model analysis. The structural model displays the relationships between the constructs and their effects on each other, on the assumption, thus testing the hypotheses of each relationship. The testing was completed by using the parameter value with a t-statistic value > 1.645 and $p < 0.05$.

Table 2. Operational definitions of construct variables

Variable	Operational definition	References
Family related factors	Including encouragement, role modelling, shared environmental values, environmental discussion and demonstrate eco-friendly practices influencing the implementation of green behaviours such as energy conservation, recycling and reducing waste	Al-Alawneh et al., 2023
University related factors	encompassing various initiatives, policies, resources, training programmes aimed at encouraging eco-friendly behaviours among students	Anghel & Anghel, 2022
Social environmental factors	referring to the validation, encouragement, and reinforcement individuals received from their social networks, including friends, peers, and communities, in adopting and maintaining eco-friendly practices	Anghel & Anghel, 2022
Environmental awareness	referring to (1) the ideas, opinions and values about environment where human live and develop, commonly for certain social groups; (2) the state of people's opinions, notions and knowledge about the role of the environment in individual's life, including the state of knowledge about tools and methods for the management of using, knowledge and protecting the environment	Wielewska & Zuzek (2015)
Green living behaviour	Green living suggests plentiful advantages for humans, the environment, and the communities. By implementing sustainable activities and making ecological choices, a better world for present and future generations could be created. In other words, a green living that protects the environment is a symbol of a commitment between oneself and sustainable development in the future, minimising the burden on nature and resources on earth. Some green living criteria are currently being applied in the world and in Vietnam today: + Three principles: (1) Reduce; (2) Reuse; (3) Recycle + 5R criteria: (1) Refuse and say no to waste (Refuse); (2) Reduce the number of belongings, create a simple life (Reduce); (3) Reuse and make full use of the functions of the items you own (Reuse); (4) Recycle classified items after use (Recycle); (5) From kitchen waste to green manure for plants (Rot-decompose) + 07 ways to live green: (1) Save water; (2) Change means of transport; (3) Waste classification; (4) Energy saving; (5) Green living with food; (6) Planting more trees; (7) Making fertilizer at home	Welsch et al. (2021)

5. Results

5.1. Common method bias

Variance Inflation Factor (VIF) was used to evaluate the common method bias in the structural model. In this research, the VIF values should be all less than 3.33 as be presented in Table 3, so that the model might be considered as free from common method bias (KOCK, 2015).

Table 3. Collinearity statistics (VIF)

Relationship	VIF
EA -> GB	1.000
FA -> EA	2.315
SO -> EA	2.612
UN -> EA	2.290

5.2. Measurement model analysis

The results of the reliability and validity measures for five different constructs in this research are presented in Table 4. Firstly, values of Cronbach's

alpha fluctuated from 0.793 to 0.965, indicating all constructs were at a suitable level of internal consistency. The values are commonly above the suggested threshold of 0.700 thus each item within the construct reliably measures the underlying concepts. Moreover, Composite reliability (CR) values are conveyed, and they once again prove good internal consistency, with CR values fluctuating from 0.878 to 0.973, respectively. These values show that the constructs are extremely reliable, because they surpass the generally accepted threshold of 0.700. Constructs in this research have AVE values above 0.5 (ranging from 0.748 to 0.894), demonstrating that each construct could account for at least 50% of the variance of each item in the model.

Another step is to measure discriminant validity, HENSELER ET AL. (2015) proposed the HTMT to test this dimension. Accepted HTMT ratio values should be below 0.90, showing that a construct has specific discriminated indicators (HENSELER ET AL., 2015; HAIR ET AL., 2019).

Table 4. Evaluation of measurement model test results

Constructs	Items	Loadings	CA	CR	AVE
Family related factors (FA)	FA1	0.812	0.887	0.922	0.748
	FA2	0.828			
	FA3	0.849			
	FA4	0.963			
University related factors (UN)	UN1	0.910	0.960	0.971	0.894
	UN2	0.934			
	UN3	0.946			
	UN4	0.989			
Social environmental factors (SO)	SO1	0.911	0.965	0.973	0.879
	SO2	0.907			
	SO3	0.903			
	SO4	0.980			
	SO5	0.982			
Environment awareness (EA)	EA1	0.838	0.793	0.878	0.706
	EA2	0.826			
	EA3	0.856			
Green living behaviour (GB)	GB1	0.914	0.934	0.950	0.791
	GB2	0.897			
	GB3	0.933			
	GB4	0.781			
	GB5	0.914			

Table 5 demonstrates how the model meets the criteria for discriminant validity testing. In the research, all values below 0.9 show that the model discriminates each construct. The R-Square values for EA and GB are 0.367 and 0.484, respectively, showing that 36.7% of the variance in environmental awareness could be explained by family, university and social environmental factors, while 48.4% of the variance in green living behaviour could be explained by family, university, social environmental factors and environmental awareness. This points out that the proposed model has modest strength for predictive accuracy.

Table 5. Discriminant validity

	EA	FA	GB	SO	UN
EA					
FA	0.566				
GB	0.786	0.681			
SO	0.579	0.774	0.683		
UN	0.660	0.724	0.655	0.744	

Table 6. Path coefficients, f^2 and Hypothesis testing results for direct relationship

Hypothesis	Beta coefficient	T statistics	P values	f^2	LLCI 2.5%	ULCI 97.5%	Decision
H _{1a} : FA -> EA	0.116	3.397	0.001	0.009	0.047	0.181	<i>Supported</i>
H _{2a} : UN -> EA	0.413	9.120	0.000	0.118	0.323	0.501	<i>Supported</i>
H _{3a} : SO -> EA	0.135	3.454	0.001	0.011	0.059	0.210	<i>Supported</i>
H _{4a} : EA -> GB	0.696	39.444	0.000	0.939	0.660	0.729	<i>Supported</i>

Table 7. Path coefficients, f^2 and Hypothesis testing results for indirect relationship

Hypothesis	Beta coefficient	T statistics	P values	LLCI 2.5%	ULCI 97.5%	Decision
H _{1b} : FA -> EA -> GB	0.081	3.346	0.001	0.033	0.127	<i>Supported</i>
H _{2b} : UN -> EA -> GB	0.287	8.677	0.000	0.040	0.148	<i>Supported</i>
H _{3b} : SO -> EA -> GB	0.094	3.414	0.001	0.222	0.351	<i>Supported</i>

5.4. Predictive performance

The PLS predict analysis indicates distinct predictive performance for each item listed, focusing on key metrics such as (Q^2), PLS-SEM RMSE, LM RMSE, and the difference between PLS and LM RMSE (PLS-LM), the PLS predict result is presented in Table 8. The (Q^2) values highlight the model's predictive relevance for each endogenous construct measured across items EA1 to GB5, where values closer to 1 demonstrate better predictive accuracy. Notably, GB3 exhibits the highest (Q^2) value of 0.376, indicating strong predictive capability. Regarding

5.3. Structural model analysis

Table 6 and Figure 1 show the results of hypothesis testing using the bootstrapping function in SmartPLS software; it enlightens that all hypotheses are supported, representing a significant positive influence among the variables being tested. This could be seen from p value < 0.05, all the positive path coefficient values and t-statistic values overhead 1.645.

As can be seen from Table 7, the independent variables are mediated by the environmental awareness variable toward the dependent variable. Table 7 also shows that the three independent variables, namely, family related factors, university related factors and social environmental related factors, are mediated by the environmental awareness variable in influencing the independent variable of green living behaviour, as they meet the significance criteria with a p value < 0.05 and t-statistic value < 1.645. From these results, it can be stated that the proposed model has the capability to depict the factors that influence students' green living behaviour.

root mean square error (RMSE), the PLS-SEM RMSE is consistently lower than the LM RMSE for all items, suggesting that PLS-SEM may offer improvements in predictive accuracy over simple linear modelling. The negative PLS-LM differences further support this observation, with GB5 showing the smallest gap at -0.074, indicating a relatively better fit for the partial least squares structural equation modelling approach than linear regression for this specific variable.

The Cross Validated Predictive Ability Test (CVPAT) provides insights into the relative predictive performances of models with statistically significant

findings. As stated in Table 9, the average loss difference indicates negative values for both EA and GB, with EA at -0.019 and GB at -0.071. This highlights that the models being assessed tend to outperform the baseline models with lower prediction errors. The t-values for EA and GB, 3.267 and 7.510, respectively, suggest robust statistical significance, further supported by their corresponding p-values. Specifically, the p-values for both EA and GB are below the conventional significance level of 0.05, with EA at 0.001 and GB at 0.000, indicating strong evidence that the observed differences in predictive loss are not due to random chance. Overall, the combined analysis confirms a collective improvement in predictive capabilities across all contexts examined, as reflected by the overall t-value of 7.483 and p-value of 0.000, solidifying the reliability and enhanced prediction performance of the evaluated models.

The Importance-Performance Map Analysis (IPMA) evaluates constructs based on their relative importance and performance, providing strategic insights for enhancing effectiveness. Utilising IPMA can guide prioritisation in improvement efforts by highlighting areas that require attention. The IPMA results in Table 10 showed that the construct "UN" demonstrates the highest importance with a score of 0.413 and performance at 69.581, suggesting that it plays a crucial role and performs reasonably well.

Conversely, "FA" shows the lowest importance of 0.116 and a relatively mediocre performance of 66.188. To improve FA's impact on collaborative learning, strategies might include enhancing facilitator skills, integrating interactive technologies to better engage participants, and providing targeted training sessions to increase understanding and skills for improved facilitation. By boosting FA's importance and performance, institutions can achieve a more balanced and effective collaborative learning environment.

Table 8. PLSpredicts

	Q ² predict	PLS-SEM RMSE	LM RMSE	PLS-LM
EA1	0.340	0.554	0.691	-0.137
EA2	0.180	0.551	0.680	-0.129
EA3	0.229	0.493	0.611	-0.118
GB1	0.289	0.515	0.638	-0.123
GB2	0.287	0.529	0.657	-0.128
GB3	0.376	0.497	0.587	-0.090
GB4	0.267	0.608	0.694	-0.086
GB5	0.358	0.528	0.602	-0.074

Table 9. Cross Validated Predictive Ability Test (CVPAT)

	Average loss difference	t-value	p-value
EA	-0.019	3.267	0.001
GB	-0.071	7.510	0.000
Overall	-0.052	7.483	0.000

Table 10. Importance-Performance Map Analysis (IPMA)

	Importance	Performance
FA	0.116	66.188
SO	0.135	63.574
UN	0.413	69.581

6. Discussion

This research inspected factors that affect the green living behaviour of Vietnamese students by measuring the direct relationships of family related factors, university related factors, social environmental factors and environmental awareness with green living behaviours, and indirectly assessed environmental awareness as a mediator. Not many studies have observed these additional factors on green living behaviours through the mediation of environmental awareness in the context of study. Based on the findings stated in Table 6, all four direct hypotheses H_{1a}, H_{2a}, H_{3a}, H₄ have a positive relationship with green living behaviours of Vietnamese students and thus were supported.

The research's findings have assured the positive and substantial impact of family related factors positively affecting student's green living behaviours which is consistent with earlier studies (VERACHTERT, 2023; NURSETIAWATI ET AL., 2020). Families play a key role in shaping green lifestyles by determining the attitudes, behaviours and aspirations of their members. Families act as a bridge to transfer knowledge between generations, promoting a sense of responsibility, respect, love for the environment and the importance of environmental protection. When families practice green living and take a conscious approach to consumption and resource management, they contribute to a holistic change in society towards sustainability. These outcomes recommend that education, encouragement and support from family equip students with the essential expertise and skills for green living as well as enhancing their environmental awareness to participate in a green living lifestyle.

The research also showed the direct and positive relationship of university related factors and green

living behaviours as seen in a previous study (AKHTAR ET AL., 2022). This result shows that when the university offers the performance evaluation, performance appraisal, rewards, and incentives to the students for green living behaviours, this would encourage them to put additional effort into attaining green objectives. Universities encourage policies such as lectures, training programs through workshops and seminars for increasing environmental awareness and knowledge because learners with environmental awareness participate in a green living lifestyle. Additionally, the research of KIM ET AL. (2005) also demonstrated that extrinsic rewards suggestively impact the recycling behaviour of undergraduate students from a private and public university. Universities may also offer certificates, prizes and green rewards for good green performance; therefore, these achievements would encourage the student's preference toward green living. Especially in this case, the research sample was conducted in Hanoi, Vietnam, where universities have organised numerous programs and events to increase students' green living practices. For example, Hanoi University of Science and Technology and Foreign Trade University have organised programs to classify waste at the source. On campus, there are bins to classify organic, plastic, and non-recyclable waste. There are also activities to collect plastic and paper waste for recycling, exchanging them for gifts or small rewards for students. The Forestry University and Hanoi National University of Education have implemented many tree planting campaigns on campus and surrounding areas. The University of Transport has installed solar power systems to provide electricity to some areas of the campus, reducing dependence on electricity from the national grid and saving energy. The University of Languages and International Studies regularly organises plastic-free days, encouraging students to bring their own water bottles and reusable food containers. The National Economics University organises an environmental protection club where students can participate in collecting rubbish, exchanging environmental knowledge, and organising green living workshops. These activities not only help reduce environmental impacts on campus but also create good habits for students and contribute to the community's efforts to protect the environment.

The positive relationship found in this study between social environmental factors and green living behaviour is complementary to similar positive relationships found by other studies

(GIFFORD & NILSSON, 2014). People are seriously influenced by the situation where they live. Social influence is the leading predictor of green purchasing behaviour among adolescents (LEE, 2008). The strong influence of friends and peers, a type of social influence, is believed to be the reason behind the group effect in environmental behaviour. People with green living tendencies investigate green products, resources, and ways of living, they intensively search for all available information from all possible sources in society. Supplementary emphasis could be placed on "green media" as a communication tool to uplift green living behaviour, as the tool is one of the ways to shape social influence. The positive thing about green living behaviour is the growth in social influence, which will happen with the advancement and ease of communication that is taking place nowadays. This study has confirmed that the social environment will continue to positively influence green living behaviour.

Environmental awareness could suggestively and definitely predict green living behaviours. This discovery is consistent with the aforementioned research of KANG ET AL. (2009) and SI ET AL. (2022) which indicated that environmental awareness is one of the vital leading factors influencing environmentally friendly behaviours. This mechanism of impact might be: firstly, students with more environmental knowledge would be more likely to understand the relationship between routine behaviours and environmental protection, and would also acquire more knowledge connected to pro-environmental behaviours, consequently driving people to adopt green living behaviours in their daily lives. Secondly, the more students are motivated toward naturalistic concepts, the more likely they are to adopt everyday green living behaviours. Thirdly, when students feel solid environmental values, they habitually touch a high stage of emotional involvement with the environment, they increase their sense of familiarity with the natural environment, increase their likelihood of attaching with the natural world around them, and believe they are faithfully connected to the natural world everywhere. As soon as this sense of connection to the environment is felt, students often increase their level of engagement with green living actions.

6.1. Managerial implication

Although the environment is in a state of emergency, there is still time and numerous ways

to make changes and protect the environment. If humans engage with green living it is not only an advantage for the world, but it also helps save time, money and resources as well as making sure future generations have access to resources such as clean water and air. This managerial implications of this research point to understanding and addressing the factors that affect environmental awareness and green living behaviours among students. Firstly, the practices of green living behaviours by students can be encouraged by raising their environmental awareness.

Education can be done not only by universities and governments but also by families so that students have full awareness of environmental protection, its importance and prospects for future growth. Educational content must be appropriate, actionable and practical in order for students to understand what they could do to make an impression on the environment. Environmental education can be applied to decision making to change people's cognitive orientation towards the environment (HALL, 2013).

Environmental education influences and builds positive attitudes about the environment (ERHABOR & DON, 2016). Furthermore, it is important to increase student knowledge about the environment, especially to increase their skills and knowledge so that they can be used in their daily routines. Additionally, improving the quality of the living environment. The higher the quality of a student's living environment, the superior the influence on green living behaviours. That means not only paying more devotion to public hardware facilities but also investing in software facilities. Consequently, it is more important to pay attention to building a communal human environment, creating a good cultural atmosphere for students in their families, universities and public places. For example, appropriate factors such as establishing suitable waste recycling facilities for students to sort their rubbish and to establish effective management systems for students to sort household waste are crucial. These appropriate factors will support students in implementing green living behaviours.

6.2. Limitations, recommendations and further research

This research was undertaken at a point in time, whereas students' environmental awareness might change over time as new knowledge is acquired.

Additionally, the research data has been collected only in Hanoi, Vietnam, thus the results do not account for possible variations in green living behaviours among students from different regions of Vietnam. Cross-province or cross-country research is recommended for comparisons of green living behaviours from different provinces or countries. Further research could mention whether students from different majors of study exhibit different levels of environmental awareness and green living behaviours. Furthermore, future research could discover other factors and other models to deliver supplementary perspectives on green behaviours. Through applying these alternative frameworks, researchers can better understand students' green living behaviours and recognize unique predictors and elements, ultimately increasing overall awareness.

7. Conclusions

This research investigated factors influencing green living behaviours with environmental awareness as a mediating factor. The research emphasised three factors that affect the variables, including family, university and social environmental factors. The results of the research show that:

- The positive and direct influence of family, university and social environmental factors on students' green living behaviours is mediated by environmental awareness.
- Raising environmental awareness through family, university and social environment factors is very important for students' green living behavior, considering the increase in green living practices in the future.
- Most correspondents were aware of environmental issues.
- University related factors were demonstrated to have the most direct and positive impact on students' environmental awareness and green living behaviours.

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