Environmental behavior of university students

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Abstract

Purpose – This study aims to build a model for the analysis of the environmental behavior of university students.

Design/methodology/approach – A partial least square method was adopted, and a questionnaire on intelligence, knowledge, attitude and environmental behavior was performed on 480 Spanish university students.

Findings – The results indicate that environmental intelligence positively affects university students' environmental behavior through environmental knowledge and attitude.

Research limitations/implications – The conclusions of the present study are based on a sample drawn from Spanish university students. Therefore, new studies are needed to cover other educational institutions and cultural contexts.

Practical implications – Many university students' environmental behavior depends on implementing educational actions that improve their environmental intelligence and knowledge.

Social implications – The study suggests that educational programs should implement strategies that maintain a sense of responsibility toward the sustainable development of university students, ensuring that future generations can live a quality life in a sustainable and safe environment.

Originality/value – The present study identifies the mechanism through which the environmental behavior of university students is formed.

Keywords University students, Partial least square, Enviornmental behavior, Enviornmental education, Sustainable development strategy

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1. Introduction

The First World Conference on the Environment (United Nations, 1972) and the latest international events such as the 2030 Agenda and the Sustainable Development Goals (SDGs; United Nations, 2015), Principles for Responsible Management Education (PRME, 2017) and Global Compact in Education (2019) highlight the importance of education as a goal in itself and as a medium, recognizing its transversal nature as a critical facilitator of sustainable development. In this sense, the importance of environmental education is noted as a necessary instrument in favor of promoting changes in behavior that have accelerated environmental degradation. For this reason, many actions related to educational policy and programming are being carried out to assess whether the integration of values and concepts of sustainable development in the learning process translates into changes in the sustainable behavior of students (Pan and Hsu, 2022). However, although sustainability has been considered a critical issue for decades, conflicting views on sustainable behavior are still reflected throughout the education system (Thapa, 2010; Oluyinka, 2011).

Several recent studies have sought to explore the extent to which sustainability is embedded in higher education (Janmaimool and Khajohnmanee, 2020; Schmitz and Rocha, 2018; Evans *et al.*, 2018), and how environmentally educated people will become professionals with high environmental performance. Authors such as Gündüz (2017) maintain that pro-environmental education positively influences the environmental behavior of university students. Istiana *et al.* (2020) also argue that students who develop environmental intelligence through their education have better environmental behavior because this intelligence improves the ability to understand natural conditions, recognize the impacts of the deteriorated environment and remain sensitive to weather conditions. Other studies indicate that the factors that influence the environmental behavior of students are related to their knowledge and attitude toward sustainability (Chomaini, 2021; Istiana *et al.*, 2020; Suhirman and Yusuf, 2019). However, the models used in these studies have evaluated some of the antecedents of the environmental behavior of students in isolation, and the previous literature requires more robust models capable of analyzing the environmental behavior of students with greater precision (Istiana *et al.*, 2020; Schmitz and Rocha, 2018; Rajapaksa *et al.*, 2018; Tanu and Parker, 2018). To fill this gap, the present study attempts to answer the question of whether it is possible to have a robust model for the analysis of the environmental behavior of university students. For this, a structural model has been built that integrates all the factors considered antecedents of the students' environmental behavior. Using a sample of 480 university students who have filled out questionnaires on environmental intelligence, knowledge, attitudes and behavior between January and February 2022, the results obtained have made it possible to identify the mechanism through which the environmental behavior of university students is formed.

This paper continues as follows. The research hypotheses are presented after a background of the literature on sustainable behavior in section two. The methodological aspects of the structural model, the sample, the measurement instruments and the results are detailed below in sections three and four. Finally, the conclusions and the main theoretical and practical implications of this study appear in section five.

2. Literature review and research hypotheses

Education for sustainable development is currently a topic of particular importance in academic and professional fields. Within the framework of the United Nations, many activities are being carried out related to integrating sustainable development values and concepts in the learning process. In 2015, 193 countries met to adopt the 17 SDGs in the United Nations General Assembly, whose horizon is 2030. Similarly, some studies also reveal the importance of education for sustainable development. For example, Kanapathy *et al.* (2019) argue that to achieve these sustainability goals, an individual's perception and attitude toward sustainable development must change, which can be

achieved through education. Likewise, education is fundamental in disseminating the necessary knowledge, skills and values that contribute to sustainable development. Zwickle *et al.* (2014) state that future generations, especially those with university studies, will play a critical role in serving the well-being of humanity and protecting the environment, and that action among young people will help their respective countries achieve the SDGs.

According to Brundtland (1987), sustainable development is defined as development that meets the needs of the present without compromising the capacity of future generations. Leal Filho *et al.* (2018) highlight the environmental dimension of sustainable development. Environmental problems are generally caused by the behavior of people unaware of the environment (Rogayan and Nebrida, 2019; Jena and Behera, 2017). In this sense, it is considered that environmental behavior contains several dimensions:

- Recycling;
- avoiding buying to minimize environmental impacts as a form of green consumption;
- developing an active policy within a community to influence decisions that affect the environment; and
- carrying out self-education in environmental awareness (Oluyinka, 2011; Thapa, 2010).

For their part, He *et al.* (2018) emphasize the importance of recognizing the benefits of adopting an environmental attitude and promoting behavior directed toward sustainable development. Goyal (2017) considers that environmental behavior is a measure of someone's willingness to be active in protecting the environment. Therefore, the role of environmental behavior as a mechanism for protecting the environment is key to reducing and avoiding the destruction of environmental resources.

For environmental behavior, education is of particular importance. Considering that environmental behavior is substantially correlated with environmental knowledge (Zheng *et al.*, 2018), education significantly impacts the level of knowledge about the environment (Erhabor and Don, 2016; Ergen and Ergen, 2011). Educational centers exert a significant influence on the improvement of environmental knowledge and behavior of students (Schmitz and Rocha, 2018; Tanu and Parker, 2018), and people educated from childhood in environmental knowledge become future professionals with high sustainable behavior (Evans *et al.*, 2018; Janmaimool and Khajohnmanee, 2020). Also, Balakrishnan *et al.* (2020) consider that education is particularly important in environmental behavior. Considering that environmental behavior is greatly correlated with environmental knowledge (Zheng *et al.*, 2018), education has a significant impact on the level of knowledge about the environment (Erhabor and Don, 2016; Ergen and Ergen, 2011). Educational centers significantly influence students' environmental knowledge and behavior (Schmitz and Rocha, 2018; Tanu and Parker, 2018). People educated from childhood in environmental knowledge become future professionals with high sustainable behavior (Evans *et al.*, 2018; Janmaimool and Khajohnmanee, 2020). Also, Balakrishnan *et al.* (2020) demonstrated that the appropriate knowledge, skills and values acquired through education are fundamental to shaping the perceptions and development of attitudes toward the sustainable development of university students. However, Gündüz (2017) pointed out that university students present a medium-level attitude toward sustainable development, suggesting the need to apply environmental education more efficiently. Education is, therefore, a way of spreading the ideas and principles of sustainable development to many people (Kopnina and Meijers, 2014). In this sense, universities play a fundamental role in integrating the appropriate skills, values and knowledge to instill the basic concepts of sustainable development among students (Moore, 2005), as well as to develop the necessary attitudes and perceptions among future professionals toward sustainable development (Al-Naqbi and Alshannag, 2018).

Given the importance of environmental behavior in achieving SDGs, some studies have addressed analyzing the factors that condition such behavior. Michalos *et al.* (2009) carried out an exploratory analysis to lay the foundations for the development of standardized tests of people's knowledge, attitudes and behaviors about sustainable development. The studies by Tan (2018) and Yu *et al.* (2017) detected a significant relationship between environmental knowledge and intention toward sustainable product consumption. Laroche *et al.* (2001) consistently pointed out that environmentally aware consumers are more likely to spend more on products of a sustainable nature.

On the other hand, Wirdianti *et al.* (2019) identified the positive relationship between environmental intelligence and behavior, stating that personality and environmental intelligence directly influence environmental behavior. Environmental intelligence is the ability to observe a pattern in nature and understand the components of the natural environment system, showing greater sensitivity to identify the phenomena that occur in it (Barbiero and Berto, 2018; Juniarti, 2015; Mauladin, 2013). This environmental intelligence is considered as empathy and concern for the environment, as well as a critical way of thinking about the effects and consequences of our actions on the environment (Hartika *et al.*, 2019). Gardner (2013) and Wahyuni and Mahmud (2016) agree that ambient intelligence is the human ability to understand natural phenomena and demonstrate sensitivity to nature. Authors such as Istiana *et al.* (2020) maintain that environmental intelligence has a strong relationship with the environmental behavior of students because this intelligence enhances the ability to understand natural conditions, recognize the impacts of the deteriorated environment and remain sensitive to the needs of nature. Likewise, Samsudin *et al.* (2015) claim that students who possess ambient intelligence will have instinct, and conscience and develop sustainable behavior. Similar results were obtained by Pan *et al.* (2018), Abdollahi *et al.* (2017) and Chomaini (2021), again highlighting the significant and positive relationship between ambient intelligence and environmental behavior. However, this relationship is still controversial in the literature. For example, Suhirman and Yusuf (2019) indicated that environmental intelligence did not have a direct relationship with the environmental behavior of university students.

Considering that environmental behavior is a determining factor for sustainable development (Istiana *et al.*, 2020; Wirdianti *et al.*, 2019), the present study aims to build a new model that robustly explains the environmental behavior of university students. With that aim, different research hypotheses have been established that consider environmental intelligence, environmental knowledge and environmental attitude as antecedents of the students' environmental behavior (Evans *et al.*, 2018; Al-Naqbi and Alshannag, 2018; Michalos *et al.*, 2009). Therefore, we postulate that:

H1. The environmental intelligence of university students is an antecedent to their level of environmental knowledge.

H2. The environmental intelligence of university students is an antecedent to their environmental attitude.

H3. The environmental intelligence of college students is an antecedent to their environmental behavior.

Moreover, the fourth hypothesis refers to environmental knowledge as an antecedent of environmental attitude (Michalos *et al.*, 2009) and tries to contrast whether there is a relationship between knowledge and attitude of university students. Therefore, we postulate that:

H4. The environmental knowledge of university students is an antecedent to their environmental attitude.

The fifth hypothesis considers the effect of attitude on environmental behavior (Evans *et al.*, 2018; Michalos *et al.*, 2009) and tries to test whether this effect is significant in university students. Consequently, we postulate that:

H5. The environmental attitude has a positive and significant effect on the environmental behavior of university students.

Finally, the sixth hypothesis postulates whether environmental intelligence moderates the relationship between knowledge and environmental attitude, and the relationship between attitude and environmental behavior. The hypothesis is expressed as follows:

H6. Environmental intelligence mediates the relationships between knowledge, attitude and environmental behavior of university students.

H6 hypothesis, in turn, is expressed according to the following sub-hypotheses:

H6a. Environmental intelligence mediates the relationship between knowledge and the environmental attitude of university students.

H6b. Environmental intelligence mediates the relationship between environmental attitude and environmental behavior of university students.

Figure 1 illustrates the research model and the hypotheses established in the present study.

3. Methods

3.1 Statistical procedure

The hypotheses raised above have been tested using partial least square (PLS) compatible with the theoretical context and the characteristics of the variables analyzed using the SmartPLS Version 3.3.3 software. To study the validity and robustness of the research model, the standard procedure in PLS is followed. First, by validating the measurement model and continuing with the structural model (Hair *et al.*, 2017). And second, using the blindfolding procedure to assess the predictive relevance of the proposed model.

The PLS method has been successfully used in research in the social sciences, educational sciences and behavioral sciences (Haenlein and Kaplan, 2011; Statsoft, 2013). Given the causal predictive nature of PLS, its application is frequent when the problems analyzed are complex and theoretical knowledge is scarce (Lévy and Varela, 2006). In addition, PLS allows a series of dependency relationships to be examined simultaneously, being a very appropriate technique when a dependent variable becomes an independent variable in subsequent dependency relationships. It is also suitable for evaluating the heterogeneous effects that the independent variables may have on each of the dependent variables of the model (Hair *et al.*, 2011).

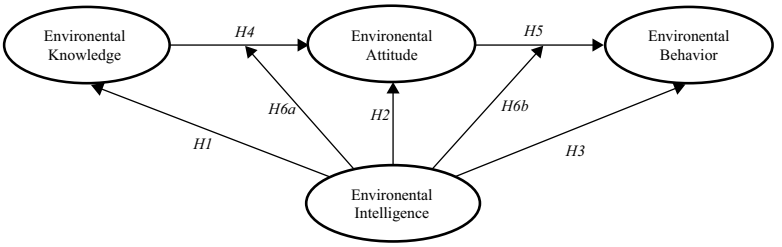

Figure 1.
Research model and hypotheses

3.2 Sample

The sample object of our research is made up of 480 students from Spanish public and private universities, randomly selected from degrees related to economics and business management. Of the total sample of students, 56.67% were women, and 43.33% were men. Sample study of 17.92%at a private university, while 82.08% are currently studying at a public university. It should be noted that the average grade of the students' record is 7.17 and that the most frequent level of studies of the mother and father of these students is university studies. A detail of the socio-demographic characteristics of the students in the sample appears in Table 1.

3.3 Measuring instruments

All students in the sample completed an environmental intelligence questionnaire based on the Howard Gardner test (MIPQ-III; Tirri and Nokelainen, 2008). This test identifies environmental intelligence concerning nature and ecological sensitivity. Table 2 shows the questionnaire used, in which each student rated the statements with "1" if they did not agree at all and "5" if they fully agreed.

Table 1. Socio-demographic characteristics of the student sample

	n	%
Gender		
Woman	272	56.67
Man	208	43.33
University type		
Public	394	82.08
Private	86	17.92
Other qualifications		
Yes	138	28.75
No	342	71.25
Mother's educational level		
Basic	71	14.79
Secondary	81	16.88
Bachelor	65	13.54
Vocational training	84	17.50
University	179	37.29
Father's educational level		
Basic	74	15.42
Secondary	107	22.29
Bachelor	53	11.04
Vocational training	78	16.25
University	168	35.00

Table 2. Environmental intelligence questionnaire

Construct	Items
Environmental intelligence	ENVINT1 I enjoy beauty and experiences related to nature
	ENVINT2 It is essential to me to protect nature
	ENVINT3 I pay attention to my consumption habits to protect the environment

In the same way, the sample of students also completed a questionnaire on knowledge, attitude and environmental behavior based on the proposal of Nizar *et al.* (2019). The version used for this study comprises 44 Items. It identifies environmental knowledge with the ability to know the environment and surrounding us, the environmental attitude with the tendency to protect and conserve natural resources and environmental behavior with how to act actively to protect the environment (Table 3). In this questionnaire, each student in the sample also rated the different items with "1" if they did not agree and "5" if they fully agreed.

4. Results and discussion

4.1 Model validation

To evaluate the measurement model, the reliability, convergent validity and discriminant validity have been examined, and the results related appear in Table 4. The values of the Cronbach's alpha coefficients used to evaluate the reliability, and internal consistency of the Latent variables exceeded the necessary threshold of 0.7 recommended by Nunnally and Bernstein (1994; environmental intelligence 0.709; environmental knowledge 0.768; environmental attitude 0.856 and environmental behavior 0.730). For its part, convergent validity is analyzed through external loads, composite reliability and the mean-variance extracted (AVE; Hair *et al.*, 2013). Loads of the indicators are above the recommended level of 0.70 for their respective constructs and are significant (Hair *et al.*, 2011). The composite reliability also exceeds the minimum of 0.7 (Nunnally and Bernstein, 1994; Fornell and Larcker, 1981), and AVE exceeds 0.5 (Fornell and Larcker, 1981), which indicates that the constructs involved in the study represent more than 50% of the variance of their respective indicators. Since all the above values are over the recommended thresholds, convergence validity is successfully met.

Discriminant validity has been analyzed following three procedures: examining the crossloads to verify if the values of the indicators load more in their construct (Table 5).

Table 6 shows that the square root of the AVE (diagonal values) of each construct is greater than their corresponding correlation coefficients (Fornell and Larcker, 1981); and

Construct	Items
Environmental knowledge	ENVKW1 Sustainable development is as much about the future as it is about what we do and need today
	ENVKW2 Corporate social responsibility is irrelevant to sustainable development
	ENVKW3 Helping people out of poverty is essential condition for a country to be more sustainable
	ENVKW4 Sustainable development has nothing to do with social justice
Environmental attitude	ENVATT1 Poverty alleviation is an essential issue in education for sustainable development
	ENVATT2 The current generation must ensure that the next generation inherits a community at least as healthy, diverse and productive as it is today
	ENVATT3 Manufacturers should discourage the use of disposables
	ENVATT4 Governments should encourage the greater use of fuel-efficient vehicles
	ENVATT5 Every girl or boy should receive an education that teaches the knowledge, perspectives, values, problems and skills for a sustainable life in a community
	ENVATT6 Gender equality has nothing to do with sustainable development
Environmental behavior	ENVBH1 I volunteer to work with charities
	ENVBH2 I invest my savings in ethically responsible funds
	ENVBH3 I often look for signs of ecosystem deterioration

Table 3. Questionnaire on environmental knowledge, attitude and behavior

Variables	Indicators	Loading	SD*	α	ρ_C	AVE
Environmental intelligence				0.709	0.836	0.631
(ENVINT)	ENVINT1	0.710	0.039			
	ENVINT2	0.862	0.013			
	ENVINT3	0.804	0.021			
Environmental knowledge				0.768	0.852	0.591
(ENVKW)	ENVKW1	0.768	0.025			
	ENVKW2	0.814	0.025			
	ENVKW3	0.783	0.032			
	ENVKW4	0.705	0.036			
Environmental attitude				0.856	0.893	0.583
(ENVATT)	ENVATT1	0.739	0.036			
	ENVATT2	0.795	0.025			
	ENVATT3	0.805	0.025			
	ENVATT4	0.792	0.026			
	ENVATT5	0.734	0.034			
	ENVATT6	0.710	0.034			
Environmental behavior				0.730	0.849	0.653
(ENVBH)	ENVBH1	0.803	0.023			
	ENVBH2	0.898	0.011			
	ENVBH3	0.714	0.033			

Table 4.
Reliability and convergent validity

Notes: Significance and standard deviations (SD) performed by 5,000 repetitions Bootstrapping procedure; α: Chronbach's alpha; ρC = Jöreskog's composite reliability; AVE = Average Variance Extracted; * = All loadings are significant at a 0.001 level

	Environmental intelligence	Environmental knowledge	Environmental attitude	Environmental behavior
ENVINT1	*0.710*	0.348	0.377	0.291
ENVINT2	*0.862*	0.551	0.545	0.429
ENVINT3	*0.804*	0.316	0.409	0.665
ENVKW1	0.502	*0.768*	0.546	0.253
ENVKW2	0.322	*0.814*	0.550	0.147
ENVKW3	0.379	*0.783*	0.508	0.208
ENVKW4	0.366	*0.705*	0.515	0.278
ENVATT1	0.372	0.516	*0.739*	0.229
ENVATT2	0.473	0.583	*0.795*	0.284
ENVATT3	0.501	0.552	*0.805*	0.348
ENVATT4	0.396	0.488	*0.792*	0.307
ENVATT5	0.412	0.504	*0.734*	0.330
ENVATT6	0.414	0.513	*0.710*	0.349
ENVBH1	0.470	0.218	0.332	*0.803*
ENVBH2	0.544	0.232	0.354	*0.898*
ENVBH3	0.425	0.260	0.294	*0.714*

Table 5.
Cross loadings

		I	II	III	IV
I	Environmental intelligence	*0.794*	*0.682*	*0.711*	*0.805*
II	Environmental knowledge	0.517	*0.769*	*0.849*	*0.39*
III	Environmental attitude	0.565	0.691	*0.763*	*0.511*
IV	Environmental behavior	0.596	0.290	0.405	*0.808*

Table 6.
Divergent validity

that the HTMT values are all below 0.85 (Hair *et al.*, 2011; Henseler *et al.*, 2015). Therefore, adequate discriminant validity is confirmed.

4.2 Structural model

On the other hand, the results obtained on the adjustment of the model appear in Table 7. It is observed that the residual standardized mean square root (SRMR) is less than 0.10 (Williams *et al.*, 2009). Also, that the exact fit criteria such as unweighted least squares discrepancy (d_ULS) and geodesic discrepancy (d_G) are less than 0.95 (Dijkstra and Henseler, 2015). Consequently, the model¨s fit is also confirmed by the overall quality of the measurement and multiple indicators.

Finally, the structural model was evaluated by reviewing the significance of the trajectory coefficients, the explained variance R^2 and the predictive relevance Q^2 (Hair *et al.*, 2017). Before evaluating these criteria, the possible existence of collinearity problems was verified. In this sense, all the values of the variance inflation factor (VIF) are less than 3 (Hair *et al.*, 2019), so it can be stated that there is no collinearity (see Tables 8 and 9).

The results of the test of the first five hypotheses are summarized in Table 8. All paths (ß) are significant; therefore, hypotheses *H1, H2, H3, H4* and *H5* have been accepted. Environmental intelligence is positively related to environmental knowledge (*H1*: $\beta = 0.517$, $p < 0.001$), with environmental attitude (*H2*: $\beta = 0.281$, $p < 0.001$) and with environmental

	Measurement model	Overall model
SRMR	0.079	0.083
d_ULS	0.850	0.944
d_G	0.264	0.273
Chi^2	728.535	760.938

Table 7. Model fit

Hypotheses	*ß*	SD	*p*-values*	95% confidence interval	VIF	
H1: ENVINT → ENVKW	0.517	0.040	0.000	[0.445; 0.578]	1.000	Supported
H2: ENVINT → ENVATT	0.281	0.039	0.000	[0.215; 0.342]	1.428	Supported
H3: ENVINT → ENVBH	0.572	0.048	0.000	[0.488; 0.646]	1.522	Supported
H4: ENVKW → ENVATT	0.540	0.042	0.000	[0.469; 0.605]	1.636	Supported
H5: ENVATT → ENVBH	0.177	0.048	0.000	[0.097; 0.255]	1.772	Supported

Notes: ß = Path coefficient; SD = Standard deviations; VIF = Variance inflation factor; * = All path coefficients are significant at 0.001 level

Table 8. Standardized structural estimates and tests of the main hypotheses

Hypotheses	*ß*	SD*	*p*-values	95% confidence interval		VIF	
H6a: ENVATT × ENVINT	0.123	0.034	0.000	[0.068;	0.180]	1.503	Supported
H6b: ENVKW × ENVINT	−0.008	0.032	0.403	[−0.060;	0.043]	1.471	Not supported

Notes: *ß* = Path coefficient; SD = Standard deviations; VIF = Variance inflation factor; * = All path coefficients are significant at 0.001 level

Table 9. Moderation analysis results

behavior (*H3*: $\beta = 0.572$, $p < 0.001$). It is also confirmed that there is a positive relationship between knowledge and environmental attitude (*H4*: $\beta = 0.54$, $p < 0.001$) and between attitude and environmental behavior (*H5*: $\beta = 0.177$, $p < 0.001$).

We have also verified that ambient intelligence moderates the relationship between attitude and environmental behavior (*H6a*: $\beta = 0.123$, $p < 0.001$). Hence, the *H6a* hypothesis has also been accepted. However, it has been detected that ambient intelligence does not moderate the relationship between knowledge and attitude, rejecting hypothesis *H6b* (Table 9).

In addition, we have observed that individual R^2 values are greater than the recommended minimum value of 0.10 (Chin, 1998; Falk and Miller, 1992). Also, the model explains 26.7% of the variance associated with environmental knowledge, 53.6% of the variance associated with environmental attitude, and 38.2% of the variance associated with environmental behavior. Regarding the predictive capacity, the Q^2 values are higher than zero, showing great predictive relevance for endogenous variables (Chin *et al.*, 2008). As offered in Table 10, Q^2 for environmental knowledge, attitude and behavior are 0.150, 0.302 and 0.240, respectively. Figure 2 reports path coefficients and their significance levels.

4.3 Discussion

This study has modeled the environmental behavior of university students. The results show that ambient intelligence is the main antecedent of said behavior, with a more significant impact than environmental knowledge or attitude (ß = 0.572). Similar results can be found in the studies by Samsudin *et al.* (2015) and Istiana *et al.* (2020). They also maintain that ambient intelligence has a strong relationship with the environmental behavior of students because this intelligence enhances the ability to understand natural conditions. However, these results are different from those of Suhirman and Yusuf (2019), as they indicated that ambient intelligence had no significant relationship with the environmental behavior of university students. Verifying this relationship may be due to using a robust structural model considering all the antecedents of environmental behavior. Other studies

Endogenous constructs	R^2	Q^2
Environmental knowledge	0.267	0.150
Environmental attitude	0.536	0.302
Environmental behavior	0.382	0.240

Table 10.
Structural model assessment

Notes: R^2 = Explained variance of the endogenous constructs; Q^2 = cross-validated redundancies index performed by a seven-step distance-blindfolding procedure

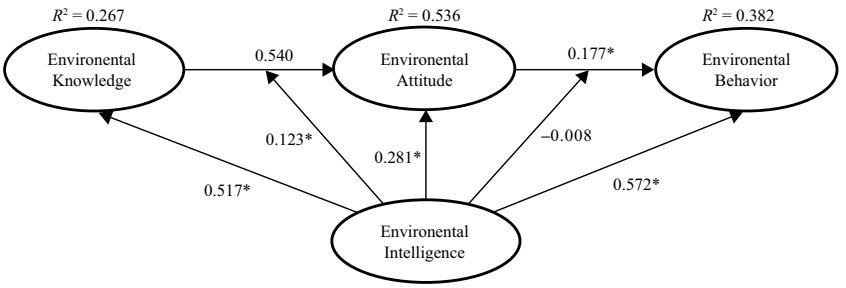

Figure 2.
Structural model results

only included some variables that could potentially be the antecedent of sustainable behavior or have even used relatively more minor samples than the one used in the present study. Likewise, this controversy of results may be due to the difficulty in measuring the causalities between these variables reliably. Also, due to the extensive set of factors that influence the environmental behavior of university students and the existence of a complex interrelationship between them.

On the other hand, we have also been able to confirm a positive relationship between the attitude and sustainable behavior of university students. Likewise, this relationship is the one with the least impact of all the variables analyzed ($\beta = 0.177$). In the same sense, the research by Handayani *et al.* (2021) indicates that individuals with a high level of attitude toward the environment are more likely to manifest positive pro-environmental behaviors. Michalos *et al.* (2009) obtained similar results with a sample of Manitoban adults and youth, and Olivera *et al.* (2020) also pointed out that the environmental attitude of university students is an indicator of pro-environmental behavior, regardless of gender and the study area.

In general, previous literature mention studies indicating that the factors that influence the environmental behavior of young people and students are related to their environmental knowledge and attitude. However, these studies also demand new research that provides more excellent knowledge about the factors that explain said environmental behavior (Istiana *et al.*, 2020; Schmitz and Rocha, 2018; Tanu and Parker, 2018). In this sense, it should be noted that the results of our research show a direct relationship between the environmental knowledge of university students and their environmental attitude, which confirms that people educated in environmental knowledge can in the future become professionals with high sustainable behavior (Zsóka *et al.*, 2013; Zheng *et al.*, 2018; Schmitz and Rocha, 2018; Evans *et al.*, 2018; Janmaimool and Khajohnmanee, 2020). Also, Saza-Quintero *et al.* (2021) have confirmed this relationship in students from a university in Colombia. Possibly, the fact that a university education is essential to promote and disseminate knowledge about sustainability, is generating attitudes that benefit the environment.

Additionally, our results have confirmed the direct and significant impact of ambient intelligence levels on environmental knowledge, which means that the university students who show the most developed ambient intelligence are also those who, consequently, have acquired more excellent environmental knowledge. However, these results could not be contrasted with the previous literature, as this relationship had not been detected in previous studies.

Finally, our model also proposes moderating effects of ambient intelligence in the relationships between environmental knowledge, attitude and behavior, which had not been previously considered in research. In this sense, the moderating effect of ambient intelligence in the relationship between knowledge and environmental attitude has been confirmed. Still, this moderating effect has not been significant in the relationship between attitude and behavior. Therefore, these results may indicate that higher ambient intelligence transforms environmental knowledge into a more intense environmental attitude of university students, causing a double positive effect on said attitude, first as a direct antecedent of environmental knowledge, and second moderating the relationship between environmental knowledge and attitude. We consider the finding of this moderating effect relevant given the scarcity of research that has considered the relationship to environmental intelligence as a moderating variable. Environmental intelligence, therefore, can help to the environmental attitude of university students, which will be greater in those cases of students with high levels of environmental intelligence.

5. Conclusions

The present study has proposed a structural model to understand the formation process of the environmental behavior of university students. Understanding the mechanism by which the environmental behavior of university students develops is essential because people educated in environmental knowledge could, in the future, become professionals who ensure practices oriented to sustainability.

5.1 Theoretical contributions

Currently, studying university students¨ environmental behavior is the subject of great attention because, ultimately, they will contribute to achieving the vision of SDG. Previous literature has suggested that different variables can influence the environmental behavior of university students. However, these studies only offer individual analysis of the environmental behavior antecedents. The present study investigated the environmental behavior of a sample of Spanish university students using a structural model. The results show that environmental intelligence positively affects students' environmental behavior through environmental knowledge and attitude. Also, environmental intelligence influences environmental behavior through a moderator effect on the relationship between environmental knowledge and environmental attitude. Therefore, we suggest that much of the environmental behavior of university students depends on the implementation of actions that improve, through education, their environmental intelligence and knowledge.

This study offers three crucial contributions to the literature on environmental behavior. First, it overcame some limitations in previous environmental behavior studies by jointly analyzing all the antecedents of said behavior. Second, it examined university students¨ intelligence-knowledge-attitude-behavior structure in the sustainability field. Last, this study presented empirical evidence from a large sample covering a broad spectrum of socio-demographic characteristics of university students.

5.2 Practical contributions

From an applied perspective, this study has implications to help improve the environmental behavior of university students. The results suggest that educational programs should implement strategies that maintain a sense of responsibility toward the sustainable development of university students, ensuring that future generations can live a quality life in a sustainable and safe environment. Also, considering that an increase in the levels of environmental intelligence and environmental knowledge of university students could improve both their attitude and environmental behavior, it would be essential to improve students' skills through various innovations in learning media. This study also reveals that students with more excellent knowledge of the environment have better attitudes toward developing sustainable behavior. Thus, promotional actions that encourage students to adopt an environmental education could contribute to future sustainable development.

Universities should provide facilities or strategies that potentially encourage students to improve their environmental behavior. Recycling facilities and offering green products could strongly affect students' commitment to sustainability. On the other hand, and given that the degree to which teachers receive environmental training will undoubtedly affect the type of environmental knowledge transmitted to their students, it is suggested that before engaging in related teaching, they acquire literature and data on environmental education, participate in activities relevant training courses and interact with groups or individuals related to environmental protection to broaden their professional knowledge and enrich the lessons. For this, it could be interesting to provide scholarship opportunities for teachers to improve their environmental training.

In general, we propose greater avenues of awareness on education and environmental awareness. The findings of this study provide information for policymakers and planners to make effective decisions on the development of pro-environmental behaviors in different social groups, particularly university students. Therefore, professionals, educators and the government must reconsider current pro-environmental behaviors and their future interventions. These interventions, in addition to increasing environmental knowledge, should also enrich prosocial environmental values.

5.3 Limitations and future research

The conclusions of the present study are based on a sample drawn only from Spanish university students. Therefore, the findings may not apply to all university students from a global perspective. Further studies are needed to cover other educational institutions and other cultural contexts to analyze possible variations in the antecedents that affect university students' attitude and environmental behavior. Furthermore, and given that the analysis of the contribution of young people and students to sustainable development is a relatively new topic, a more detailed examination of the process of formation of environmental attitudes and behavior is warranted.

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