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Engineering Students Education in Sustainability: The Moderating Role of Emotional Intelligence

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Abstract: In the context of a lack of quantitative research approaching an engineering education in sustainability, this cross-sectional study aims to investigate whether efforts to promote sustainability education contribute to shaping the beliefs, attitudes, and intentions towards sustainability in a sample of Portuguese engineering schools students; in addition, this study investigates whether emotional intelligence impacts the students' motivation to learn more about sustainability and whether it plays a role in moderating the relationships between those variables. A survey was carried out on a sample of 184 students from two major Portuguese engineering schools. A model was found showing that beliefs, attitudes, and gender are predictors of students' intentions towards sustainability, explaining 62.6% of its variance. Furthermore, the findings reveal that women have stronger beliefs and intentions towards sustainability than men and that students with higher emotional intelligence are more motivated to learn more about sustainability. In addition, emotional intelligence has a negative and significant moderating impact on the relationship between attitudes and students' intentions towards sustainability, being stronger for lower levels of emotional intelligence and having a similar, yet non-significant, effect on the relationship between beliefs and students' intentions towards sustainability. The results suggest that emotional intelligence should be considered a competence and a tool in engineering education in order to enhance students' inclination towards sustainable development.

Keywords: sustainability; emotional intelligence; beliefs; attitude; intention; engineering students; moderation; sustainability education

Citation: Nogueira, T.; Castro, R.; Magano, J. Engineering Students Education in Sustainability: The Moderating Role of Emotional Intelligence. *Sustainability* **2023**, *15*, 5389. https://doi.org/10.3390/su15065389

Academic Editor: Rosabel Roig-Vila

Received: 14 February 2023
Revised: 15 March 2023
Accepted: 16 March 2023
Published: 17 March 2023

1. Introduction

Only in the past few decades have concerns about sustainability and sustainable development become extensively recognized as a societal concern [1]. According to the World Commission on Environment and Development, sustainability is aimed at "promoting harmony among human beings and between humanity and nature" [2]; such "harmony" is translated into the "triple bottom line" concept, which propounds a balance between economic, social, and environmental sustainability [3]. Despite this multidisciplinary perspective of sustainability, there is no consensus about the importance and priorities of each dimension [4]. The sustainable development concept, introduced in the Brundtland Report [2], is referred to as " . . . development that meets the needs of the present without compromising the ability of future generations to meet their own needs"; this has become a reference for scientific research on the environment [5], underlying the progress of our society from a responsible economic perspective, and is in agreement with environmental and natural practices [6]. Sustainability frameworks and approaches for scientific research and environmental management keep evolving [7]. Nevertheless, the terms 'sustainability' and 'sustainable development' are often used as synonyms [8], despite there existing a contradiction in that it is not possible to sustain infinite growth on a limited planet [9]. In this study,

we will use the concepts interchangeably, referring to a systems approach that conveys a multidisciplinary sustainability perspective (economic, social, and environmental).

Sustainability has gained significant attention over the years amongst engineers [10], who play a crucial role in designing, building, and maintaining sustainable systems and infrastructure. It is, therefore, of interest to positively influence the attitudes of engineering students towards sustainability; thus, educators and universities should play an important role in fostering their values and beliefs towards sustainability [11]. In fact, education aspires to transform the attitudes and behaviors of forthcoming generations towards sustainability through the combined efforts of educators and educational organizations [11,12]. A person's behavior is determined by how highly a goal is valued and by the degree to which the person expects to succeed [13]. Increasing knowledge could influence one's beliefs, values, and intentions [13,14]. Beliefs convey a person's acceptance that something is true and deal with the establishment of a person's values and convictions, that, in turn, can be transformed by knowledge [15]. Attitudes refer to a person's lasting evaluations, emotional feelings, and inclinations towards some object or idea, and translate a person's beliefs that are then confirmed through actions and thoughts, which influence intentions and thus drive a person's future actions [14]. Ajzen and Fishbein [13] suggest that beliefs drive the creation of attitudes that thus affect the intention of an individual to act.

Educating engineers in sustainability is essential to foster fundamental changes in their conviction and values; given sustainability's transdisciplinary nature [16], such an endeavor could be achieved by inserting educational content into several engineering disciplines, especially those that have substantial roles in achieving sustainability (although the elements necessary to achieve sustainability stem from all aspects of engineering) [17]. Consequently, it is of interest to assess the effectiveness of sustainability educational efforts; this is, indeed, if engineering schools are successful in shaping students' attitudes and beliefs towards sustainability and in developing their sustainability traits. However, there is a lack of sufficient empirical studies that address such a concern [11,18]. Given such a context, we hypothesize the following:

H1. *Beliefs towards sustainability have a significant direct relationship with the intention to act more sustainably.*

H2. *Attitudes towards sustainability have a significant direct relationship with the intention to act more sustainably.*

Another aspect of sustainable development education is that it should consider students' emotional development in order to enhance their skills and academic performance, and lay the foundation for a more collaborative and humane society; thus, building sustainable societies implies developing and managing emotional skills in addition to economic, social, and environmental factors [19]. Emotional intelligence refers to a person's ability to manage their feelings so that those feelings are expressed appropriately and effectively [20], or are referred to as "the individual's ability to use reason to understand and deal with emotions (own and others) and use emotions to understand the context and make more rational decisions" [21]. Previous research has sought to explain how beliefs and attitudes shape favorable behaviors towards the environment [22–25], and has implied that the intelligent usage of emotions is an element of positive environmental behavior [26], namely the ability to assess and regulate one's emotions [26]. On the other hand, emotional intelligence is vital in learning and in individual development [27], contributes to and enhances the cognitive abilities of students [28,29], and is accepted to be essential for the formation of engineers [30]. Emotional intelligence can be seen as a trait, being that the students' emotional profile can vary according to gender and age [31]. In addition, there is evidence of the linkage between sustainable development and emotional intelligence [22,32,33]; this considers the latter to be a dimension of sustainability that plays a principal role in sustainable engineering education. Riemer [34] suggests that emotional intelligence is not only a tool for engineering students while they are learning, but that it also offers career skills for the engineering graduate. Aguilar et al. [26] suggest that considering emotional intelligence as

moderating the relationship between beliefs, attitudes, and intentions towards sustainable behavior would contribute to a better understanding and better prediction of sustainable behavior. However, despite the progress that has been made in engineering education towards sustainability, emotional intelligence has not received enough attention and there is a lack of empirical studies that address such a gap [11]. Accordingly, we hypothesize the following:

H3. *Students with higher emotional intelligence will be more motivated to learn more about sustainability.*

H4. *Differences in beliefs, attitudes, and intentions towards sustainability according to gender will be found.*

H5. *Emotional intelligence will play a moderating role in the relationship between attitudes and intentions towards sustainability (H5a), and between beliefs and intentions towards sustainability (H5b).*

The generic research question of this study asks whether sustainability education could generate positive effects in terms of the beliefs, attitudes, and intentions towards sustainability of a sample of engineering students in Portuguese engineering schools; in addition, it asks whether emotional intelligence plays a role in moderating the relationships between these variables and the engineering students' motivation to learn more about sustainability (an exploratory approach that is motivated by the current lack of evidence regarding the role of emotional intelligence in contributing to a sustainable mindset).

As such, this study was carried out on a sample of engineering students in two major Portuguese engineering schools, who undertook courses with basic content on sustainability in the first semester of 2022/23; such content and the effort to deliver it were expected to impact the students' beliefs regarding sustainability, leading to positive changes in their attitudes and intentions, and thus enhancing their sustainability traits. For that purpose, a survey was carried out using measurement instruments drawn from the literature and described in Section 2, namely concerning beliefs, attitudes, intentions towards sustainability and emotional intelligence.

The remainder of the article Is organized as follows: Section 2 describes the procedures, measurement instruments, data analysis method used in the study, and the sample characteristics; Section 3 documents the results, which are discussed in Section 4; and Section 5 presents the conclusions and limitations of the study.

2. Methods

2.1. Procedures

A cross-sectional survey was designed and carried out between 23 November and 19 December 2022 at two Portuguese higher education institutions—the School of Engineering of the Polytechnic Institute of Porto (ISEP-IPP) and the Instituto Superior Técnico of the University of Lisbon (IST-UL)—in order to analyze the impact of sustainability education efforts among engineering students in both schools regarding their beliefs, attitudes, and intentions towards sustainability, and if their emotional intelligence moderated the relationships between those variables. For this purpose, at the beginning of the semester, the authors identified courses for the undergraduate and master's degrees with sustainability content. The identified courses were designed to encourage the teaching of fundamental knowledge on sustainability and sustainable development, enhancing the respective benefits of engineering practice; this includes making decisions concerning materials and processes in project management, stimulating an intrinsic motivation towards sustainability, and, in general, enhancing the students' awareness of sustainability's economic, environmental, and societal dimensions (Elkington's triple bottom line). They were also designed to describe the United Nations Sustainable Development Goals (SDGs), and enhance their significant human-centric attributes [35]. The questionnaire included items adapted from Tang [11] and Rego and Fernandes [36]; authorization from the authors was requested.

The 25 items from Tang [11] were translated from English to Portuguese using the back-translation technique to ensure the quality of the translation. Before starting the fieldwork, a small group of researchers was invited to critique the initial draft of the questionnaire. As a result, the wording and suitability of the form were improved, and the questionnaire was pretested on a group of 31 students. Once making the revisions suggested after this pilot study, the target students were surveyed by administering the questionnaire during classes in the final weeks of the semester. When answering the questionnaire about their beliefs, attitudes, and intentions regarding sustainability, students were asked to compare their position at the time of answering with the one they had at the beginning of the school semester. Any invalid (incomplete or incorrectly completed) responses that were obtained were removed from the analysis. The research protocol included informed consent, which contained the study's objectives and ensured the participants' confidentiality and anonymity.

2.2. Measure Instruments

The questionnaire consisted of three sections. The first section comprised the 23 items of the emotional intelligence scale that was suggested and validated by Rego and Fernandes for the Portuguese population [36]. Prior research applying this instrument reported an internal consistency (Cronbach's alpha) of over 0.7 [37]. Answers were assessed with a 7-point Likert scale (1—'the statement does not apply to me', up to 7—'the statement applies to me completely'). The second section included ordinal-scale items to examine students' beliefs, attitudes, and intentions towards sustainability. These unidimensional variables were measured with five-point Likert scales (1—'strongly disagree' to 7—'strongly agree'), comprising 25 items altogether (Beliefs—6 items; Attitudes—13 items; Intentions—6 items), suggested by Tang [11] in order to gauge the three domains in the context of sustainability education. The third section comprised a sociodemographic questionnaire with questions related to gender (masculine—1; feminine—0;), age, and nationality (Portuguese—1; Other—0), a question to describe the course the respondents were enrolled in ('What course are you currently taking?') and its degree ('Degree of the course you are currently attending?', being 1—Bachelor and 0—Master's degree), a question about the respondents' prior training in sustainability ('Have you had training on sustainability in any course that you attended before the current semester?', being 1—'Yes' and 0—'No'), and, finally, a question on the motivation to acquire more training on the subject ('Do you feel motivated to learn more about sustainability?', being 1—'Yes' and 0—'No').

2.3. Data Analysis

Statistical analyses were carried out using SPSS (version 28.0). The sample was characterized by descriptive analysis (means, standard deviations, percentages, cumulative percentages). The normality of the items' distribution was evaluated by determining skewness and kurtosis indicators: skewness values under 3 and kurtosis values under 10 suggest normality [38]. In order to establish whether items fit the study's data, correlations between items and a principal component analysis (with varimax orthogonal rotation) were carried out for beliefs, attitude, and intentions towards sustainability instruments, which were not validated for the Portuguese population [39]. As such, items with no Pearson's r above 0.3 were removed, as well as items with factor loadings below 0.5 [40]. To assess the construct's reliability, Cronbach's alpha coefficients were determined ($\alpha > 0.7$) [41]. Convergent validity was evaluated by determining each construct's composite reliability (CR > 0.7) and the average variance extracted (AVE > 0.5), applying Fornell and Larcker's cut-off values [42]. Discriminant validity was assessed by ensuring that shared variance among the variables did not exceed the square root of the AVE. A hierarchical multiple regression was performed to estimate the effects of the control variables and attitudes and beliefs towards sustainability on students' intentions towards sustainability. Furthermore, differences were investigated using the independent t-test and the Mann–Whitney test, whose interpretation followed Cohen's [43] guidelines. The statistical significance threshold

was set at 0.05. Finally, the PROCESS macro for SPSS [44] was applied to examine whether emotional intelligence would moderate the relationship between the beliefs, attitudes, and intentions to act towards sustainability.

2.4. Sample

The fieldwork yielded a sample of 184 valid responses. The general characteristics of this sample are reported in Table 1. As can be seen, most students were males (72.8%), whereas the number of students from both institutions was balanced (ISEP-IPP—48.4 %; IST-UL—51.6%). Over two thirds were master's students (first year), whereas 31.0% were undergraduate students (last year).

Nearly 75% of the sample was made of Portuguese students, whereas 26.1% had other nationalities (especially associated with master's degrees of IST-UL); the most represented nationalities were Indian (10 students), German (6), French (5), Spanish (4), and Italian (4) (Figure 1).

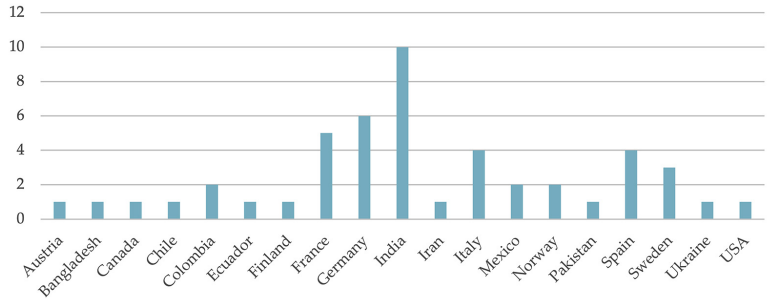

Figure 1. Non-Portuguese students—country of origin.

Most students were enrolled in Electrical and Computer Engineering, Energy Engineering and Management, and Power Systems Engineering (Figure 2); other courses (8%) included Engineering and Industrial Management, Biomedical Engineering, Energy Technologies, and Mechanical Engineering.

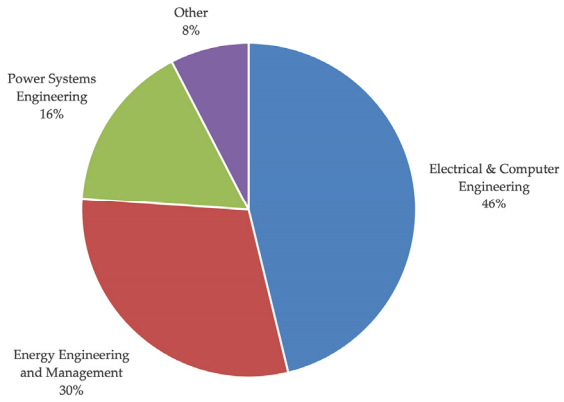

Figure 2. Sample students' engineering courses.

Table 1. General characteristics of the sample.

Variables	Total			ISEP-IPP			IST-UL		
	N	**Percent**	**Cumulative Percent**	***N***	**Percent**	**Cumulative Percent**	***N***	**Percent**	**Cumulative Percent**
Sample	184	100	100	89	48.4		95	51.6	
Gender									
Male	134	72.8	72.8	71	38.6	38.6	63	34.2	34.2
Female	50	27.2	100.0	18	9.8	48.4	32	17.4	51.6
Degree									
Undergraduates	57	31.0	31.0	55	29.9	29.9	2	1.1	1.1
Master's	127	69.0	100.0	34	18.5	48.4	93	50.5	51.6
Nationality									
Portuguese	136	73.9	73.9	85	46.2	46.2	51	27.7	27.7
Other	48	26.1	100.0	4	2.2	48.4	44	23.9	51.6
	M	*SD*	*Min–Max*	*M*	*SD*	*Min–Max*	*M*	*SD*	*Min–Max*
Age	24.0	4.882	19–55	24.6	6.410	19–55	23.5	2.720	20–37

Note: *N* = frequencies; % = percentage; *M* = mean; *SD* = standard deviation; *Min* = minimum; *Max* = maximum.

3. Results

Table 2 presents the descriptive statistics related to the items of the instruments used in this study: Beliefs, Attitudes, Intentions, and Emotional intelligence. All skewness and kurtosis values are within the normative values, ensuring the normality of the distribution.

Table 2. Item frequencies.

	Variables/Items	Scale	*M*	*SD*	Skewness	Kurtosis
	Beliefs	1–5	3.94	0.744	−0.516	0.633
BF01	I feel more morally obliged to do something about environmental problems.		3.99	0.890	−0.647	0.181
BF02	I feel more morally obliged to do something about social problems.		3.84	0.903	−0.528	0.014
BF03	I think I should take more responsibility for sustainable development.		3.98	0.890	−0.720	0.359
BF04	I believe that humans have the right to subdue and control nature.		3.46	1.270	−0.408	−0.885
BF05	I believe that humans should adapt to nature rather than modify it to suit them.		3.93	1.051	−0.750	−0.160
BL06	I think it is important to control human population to ensure social sustainability.		3.46	1.157	−0.412	−0.580
	Attitudes	1–5	3.82	0.565	−0.556	0.674
AT01	I am more aware of current environmental, social, economic, and cultural issues.		4.14	0.738	−1.294	3.565
AT02	I can analyze issues related to sustainable development more holistically.		3.92	0.731	−0.636	1.152
AT03	I am more concerned about environmental pollutions.		4.09	0.854	−0.924	1.014
AT04	I am more willing to safeguard sustainable development.		4.10	0.721	−0.689	1.266
AT05	I make an effort to use green products and services whenever possible.		3.76	0.899	−0.682	0.416
AT06	I refuse the use of packaging.		2.96	1.073	−0.085	−0.638
AT07	I set aside garbage for reuse, recycling, or safe disposal.		4.15	0.969	−1.185	0.994
AT08	I reduce the use of air-conditioning, lighting, and domestic electrical appliances.		3.79	1.077	−0.695	−0.076
AT09	I consciously make a change in my lifestyle to reduce my carbon footprint.		3.48	1.040	−0.486	−0.035
AT10	I consciously reduce the amount of waste generated from my daily activities.		3.67	0.965	−0.522	−0.052
AT11	I make an effort to use energy and resources more efficiently.		4.09	0.847	−1.049	1.427
AT12	I reduce water consumption.		3.91	0.916	−0.636	0.087
AT13	I am willing to pay more for energy-efficient products.		3.60	1.087	−0.641	−0.108
	Intentions	1–5	4.02	0.680	−0.794	1.716
IT01	I prefer to work for an environmentally responsible employer in the future.		4.17	0.836	−1.065	1.755
IT02	I prefer to work for a socially responsible employer in the future.		4.22	0.789	−1.229	2.812
IT03	I intend to change/continue to change my lifestyle for better sustainability.		4.22	0.746	−0.946	1.535
IT04	I will promote the concept of sustainable development to my family and friends.		4.13	0.792	−0.637	0.277
IT05	I will participate in campaigns/causes that promote sustainable development.		3.57	1.006	−0.359	−0.187
IT06	I will apply the concept of triple bottom line more in making decisions.		3.80	0.890	−0.498	0.268
	Emotional intelligence	1–7	5.39	0.629	−0.094	−0.165
EI01	When a friend of mine wins an award, I feel happy for him.		6.35	0.875	−1.350	1.331
EI02	I am indifferent to the happiness of others. (i)		5.58	1.719	−1.203	0.384
EI03	I feel good when a friend of mine gets a compliment.		5.97	1.123	−1.443	3.328
EI04	I live my friends' problems as if they were my problems.		4.17	1.467	−0.054	−0.439
EI05	I get irritated when people criticize me—even though I know other people are right. (i)		4.68	1.514	−0.330	−0.529
EI06	It is hard for me to accept a criticism. (i)		5.29	1.267	−0.590	−0.148
EI07	I don't deal well with the criticisms they make of me. (i)		5.36	1.255	−0.740	0.304
EI08	I have difficulty talking to people who do not share the same views as mine. (i)		5.52	1.297	−0.909	0.383
EI09	When I'm defeated in a game, I lose control. (i)		6.06	1.335	−1.892	3.660
EI10	I can remain calm even when others are angry.		5.11	1.562	−0.791	0.002
EI11	I react calmly when I am under stress.		4.48	1.578	−0.166	−0.654
EI12	Am I really able to control my own emotions?		4.81	1.426	−0.368	−0.389
EI13	I do my best to achieve the goals I set for myself.		5.73	1.310	−0.970	0.335
EI14	I usually encourage myself to do my best		5.75	1.303	−1.055	0.525
EI15	In general, I usually set goals for myself.		5.63	1.454	−1.049	0.327
EI16	I know well what I feel.		5.34	1.305	−0.583	−0.078
EI17	In general, I am aware of my feelings.		5.58	1.286	−1.109	1.735
EI18	I understand the causes of my emotions.		5.27	1.273	−0.540	0.051
EI19	I understand my feelings and emotions.		5.29	1.271	−0.524	−0.241
EI20	When I'm sad, I know what the reasons are.		5.15	1.410	−0.593	−0.397
EI21	I try to understand the feelings of the person I am listening to.		5.78	1.124	−0.915	0.744
EI22	I can understand my friends' emotions and feelings by seeing their behavior.		5.44	1.134	−0.544	0.034
EI23	I strive to understand other people's points of view.		5.58	1.269	−1.133	1.637

Note: *M* = mean; *SD* = standard deviation; (i) reverse item.

Several items were removed from subsequent analysis: items BF4, BF5, and BF6 displayed weak correlations ($r < 0.3$); items AT5, AT6, AT7, and AT13 had low factor loadings (<0.5). The instruments' internal consistency was assessed using Cronbach's alpha (Table 3). The results found that Cronbach's α of each construct was greater than

0.7 (0.78–0.89), showing high reliability for our survey instrument [45]. Furthermore, as shown in Table 3, the factor loadings of all the constructs exceeded 0.5 and thus conformed to the test of item reliability [40]. In addition, the composite reliabilities of all constructs exceeded the 0.7 (0.76–0.94) cut-off value, as recommended by Fornell and Larcker [42]. In addition, the average variance extracted from each construct exceeded 0.5, indicating convergent validity [42]. In short, the convergent validity test demonstrated that the proposed constructs were adequate.

Table 3. Variables descriptive statistics and reliability.

Construct	Factor Loadings	*CR*	*AVE*	Cronbach's α
Beliefs		0.756	0.509	0.890
BF01	0.746			
BF02	0.714			
BF03	0.678			
Attitudes		0.913	0.539	0.778
AT01	0.843			
AT02	0.821			
AT03	0.690			
AT04	0.706			
AT08	0.694			
AT09	0.625			
AT10	0.777			
AT11	0.674			
AT12	0.751			
Intentions		0.864	0.516	0.837
IT01	0.793			
IT02	0.697			
IT03	0.710			
IT04	0.730			
IT05	0.687			
IT06	0.687			

Note: *CR* = composite reliability; *AVE* = average variance extracted.

In addition, discriminant validity was employed to measure how much the constructs differed; if the items in a construct were more strongly associated with each other than with the items measuring other constructs, the measure was seen as having discriminant validity. As portrayed in Table 4, the shared variance among the variables did not exceed the square root of the AVE. Therefore, discriminant validity is confirmed.

Table 4. Construct means, standard deviations, correlations, and AVE.

Variable	M	SD	BLF	ATT	INT	AVE
Belief	3.94	0.74	**0.71**			0.454
Attitude	3.88	0.58	0.65 **	**0.73**		0.488
Intention	4.02	0.68	0.66 **	0.69**	**0.72**	0.563

Note: ** $p < 0.01$. BLF—Beliefs; ATT—Attitudes; INT—Intentions; AVE = average variance extracted; bold (diagonal) = AVE square roots.

A hierarchical multiple regression was performed to estimate the effects of the control variables and attitudes and beliefs towards sustainability on students' intentions towards sustainability. An independence of residuals was found, as assessed by a Durbin–Watson statistic of 1.946. The independent variables were entered in three blocks; consequently, two nested models were generated. Model 1 estimated the effect of the control variables (gender, age and country of origin were not statistically significant); Model 2 added beliefs, and Model 3 added attitudes (Table 5). The results revealed that attitudes and beliefs towards sustainability have a statistically significant positive direct effect on intentions

towards sustainability. The full model of gender, beliefs and attitudes that was used to predict intentions towards sustainability (Model 3) was statistically significant, $R^2 = 0.626$, $F(3,180) = 100.58$, $p < 0.001$; adjusted $R^2 = 0.620$. The addition of beliefs to the prediction of intentions towards sustainability (Model 2) led to a statistically significant increase in R^2 of 0.394, $F(1, 181) = 125.741$, $p < 0.001$. The addition of attitudes to the prediction of intentions towards sustainability (Model 3) also led to a statistically significant increase in R^2 of 0.193, $F(1, 180) = 93.091$, $p < 0.05$. Therefore, H1 and H2 are accepted.

Table 5. Hierarchical multiple regression for intentions towards sustainability.

Variables	Model 1			Model 2			Model 3		
	B	**Std β**	***t*-Value**	***B***	**Std β**	***t*-Value**	***B***	**Std β**	***t*-Value**
(Constant)	4.24 **		44.85	1.78 **		7.70	0.58 *		2.57
Gender	−0.30 **	−0.20	−2.73	−0.10	−2.06	−1.11	−1.60 *	−0.11	−2.24
Beliefs				0.59 **	0.64	11.21	0.24 **	0.26	4.24
Attitudes							0.68 **	0.58	9.65
R^2	0.039			0.433			0.626		
F	7.44 *			69.14 **			100.58 **		
ΔR^2	0.039			0.394			0.193		
ΔF	7.44 *			7.44 **			93.09 **		

Note: R^2 = explained variance; B = shared variance between variables; Std β = standardized regression coefficient; t = Student's t-test. * $p < 0.05$; ** $p < 0.001$.

A Mann–Whitney test was conducted to compare beliefs, attitudes, and intentions towards sustainability for gender, for the groups who have/have not had prior training in sustainability, school of origin, and nationality; differences were found only for gender (Table 6) concerning beliefs and intentions towards sustainability, being that, in both cases, females scored significantly higher. Consequently, H4 is accepted. An independent-samples t-test was run to determine whether there were differences in emotional intelligence between men and women; women scored higher in EI ($M = 5.43$, $SD = 0.49$) than men ($M = 5.37$, $SD = 0.67$), but this difference was not statistically significant, $M = -0.23$, 95% CI [−0.50, 0.04], $t(182) = -1.688$, $p = 0.093$. Another independent-samples t-test was run to determine whether there were differences between the emotional intelligence levels of the respondents who felt more motivated to learn about sustainability and those who did not; students that felt more motivated scored higher in EI ($M = 5.30$, $SD = 0.89$) than men ($M = 5.12$, $SD = 0.78$), making this difference statistically significant, $M = -0.18$, 95% CI [−0.42, 0.06], $t(182) = -1.456$, $p = 0.147$, and thus supporting H3.

Table 6. Differences by gender and motivation to learn more about sustainability.

Variable	Gender	*N*	*MR*	*Md*	*U*	*Z*	*p*	*r*
Beliefs	Male	134	85.18	4.00	2369.5	−3.09	**0.002**	−0.23
	Female	50	112.11	4.33				
Attitudes	Male	134	90.47	3.90	3078.0	−0.848	0.396	−0.06
	Female	50	97.94	3.90				
Intentions	Male	134	86.37	4.00	2528.5	−2.568	**0.010**	−0.19
	Female	50	108.93	4.17				

Table 6. *Cont.*

Variable								
Emotional intelligence	**Gender**	***N***	***M***	***SD***	***t***	***df***	***p***	***d***
	Male	134	5.37	0.67	−0.670	119	0.504	0.63
	Female	50	5.43	0.49				
	Motivation to Learn More about Sustainability	***N***	***M***	***SD***	***t***	***df***	***p***	***d***
	No	102	5.26	0.62	−3.051	182	**0.003**	−0.61
	Yes	82	5.54	0.61				

Note: *N* = frequencies; *MR* = mean rank; *Md* = median; *U* = Mann–Whitney test; *r* = effect size; *M* = mean; *SD* = standard deviation; *t* = *t*-test; *df* = degrees of freedom; *p* = *p*-value; *d* = Cohen's d. In bold: statistically significant values.

A moderation analysis was conducted to test the hypothesis that emotional intelligence plays a moderating role in the relationship between attitudes (H5a) and beliefs (H5b), and intentions towards sustainability. Firstly, intentions towards sustainability was set as the dependent variable, attitudes was set as the independent variable, and emotional intelligence was set as the moderating variable. The results indicate the negative and significant moderating effect of EI on the relationship between ATT and INT ($B = -0.224$, 95% CI (−0.39; −0.06), $t = -2.717$, $p = 0.007$), being that the interaction term increases the explained variance of INT (ΔR^2 = 1,7%, ($F(1,180) = 7.38$, $p = 0.007$), supporting H5a. A simple slope analysis carried out to better understand the nature of this moderating effect, at the mean of EI and ±1 standard deviation from the mean, reveals that the impact of ATT on INT is stronger for lower levels of EI ($B = -0.926$, 95% CI (0.77; 1.00), $t = 11.859$, $p < 0.001$) than for higher EI ($B = -0.644$, 95% CI (0.47; 0.82), $t = 7.422$, $p < 0.001$); in other words, as the level of EI increases, the strength of the relationship between ATT and INT decreases. Similarly, students' intentions towards sustainability was again set as the dependent variable, beliefs was set as the independent variable, and emotional intelligence was set as the moderating variable. The results indicate the negative yet non-significant moderating impact of EI on the relationship between BLF and INT ($B = -0.096$, 95% CI (−0.23; −0.04), $t = -1.405$, $p = 0.162$), increasing the explained variance of INT (ΔR^2 = 0.6% ($F(1,180) = 1.97$, $p = 0.162$); thus, H5b is rejected. In sum, all hypotheses were accepted except H5b.

4. Discussion

The results document that, after being delivered, the educational sustainability content in the courses undertaken by respondents revealed a widespread moderate to strong agreement between beliefs, attitudes, and intentions towards sustainability, which is in line with [11,12,46]. Among the items that scored the highest within beliefs, one can highlight the conviction that students should act with regard to environmental issues and should take responsibility for sustainable development. Regarding attitudes towards sustainability, they indicate a willingness to set aside garbage for reuse, recycling, or safe disposal, and show a stronger awareness of current environmental, social, economic, and cultural issues. These results align with the literature, which confirms that sustainability education can positively affect students' ecological footprint [18]. The item that scored the lowest was refusing the use of packaging ($M = 2.96$, $SD = 1.073$), possibly reflecting an impediment to the acceptance of a more sustainable lifestyle. In terms of the intention to act towards sustainability, the results enhance the students' willingness to work with environmentally and socially responsible employers and their inclination to adapt their lifestyle for higher levels of sustainability. In general, the courses have created motivation among the students to follow a sustainable lifestyle and practices, as can be inferred by the mean ratings obtained in most items (all above 3.0, except for item AT6).

A model was found in which attitudes, beliefs, and gender significantly correlate with students' intentions towards sustainability; as predictors of such an intention, they

explain, as a whole, 62.6% of the variance in these dependent variables. This is in line with previous research [11,18] that has suggested that sustainability education could change beliefs and attitudes, and, in turn, impact students' intentions to act towards sustainability; this is also in line with the suggestion that there may be differences concerning gender [31]. Furthermore, women scored significantly higher in attitudes and intentions towards sustainability, which is possibly linked to the fact that they also revealed higher levels of global emotional intelligence; this is an outcome that aligned with Zhoc et al. [29], who state that EI contributes to key learning outcomes in higher education (including social, cognitive and self-growth outcomes) and that women develop higher levels of emotional intelligence [30]. However, this is in contrast with the results obtained by Ryu et al. [18], who found that gender had no statistical significance in post-sustainability training regarding attitudes and intentions towards sustainability.

Several studies report that emotional intelligence has positive effects on engineering learning [32,37] and that it enhances behaviors towards sustainability [22,26]; this study's results are similar, finding that students with higher emotional intelligence are more motivated to learn about sustainable development and how they can help build a more sustainable future for all. On the other hand, EI was found to negatively and significantly moderate the relationship between attitudes and students' intentions towards sustainability, being that the lower the emotional intelligence, the stronger the relationship. A possible explanation for such an outcome is that the higher the emotional intelligence, the less conditioned students are by beliefs or attitudes, likely because they are more complex and may reflect more on sustainability issues. However, the moderating effect of EI on the relationship between beliefs and intentions towards sustainability in our sample was not statistically significant, though it was not distant from the effect on the relationship between attitudes and intentions towards sustainability.

The findings of this study underline the impact of inserting educational content on sustainability into engineering courses, which may, among engineering students, generate stronger beliefs, attitudes, and intentions to act more sustainably and also enhance the effect of emotional intelligence in the learning process. Among the reasons to include emotional intelligence in an education on sustainability in engineering, one can mention that it could improve the ability of engineers to understand the emotional context of sustainability issues and to communicate effectively with stakeholders (for example, engineers who are trained in emotional intelligence are better equipped to understand the emotional barriers that may prevent stakeholders from engaging in sustainability initiatives). In addition, emotional intelligence helps engineers recognize the impact of their emotions and biases on the sustainability decision-making process and take steps to mitigate these effects. In addition, emotional intelligence enables engineers to collaborate effectively with others in promoting sustainability by fostering trust, empathy, and mutual respect. However, most of all, emotional intelligence impacts the learning process itself [20,34,47], suggesting that it should be adequately used to ensure that education on sustainability is more effective among engineering students; as suggested by some authors, EI could even be seen as a competence for engineering education [30,48]. In that regard, a recommendation that may contribute to the education of engineers towards sustainability is integrating EI-related skills into engineering curricula to foster its relevance in education, across disciplines, and in society. Furthermore, improvements in EI may support students to build up knowledge in their discipline more thoroughly, alongside other core skills needed for becoming an engineer [30]. That could be achieved, for instance, by using EI-oriented contents, context-specific role-plays, PBL, or exercises that enhance context and self-awareness, communication skills, team working, the conveyance of ideas, the acceptance of criticism, learning to adapt, leadership [30,34,37,49], and reflection skills and abilities [34]; this is compared to embodying sustainability topics (e.g., sustainable engineering, sustainable technologies and processes, risk and sustainable analysis, sustainable engineering design, and leadership, as recommended by Boyle [17]).

Our results and the implications described above should take into account that this study has some limitations. Firstly, the sample could benefit from being larger and including a more diverse range of students, namely, to allow for investigating significant differences in engineering disciplines and courses. Another limitation is that we relied on the assumption that all the students provided honest answers to the questionnaire; because the respondents were asked to answer it at the end of a lesson, we should expect that some may not have taken it seriously. Furthermore, being a cross-sectional study, we tried to capture whether the educational content on sustainability that was included in the semester's courses indeed impacted the students; nevertheless, we had to rely on the respondents' judgment regarding whether that content had changed their beliefs, attitudes, and intentions to act more sustainably from the beginning to the end of the semester. Another shortfall is that we only approached engineering students on their way to completing undergraduate courses or attending master's degree lectures. The reason for this decision was the consideration that sustainable engineering demands the capability to realize the multifaceted systems that exist within the environment and in society, as well as the restraints on those systems, and thus a greater maturity than that of most traditional engineering disciplines [17]. However, EI competencies also vary with age, suggesting that their use as an effective sustainability learning tool should also involve students at earlier stages of their undergraduate education, as there is also evidence that we can influence students' sustainable behavior then as well [50]. A longitudinal study may be of interest to ensure that the same cohort of students is followed over time and that more reliable conclusions are drawn concerning the impact of efforts to provide education on sustainability and the use of EI within such a context. Finally, our study has addressed emotional intelligence as a whole; that is, we have not decomposed EI into a series of sub-dimensions that deserve analysis on their own (namely, attention to one's emotions, sensitivity to others' emotions, emotional maturity, empathy and emotional contagion, understanding of the causes of one's emotions, self-encouragement, understanding of one's emotions, and emotional self-control). Students could score differently in such sub-dimensions, possibly affecting the effectiveness of the educational approach in student groups, namely concerning gender and age [31].

5. Conclusions

This study was conducted to examine the relationship between engineering students' beliefs and attitudes and also between attitudes and intentions; furthermore, this was to investigate whether emotional intelligence acts as a moderating variable in those relationships, thus contributing to the literature, which lacks quantitative studies that address sustainability in engineering education and the consideration of emotional intelligence in the learning process. The results indicated that the engineering students became more aware of sustainability and strengthened their beliefs, attitudes, and intentions to act towards it in the future after undertaking courses with educational content on sustainability; however, in students with higher EI, the relationships between those variables weaken. In addition, students with higher global emotional intelligence were more willing to learn about sustainability. Such findings support the inclusion of emotional intelligence as a moderator variable in the relationship between engineering students' beliefs, attitudes, and intentions towards; as such, sustainability could help one understand and improve the models used for predicting sustainable behavior, as well as engineering curricula and activities used to enhance effective sustainability learning and graduates' skills and abilities. Emotional intelligence could be an important factor in learning about sustainability, as it helps individuals develop a greater appreciation for the interconnectedness of people, nature, and the environment; EI is known to allow individuals to build strong relationships with others, to be more resilient, flexible, and open-minded in their approach to sustainability, and to be more proactive in their efforts to address sustainability challenges. The ultimate goal would be to form engineers that are capable of addressing those challenges innovatively and holistically; by fostering emotional intelligence in individuals, we can help build a more sustainable future for all.

Author Contributions: Conceptualization, T.N. and J.M.; methodology, T.N. and J.M.; formal analysis, T.N. and J.M.; investigation, T.N., R.C. and J.M.; writing—original draft preparation, T.N. and J.M.; writing—review and editing, T.N., R.C. and J.M. All authors have read and agreed to the published version of the manuscript.

Funding: This research was funded by national funds through FCT—Fundação para a Ciência e a Tecnologia, under the projects UIDB/50021/2020.

Institutional Review Board Statement: Not applicable.

Informed Consent Statement: Informed consent was obtained from all subjects involved in the study.

Data Availability Statement: Datasets are available upon request to the authors.

Conflicts of Interest: The authors declare no conflict of interest.

References

1. Dyllick, T.; Hockerts, K. Beyond the business case for corporate sustainability. *Bus. Strategy Environ.* **2002**, *11*, 130–141. [CrossRef]
2. WCED. *Our Common Future: World Commission on Environment and Development*; Oxford University Press: Oxford, UK, 1987; pp. 1–91.
3. Elkington, J. Towards the sustainable corporation: Win-win-win business strategies for sustainable development. *Calif. Manag. Rev.* **1994**, *36*, 90–100. [CrossRef]
4. Whyte, P.; Lamberton, G. Conceptualising sustainability using a cognitive mapping method. *Sustainability* **2020**, *12*, 1977. [CrossRef]
5. Alvarado-Herrera, A.; Bigne, E.; Aldas-Manzano, J.; Curras-Perez, R. A scale for measuring consumer perceptions of corporate social responsibility following the sustainable development paradigm. *J. Bus. Ethics* **2017**, *140*, 243–262. [CrossRef]
6. Glavič, P.; Lukman, R. Review of sustainability terms and their definitions. *J. Clean. Prod.* **2007**, *15*, 1875–1885. [CrossRef]
7. Ruggerio, C.A. Sustainability and sustainable development: A review of principles and definitions. *Sci. Total Environ.* **2021**, *786*, 147481. [CrossRef]
8. Olawumi, T.O.; Chan, D.W. A scientometric review of global research on sustainability and sustainable development. *J. Clean. Prod.* **2018**, *183*, 231–250. [CrossRef]
9. Spaiser, V.; Ranganathan, S.; Swain, R.B.; Sumpter, D.J. The sustainable development oxymoron: Quantifying and modelling the incompatibility of sustainable development goals. *Int. J. Sustain. Dev. World Ecol.* **2017**, *24*, 457–470. [CrossRef]
10. Rosen, M.A. Engineering and sustainability: Attitudes and actions. *Sustainability* **2013**, *5*, 372–386. [CrossRef]
11. Tang, K.H.D. Correlation between sustainability education and engineering students' attitudes towards sustainability. *Int. J. Sustain. High. Educ.* **2018**, *19*, 459–472. [CrossRef]
12. Andersson, K.; Jagers, S.C.; Lindskog, A.; Martinsson, J. Learning for the future? Effects of education for sustainable development (ESD) on teacher education students. *Sustainability* **2013**, *5*, 5135–5152. [CrossRef]
13. Ajzen, I.; Fishbein, M. *Understanding Attitudes and Predicting Social Behavior*; Prentice-Hall: Hoboken, New Jersey, USA, 1980.
14. Perloff, R.M. *The Dynamics of Persuasion: Communication and Attitudes in the 21st Century*, 2nd ed.; Routledge: New York, NY, USA, 2007. [CrossRef]
15. Wyer, R.S., Jr.; Albarracin, D. Belief formation, organization, and change: Cognitive and motivational influences. In *The handbook of Attitudes*; Albarracin, D., Johnson, B.T., Zanna, M.P., Eds.; Lawrence Erlbaum Associates Publishers: Mahwah, NJ, USA, 2005; pp. 273–322.
16. Tejedor, G.; Segalàs, J.; Rosas-Casals, M. Transdisciplinarity in higher education for sustainability: How discourses are approached in engineering education. *J. Clean. Prod.* **2018**, *175*, 29–37. [CrossRef]
17. Boyle, C. Considerations on educating engineers in sustainability. *Int. J. Sustain. High. Educ.* **2004**, *5*, 147–155. [CrossRef]
18. Ryu, H.C.; Brody, S.D. Examining the impacts of a graduate course on sustainable development using ecological footprint analysis. *Int. J. Sustain. High. Educ.* **2006**, *7*, 158–175. [CrossRef]
19. Estrada, M.; Monferrer, D.; Rodríguez, A.; Moliner, M.Á. Does emotional intelligence influence academic performance? The role of compassion and engagement in education for sustainable development. *Sustainability* **2021**, *13*, 1721. [CrossRef]
20. Goleman, D. *Emotional Development and Emotional Intelligence: Educational Implications*; Basic Books: New York, NY, USA, 1997.
21. Salovey, P.; Mayer, J.D. *Emotional Intelligence*; Dude Publishing: Port Chester, NY, USA, 2004.
22. Aguilar-Luzón, M.d.C.; García-Martínez, J.M.Á.; Calvo-Salguero, A.; Salinas, J.M. Comparative Study between the Theory of Planned Behavior and the Value–Belief–Norm Model Regarding the Environment, on S panish Housewives' Recycling Behavior. *J. Appl. Soc. Psychol.* **2012**, *42*, 2797–2833. [CrossRef]
23. Bamberg, S.; Möser, G. Twenty years after Hines, Hungerford, and Tomera: A new meta-analysis of psycho-social determinants of pro-environmental behaviour. *J. Environ. Psychol.* **2007**, *27*, 14–25. [CrossRef]
24. Farrukh, M.; Raza, A.; Mansoor, A.; Khan, M.S.; Lee, J.W.C. Trends and patterns in pro-environmental behaviour research: A bibliometric review and research agenda. *Benchmarking Int. J.* **2022**. [CrossRef]

25. Onokala, U.; Banwo, A.O.; Okeowo, F.O. Predictors of Pro-Environmental Behavior: A Comparison of University Students in the Untied States and China. *J. Manag. Sustain.* **2018**, *8*, 127. [CrossRef]
26. Aguilar-Luzón, M.C.; Calvo-Salguero, A.; Salinas, J.M. Beliefs and environmental behavior: The moderating effect of emotional intelligence. *Scand. J. Psychol.* **2014**, *55*, 619–629. [CrossRef]
27. Tevdovska, E.S. The impact of emotional intelligence in the context of language learning and teaching. *Seeu Rev.* **2017**, *12*, 125–134. [CrossRef]
28. Yahaya, A.; Bachok, N.S.E.; Yahaya, N.; Boon, Y.; Hashim, S.; Goh, M.L. The impact of emotional intelligence element on academic achievement. *Arch. Des Sci.* **2012**, *65*, 2–17.
29. Zhoc, K.C.; Chung, T.S.; King, R.B. Emotional intelligence (EI) and self-directed learning: Examining their relation and contribution to better student learning outcomes in higher education. *Br. Educ. Res. J.* **2018**, *44*, 982–1004. [CrossRef]
30. Chisholm, C.U. The formation of engineers through the development of Emotional Intelligence and Emotional Competence for global practice. *Glob. J. Eng. Educ.* **2010**, *12*, 6–11.
31. Magano, J.; Silva, C.; Figueiredo, C.; Vitória, A.; Nogueira, T.; Pimenta Dinis, M.A. Generation Z: Fitting Project Management Soft Skills Competencies—A Mixed-Method Approach. *Educ. Sci.* **2020**, *10*, 187. [CrossRef]
32. Tsalaporta, E. Emotional Intelligence for sustainable engineering education: Incorporating soft skills in the capstone chemical engineering capstone design project. In Proceedings of the 10th Engineering Education for Sustainable Development Conference, Cork, Ireland, 14–16 June 2021; pp. 1–8.
33. Campos, C.B.d.; Pol, E. Can the environmental beliefs of workers from environmental certified companies predict their environmental behavior outside the organization? *Estud. De Psicol.* **2010**, *15*, 198–206. [CrossRef]
34. Riemer, M.J. Integrating emotional intelligence into engineering education. *World Trans. Eng. Technol. Educ.* **2003**, *2*, 189–194.
35. United Nations. The 17 Goals. Available online: https://sdgs.un.org/goals (accessed on 8 March 2023).
36. Rego, A.; Fernandes, C. Inteligência emocional: Contributos adicionais para a validação de um instrumento de medida. *Psicologia* **2005**, *19*, 139–167. [CrossRef]
37. Silva, C.; Magano, J.; Figueiredo, C.; Vitória, A.; Nogueira, T. A multi generational approach to project management: Implications for engineering education in a smart world. In Proceedings of the 2020 IEEE Global Engineering Education Conference (EDUCON), Porto, Portugal, 27–30 April 2020; pp. 1139–1148.
38. Kline, R.B. *Principles and Practice of Structural Equation Modeling*; Guilford Publications: New York, NY, USA, 2015.
39. Byrne, B. *Structural Equation Modeling with AMOS: Basic Concepts, Applications, and Programming*, 3rd ed.; Routledge: New York, NY, USA, 2016.
40. Hair, J.; Anderson, R.; Tatham, R.; Black, W. *Multivariate Data Analysis with Readings*; Prentice-Hall: Englewood Cliffs, NJ, USA, 1995.
41. Field, A. *Discovering Statistics Using IBM SPSS Statistics*; Sage: New York, NY, USA, 2013.
42. Fornell, C.; Larcker, D.F. Evaluating structural equation models with unobservable variables and measurement error. *J. Mark. Res.* **1981**, *18*, 39–50. [CrossRef]
43. Cohen, J. *Statistical Power Analysis for the Behavioral Sciences*, 2nd ed.; Lawrence Erlbaum Associates: Hillsdale, NJ, USA, 1988.
44. Hayes, A.F. *Introduction to Mediation, Moderation, and Conditional Process Analysis: A Regression-Based Approach*, 2nd ed.; Guilford Publications: New York, NY, USA, 2017.
45. Nunnally, J.C. An overview of psychological measurement. In *Clinical Diagnosis of Mental Disorders*; Springer: Boston, MA, USA, 1978; pp. 97–146. [CrossRef]
46. Mifsud, M. Environmental education development in Malta: A contextual study of the events that have shaped the development of environmental education in Malta. *J. Teach. Educ. Sustain.* **2012**, *14*, 52–66. [CrossRef]
47. Goleman, D. *Working with Emotional Intelligence*; Bantam Books: New York, NY, USA, 1998.
48. Encinas, J.J.; Chauca, M. Emotional intelligence can make a difference in Engineering Students under the Competency-based Education Model. *Procedia Comput. Sci.* **2020**, *172*, 960–964. [CrossRef]
49. Mitrović Veljković, S.; Nešić, A.; Dudić, B.; Gregus, M.; Delić, M.; Meško, M. Emotional intelligence of engineering students as basis for more successful learning process for industry 4.0. *Mathematics* **2020**, *8*, 1321. [CrossRef]
50. Ranganathan, P.; Aggarwal, R. Study designs: Part 1—An overview and classification. *Perspect. Clin. Res.* **2018**, *9*, 184. [CrossRef] [PubMed]