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Students' satisfaction and empowerment of a sustainable university campus

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Abstract
Universities are crucial in empowering a sustainable campus through the adoption of sustainable development practices (SDP), which are expressed in terms of economic, organizational, environmental, and social dimensions. Previous findings point out that students' satisfaction ensures universities' sustainability. Both SDP and students' satisfaction increasingly rule universities positioning. Nevertheless, research addressing the relationship between universities' SDP dimensions and students' satisfaction is limited. Given this gap, this study focuses on this still unexplored relationship, as perceived by 738 full-time students at seven Portuguese universities and their academic satisfaction, using structural equation modeling. The empirical findings reveal that SDP influence students' satisfaction, mainly through organizational and social dimensions. From the resulting implications, it is worth highlighting that: Empowerment of the sustainable university campus is positively associated with students' satisfaction; and universities need to be continuously committed to improving particularly the economic and environmental dimensions of SDP.

Keywords Empowerment · Higher education · Sustainable campus · Sustainable development practices · Students' satisfaction · Universities

1 Introduction

Dominant mindsets regarding sustainability problems and solutions can be updated through education, dissemination, and demonstration of sustainable development practices (SDP), to induce generalized social replication and translation of solutions through iterative feedback on activities (Horan et al., 2019a, 2019b). One of the moral responsibilities

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concerns handling of one's own environmental impacts, thereby signaling to the youngest generations how to act responsibly with a long-term view (Udas et al., 2018). For this reason, governance has a vital role in managing sustainable development to promote campus sustainability through education, research, campus operations and outreach (Filho et al., 2023). However, many universities have no plans for the implementation of an SDP policy as a governance tool, and do not have, for example, any kind of certification demonstrating the institutional commitment to sustainability (Filho et al., 2021).

Integration of SDP in universities is a difficult task, in that it involves functional activities and proposals with a social impact on everyday campus life, as well as commitments established with a range of stakeholders (de Lange, 2013), who sometimes create forms of resistance to change, expressed by the public to a greater or lesser degree.

Vagnoni and Cavicchi (2015) highlight the importance of stakeholders' perceptions in research related to SDP in higher education (HE). The impact of each stakeholder group depends on each university (Grudowski & Szefler, 2015). Therefore, on the one hand it is fundamental to measure stakeholders' satisfaction, as this allows measurement, correction, control and assessment of universities' performance (Grudowski & Szefler, 2015) at all levels. On the other hand, stakeholders' satisfaction influences organizations' competitiveness and image, with stakeholders' needs and expectations affecting the organization's management system (Cvetic et al., 2016).

According to the principle of participation in understanding (education for) SDP, students should not be considered just as recipients, but rather as contributors to successful educational efforts (Warwick, 2016). Education for sustainability incorporates components such as the participation of various university stakeholders in the inventive process toward sustainability, as well as the empowerment of people and groups to effect change within their sphere of influence and action (Cebriána, 2018). Students as the main stakeholders (Mainardes et al., 2013) will be the future leaders and decision-makers in society (Wong & Kong, 2001). Cole, (2006) mentions the need for the academic and student community's involvement and empowerment for the success of sustainability efforts. For the same author, stakeholders will probably have a mix of shared values, and so knowing the perspectives of each may be critical in promoting empowerment and the success of a sustainable university campus. Another aspect to underline is that stakeholders are often limited due to a lack of information and limited understanding of the initiatives undertaken by institutions, and so empowerment should be increased by forming networks and partnerships, providing educational and training services, and transferring practical skills to the workforce (Figueroa & Rotarou, 2016).

The most studied dimensions connected to SDP are economic, organizational/educational/political, environmental and socio-cultural in the university context (Aleixo et al., 2018; Larrán et al., 2016). These dimensions are integrated into activities related to teaching, research, campus operations, community actions and assessment, as well as the drawing up of reports (Aleixo et al., 2018). Following Pedro et al. (2020), this study considers separately four SDP dimensions: economic, organizational, environmental and social.

Sustainability in universities is also linked to students' satisfaction (Chaudhary & Dey, 2021). Weerasinghe and Lalitha (2017) defined students' satisfaction as a short-term attitude resulting from evaluation of the educational experience, services and facilities. For example, students' participation in sustainability initiatives undertaken by their university would enable them to develop skills in dealing with sustainability issues in their lives (Chaudhary & Dey, 2021). Despite some studies on students' perception of SDP and sustainability (e.g., Jung et al., 2019; Pedro et al., 2020), none deals with the type of relation existing between students' satisfaction and each of the four dimensions forming the

set of universities' SDP, i.e., economic, organizational, environmental, and social; or how students' satisfaction can contribute to empowering the concept of a sustainable campus, based on the student community's perception.

To fill the academic gap identified and provide guidelines for HE managers oriented to the empowerment of a sustainable campus through adopting SDP, based on students' perception measured in terms of their satisfaction, this work attempts to answer two research questions:

*RQ*1: Considering students' perception, how are the four dimensions of SDP, economic, environmental, social and organizational, separately, related to students' satisfaction?

RQ2: How can students' satisfaction contribute to empowerment of a sustainable campus within the academic community?

SDP has progressively been included in university strategy and development plans, with an emphasis on environmental, social, and technological change (Stephens et al., 2008). Measuring students' satisfaction is one approach to see how well the university is doing. This is a short-term attitude arising from an evaluation of their educational experiences on campus during their academic and social lives (Elliott & Healy, 2001a). Due to the importance of students' satisfaction, this approach is innovative and a relevant subject because it values students' satisfaction and may lead to better results for the scientific community and HE managers, helping to empower the sustainable university campus.

To address these research questions and aims, the remainder of the paper is structured as follows. The literature on the importance of universities' SDP, students' satisfaction and sustainable campus empowerment is reviewed, in order to develop the hypotheses and propose a model. This is followed by the design methodology, conclusions, and theoretical, managerial and policy implications.

2 Hypothesis development

2.1 Sustainable development practices and students´ satisfaction

Akhtar et al., (2021) consider how intrinsic motivation may be utilized to increase students' environmental awareness, ability to learn a new skill and satisfaction with environmental preservation. Students' satisfaction is a complex process that is impacted by a variety of elements (Weerasinghe & Lalitha, 2017). Elliott and Shin (2002) describe student satisfaction as a subjective evaluation of students' perceptions of educational outcomes and campus life. Students' satisfaction is influenced by image (Appuhamilage & Torii, 2019), values (Hadi et al., 2019), teaching competences, curricular flexibility, university prestige and reputation, autonomy, faculty care, students' performance and growth, student-centeredness, campus climate, institutional effectiveness, social conditions (Douglas et al., 2006; Palacio et al., 2002), and SDP (Chaudhary & Dey, 2021; Pedro et al., 2020).

The role played by universities in promoting SDP is recognized as essential (Lozano et al., 2013), with an exponential increase in the number of reports and evaluations linked to sustainability. Ceulemans et al., (2015) say that the main aims of these reports and evaluations by universities are to communicate results to their stakeholders and analyze how the organization affects and is affected by them, ultimately to assess and improve SDP in the future (Findler et al., 2018). SDP can be defined as corresponding to the methods used by universities in approaching, involving and promoting ways to minimize negative environmental, economic, social and health effects, using their

resources in their main functions of teaching, research, transfer, dissemination, cooperation and administration to help society make the transition to sustainable lifestyles, aiming to provide a complete answer to society's challenges (Velazquez-Contreras, 2002; Findler et al., 2018) conclude that the impacts universities can have on SDP lie in areas such as growth, changes in social and business practices, social cohesion, contributions to climate change, sustainable lifestyles and urban development. Horan et al., (2019a, 2019b) highlight that universities are ideal places to concentrate resources in terms of implementing and trying out decarbonization technology and demonstrating best practices to their stakeholders, for subsequent replication in society.

In general, the dimensions of SDP are related to economic, social, environmental (Sammalisto et al., 2015), organizational and cultural (e.g., Filho et al., 2015) aspects. In the specific case of universities, Larrán et al., (2016), Aleixo et al., (2018) and Pedro et al., (2020) proposed considering the economic, organizational/educational/political, social/cultural and environmental dimensions as components allowing the assessment of SDP. This study considers that universities' SDP is formed of the economic, organizational, environmental, and social dimensions.

The economic dimension of SDP concerns maintaining the organization's financial capital, the economic situation in general, and maintaining tangible assets with a monetary value, giving expression to growth (Elkington, 2000). If universities are not economically sustainable, they will not be able to improve the quality of the services provided. Subsequently, students' satisfaction with universities has been linked to economic performance (Moosmayer & Siems, 2012). Appuhamilage and Torii (2019) reveal that satisfaction is positively and directly impacted on by universities' financial support and service provision. Considering the above, the first research hypothesis arises:

H1 The economic dimension of SDP influences students' satisfaction directly and positively.

The organizational dimension concerns how universities configure their mission, vision, values and institutional behavior with an impact and social responsibility, and how their stakeholders are involved and perceive the SDP organizational dimension approach to and aims of SDP within the organization. The organizational dimension of SDP can be attained through robust inter-organizational connections (Chaudhry et al., 2014). Those links give complementary strength and generate added value for organizations to achieve a sustainable advantage (Lee, 2009). For example, through including SDP in the university's mission, vision and values; revealing and communicating concerns about ethical questions and transparency of governance; introducing curricular units or courses on SD; associating themselves with declarations on principles, charters and partnerships on national and international criteria to promote SDP, and the subsequent communication; and adopting external and internal quality assurance systems, and business process management, concerning all activities within universities (Aleixo et al., 2018). Student satisfaction emerges from different factors related to the organizational dimension, such as university image, perceived value, facilities (e.g., parking, classrooms, digital networks, sports provision, cafeterias, elevators, etc.), international opportunities (exchange programs and language learning support), services provided by the academic and administrative staff (administrative matters, academic matters and searching for job opportunities) (Lee, 2009). Considering the above, the second research hypothesis is formulated:

H2 The organizational dimension of SDP influences students' satisfaction directly and positively.

Tonial et al., (2019) mention that the environmental dimension is related to the responsibility taken by organizations for the impacts caused by their activities through using natural resources for production and consumption, so that processes are sustainable without harming the environment. The areas related to the environment and universities' contribution to climate change can have an impact on their SDP (Findler et al., 2018). Returning to the vision of Horan et al., (2019a, 2019b), considering the global growth of student numbers on campuses and the associated increase in material waste there, university campuses are useful testing grounds to implement carbon reduction strategies for similar growing populations in society at large. Students have a favorable opinion of universities' fulfillment of sustainability principles in various activities such as those connected to environmental protection (Dabija et al., 2017). Students' satisfaction is caused by factors related to the university environment (e.g., location, modernity and cleanliness) (Palacio et al., 2002). Considering the above, the third research hypothesis is formulated:

H3 The environmental dimension of SDP influences students' satisfaction directly and positively.

Finally, the social dimension is an organization's efforts to promote society's well-being, which is in any way directly or indirectly affected by the organizations' activities (Tonial et al., 2019). A higher level of awareness of the social dimension helps to balance the long-standing preconceived assumption that the environmental facet dominates understanding of sustainability (Moganadas et al., 2022). Changes in social and business practices, and social cohesion, are among the main aspects to be considered in universities' SDP (Findler et al., 2018). Social conditions have been recognized as the main determinants of students' satisfaction in HE (Douglas et al., 2006; Palacio et al., 2002). In addition, social responsibility is one of the values influencing students' satisfaction (Moosmayer & Siems, 2012). Considering the above, the fourth research hypothesis is formulated:

H4 The social dimension of SDP influences students' satisfaction directly and positively.

2.2 Students' satisfaction and the empowerment of a sustainable campus

Universities' SDP education and training not only promote environmental awareness but also emphasize the importance of providing relevant experience and good habits on and off campus (Teixeira, 2013), stimulating students toward the necessary critical thinking and empowerment of more sustainable communities (Nasibulina, 2015), particularly the academic one. Students not only learn new ways to think and act in favor of the environment and society, motivating cognitive, affective, and participatory knowledge and making them feel more satisfied, but they also learn new skills and behaviors that contribute to an environmentally desirable outcome and the empowerment of a sustainable campus (Carleton-Hug & Hug, 2010).

Empowerment is a process that allows individuals to embrace new behaviors that improve their aspirations and those of their organizations (Perkins & Zimmerman, 1995). An empowerment process is of a multi-dimensional nature, involving the mobilization of resources and individual capacities (Singh & Titi, 1995). Somerville, (1998) says that

empowerment can occur at different organizational levels (individual, group and community), being exercised and controlled by different social groups and in distinct domains. Empowerment gives the organization a capacity to respond to a changing environment, inducing appropriate changes both internally and externally, through creativity, innovation and commitment to SDP goals (Singh & Titi, 1995).

Empowerment involves organizational processes and structures (Perkins & Zimmerman, 1995), increasing stakeholder participation and extending the reach of the organization's goals. From this perspective, universities should provide opportunities for the academic community to use the campus as a laboratory for individual and collective learning (Berchin et al., 2021), and sustainable practices oriented toward SDP. Therefore, understanding students' perceptions of SD, expressed through their satisfaction, can contribute to better understanding of universities' involvement in SDP (Emanuel & Adams, 2011), allowing effective empowerment of a sustainable university campus, at both the individual (i.e., student) and collective (i.e., institutional) level. Lozano (2006) also underlines that detecting, connecting, enabling, and satisfying students, since they are sure of the importance of SD, will make them essential actors in developing the empowerment process, resulting in positive externalities for the institution. In turn, Wang and Lin (2017) emphasize that individuals' feelings about the personal capacity of operating changes and the perception of responsibility influence their environmental behavior. Therefore, if students are more satisfied with life in their university, they will be more likely, individually, to have a better perception of what goes on there, in terms of SDP, contributing to empowerment of a more sustainable campus, collectively. Considering the above, students' perception of a sustainable university campus is positioned as a form of empowerment of that campus. From that perspective, the fifth research hypothesis is formulated as follows:

H5 Students' satisfaction is directly and positively related with the empowerment of a sustainable campus.

Bearing in mind the state of the art and the above hypotheses, a conceptual model of analysis is proposed, as presented in Fig. 1:

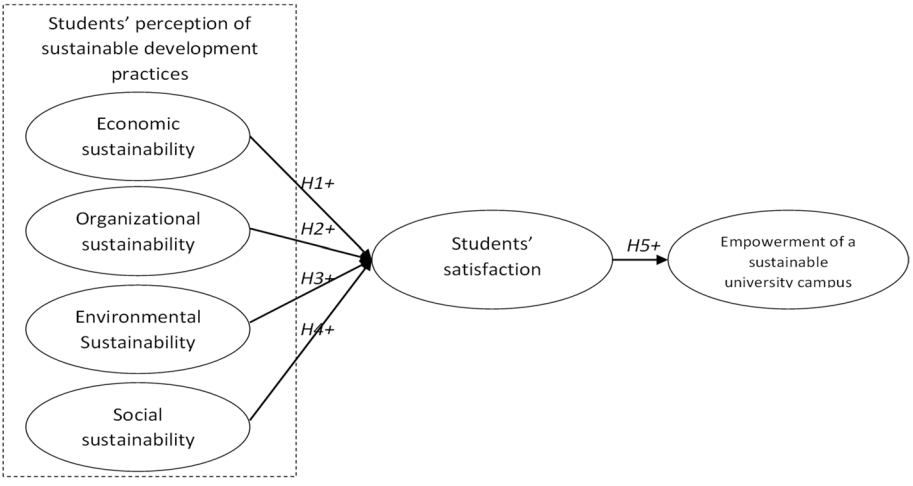


Fig. 1 Students' perception of SDP, students' satisfaction and empowerment of a sustainable university campus. Source: Own elaboration

3 Methodology

A quantitative survey is used in this explanatory-predictive investigation. It employs a structural equation modeling technique based on partial least squares (PLS-SEM). PLS-SEM is commonly employed when analyzing a theoretical framework from a prediction standpoint and when the structural model is complicated and incorporates numerous constructs, indicators, and/or model linkages (Hair et al., 2019a). The most recent evaluative PLS-SEM analysis criteria published by Ghasemy et al., (2020) are used in this work. SmartPLS3 software was used to estimate the parameters.

3.1 Variable measurement

3.1.1 Sustainable development practices

The variables to measure SDP in universities are based on the studies by Larrán et al., (2016) and Aleixo et al., (2018), and four dimensions are now considered: economic; organizational; environmental; and social.

The economic dimension encompasses economic viability and reflects on economic needs. The organizational dimension is related to the way universities define their behavior and values, how the approach and objectives related to SDP are perceived by different stakeholders. The environmental dimension proposes the incorporation of environmental concerns in the university's strategy. The social dimension includes the social/cultural dimension, covering the human resources activities of universities or the neighboring community.

3.1.2 Students' satisfaction

Satisfaction with a certain HEI corresponds to the sum of the student's academic, social, physical and even spiritual and wellness experiences (Sevier, 1996). Following the studies by Elliott and Healy (2001a) and Chaudhary and Dey (2021), students' satisfaction is measured considering: campus life; concern about expectations; concern about health; campus safety and security; and financial effectiveness.

3.1.3 Empowering a sustainable university campus

In this study, students' perception of a sustainable university campus is positioned as a form of empowerment of that campus, at the collective level. According to Alshuwaikhat and Abubakar (2008), to achieve a sustainable university campus, three factors should be considered: (i) the implementation of environmental management practices (healthy campus); (ii) public participation and social responsibility (campus community, partnership, justice and equity); and (iii) sustainability teaching and research in an integrated way (e.g., related activities). To measure a sustainable university campus, Amrina and Imansuri (2015) considered: setting and infrastructure (e.g., open spaces, planted area, budget); energy and climate change (e.g., renewable energy, smoking areas policy, and food program); waste (e.g., recycling, reducing paper and plastic); water; transportation (e.g., campus buses and bicycles); education (e.g., courses, research funding, and events).

The list of all the constructs and indicators, as well as the studies of reference, are presented in Appendix, Table A1.

3.2 Participants and sampling procedure

The population is composed of the universe of students in Portuguese State universities. Seven universities are selected to ensure the representation of one university per region (NUTS II). A basic random sample approach was employed, and a questionnaire with a seven-point Likert scale was developed in accordance with the constructs and indicators listed in Appendix, Table A1. Following pre-testing, our Public Relations Office e-mailed the final questionnaire with a link to the poll. Because the responses acquired through this connection were insufficient to establish a representative sample, some paper questionnaires were also distributed in the classroom. T tests were employed to assess the possibility of non-response bias. There were no significant differences between the two groups. The ultimate sample size was 738 students, 452 of whom were female and 286 of whom were male. The majority of students (65.2%) are in the first study cycle, and 85.1% are between the ages of 17 and 25. See Appendix, Tables A2 and A3 for a detailed characterization of HEIs, ideal sample size, and demographic profile of the students who participated in this study.

However, it should be noted that, in terms of analytic limitations, the sample only refers to Portuguese universities, making generalization of the results impossible. As a result, a recommendation for future research is to conduct cross-country comparison studies. Future studies could include more HEI stakeholders such as lecturers, researchers, and technical employees.

3.3 Results

The descriptive statistics and distribution of the mean values reveal considerable homogeneity. Skewness and kurtosis statistics show a normal distribution. All the values of the indicators are within the acceptable range of -1 to $+1$ or very close to those values (Hair et al., 2017). Multicollinearity is assessed by applying VIF (variance inflation factor). Considering both the VIF individual values and the VIF average value of 2.256, there is no evidence of potential problems of multicollinearity. The correlational relationship revealed values under or very close to 0.750 showing that autocorrelation is not a problem (for details see Appendix, Tables A4 and A5).

3.3.1 Assessment of the measurement models

This assessment involves examining (i) indicator reliability, (ii) internal consistency reliability, (iii) convergent validity, and (iv) discriminant validity (Ghasemy et al., 2020; Hair et al., 2018). Indicator reliability is checked by examining the correlations between each indicator and the loadings or correlation weights of the items (Hair et al., 2018). According to Ghasemy et al., (2020), loadings must be above 0.708. In this case, all

the loadings are above that reference, except for SAST4 (0.665) and SAST5 (0.624). However, as these indicators are very close to the reference value, and the other values observed are under the recommendations, we decided to retain them, in agreement with Hair et al., (2011), due to considering they are necessary in the model. Next, to evaluate internal consistency reliability, Cronbach's alpha and composite reliability (CR) and the new measure of Rho_A (Dijkstra & Henseler, 2015) were estimated. All the values are above 0.7 and below 0.95. The average variance extracted (AVE) evaluates convergent validity, which must be higher than 0.5. All values meet that criterion (for detailed confirmation see Appendix, Table A6).

Ghasemy et al., (2020) highlight that discriminant validity is better detected by the heterotrait–monotrait (HTMT) ratio. Values for HTMT for conceptually distinct constructs must have values under 0.85 ($HTMT_{0.85}$), and for conceptually similar constructs, values under 0.9 ($HTMT_{0.9}$). The result agrees with these recommendations. To complement this result, these authors recommend testing whether the HTMT value is significantly lower than unity (1) using bootstrapping, and in both cases, no interval has the value of one (for detailed confirmation, see Appendix,Tables A7 and A8).

3.3.2 Assessment of the structural model

As recommended by, e.g., Hair et al., (2019) and Ghasemy et al., (2020), assessment of the structural model should: (i) analyze the determination of the coefficient statistic (R^2), which measures the degree of model adjustment and should present a high value; (ii) verify the indirect effects through estimation of the effect size (f^2), and according to Cohen (1988), the reference values are: $0.02 \leq f^2 < 0.15$: small effect; $0.15 \leq f^2 < 0.35$: moderate effect; $f^2 \geq 0.35$: large effect; (iii) use the Stone–Geisser (Q^2) test as a criterion to measure the predictive relevance of the reflexive dependent constructs (Barroso-Castro et al., 2005). As in f^2, values of 0.02, 0.15 and 0.35 indicate small, moderate or large predictive relevance, respectively; (iv) to assess collinearity, the VIF of each exogenous construct should ideally be less than 3 (Hair et al., 2019); and (v) the statistical significance and relevance of the path coefficient, considering a *p value* lower than 0.05.

To test the five hypotheses, bootstrapping at a significance level of 5% with 10,000 subsamples was run. Analyzing the results in Table 1, the values of the structural model present high effect size (R^2) for "students' satisfaction" (0.528) and "students' perception of sustainable campus" (0.624); f^2 presents a large effect for "students' satisfaction" (1.650), moderate for "organizational dimension" (0.313) and small for "economic dimension" (0.003), "environmental dimension" (0.006) and "social dimension" (0.024); and Q^2 is moderate, in both "students' satisfaction" (0.325) and "students' perception of sustainable campus" (0.350). Examination of VIF values showed them all to be less than 2.5, thereby inferring no problem regarding collinearity issues.

A PLSpredict analysis was performed to evaluate the out-of-sample predictive power of the model (see, Shmueli et al., 2019). The mean absolute error (MAE) and the Q^2_predict values of the PLS model and the MAE values of the linear model (LM) were analyzed. All the Q^2_predict values were positive. In addition, in terms of MAE values, the results show that most PLS-SEM values are < LM values yielding a medium predictive power of the model (Hair et al., 2021) (for confirmation of these results, see Appendix, Table A9).

Table 1 Structural model evaluation results

Outcome	Path/Hypothesis	Coefficient	*t*-Statistic	*p* Value	Significant?	VIF	f^{2*}	R^2	Q^{2*}
Economic dimension	H1(+): Economic dimension → Students' satisfaction	–0.059	1.382	0.173	No	2.489	0.003		
Organizational dimension	H2(+): Organizational dimension → Students' satisfaction	0.606	13.239	0.000***	Yes	2.487	0.313		
Environmental dimension	H3(+): Environmental dimension → Students' satisfaction	0.073	1.809	0.068	No	1.931	0.006		
Social dimension	H4(+): Social dimension → Students' satisfaction	0.157	3.520	0.000***	Yes	2.210	0.024		
Students' satisfaction	H5(+): Students' satisfaction → Empowerment of a sustainable campus	0.790	46.463	0.000***	Yes	1.000	1.65	0.528	0.323
Empowerment of a sustainable campus								0.624	0.350

*** = 1% level of significance (≥ 2.58)

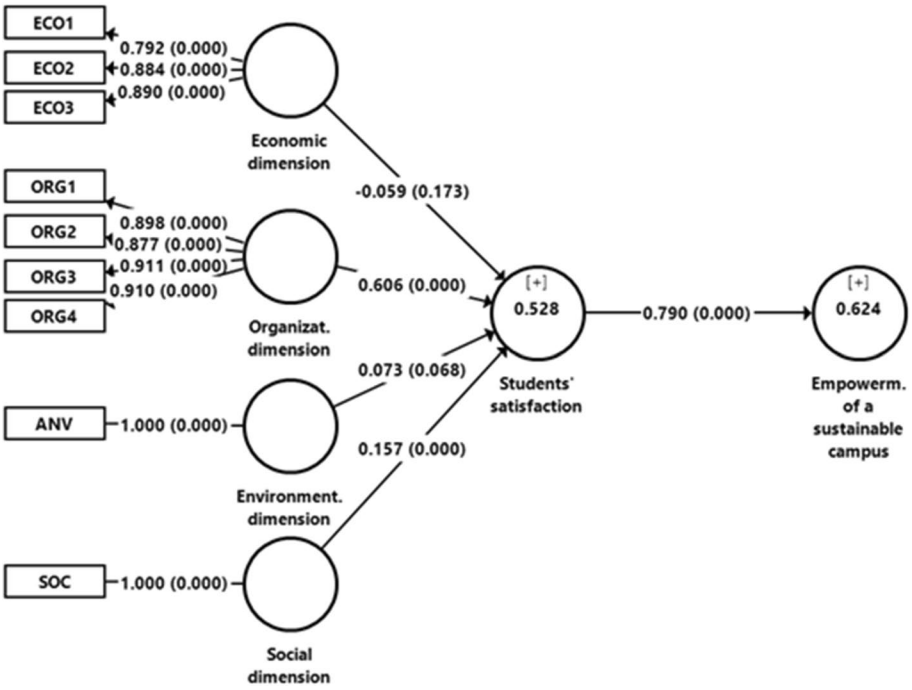


Fig. 2 Final partial least squares model

In terms of structural relations, there is good adjustment and robustness of the data used to estimate the model and test the hypotheses. The PLS model, in Fig. 2, presents path coefficients, factor loadings, and the model's explanatory power for the endogenous constructs.

4 Discussion and empirical findings

The discussion and presentation of empirical data adhere to the conceptual model of analysis for students' perceptions of SDP, students' satisfaction, and empowerment of a sustainable university campus, which is previously presented in Fig. 1.

In terms of methodology, the option of developing a PLS approach, with structural equation models estimated in simultaneous terms, allows a comparison of the relationships between the formative dimensions (e.g., economic, organizational, environmental, and social) of the construct representing students' perceptions of SDP and student satisfaction. It can also test a hitherto unexplored direct relationship between student satisfaction and the empowerment of a sustainable campus.

As a result, the estimation of structural equation models revealed that students' perceptions of both the organizational and social dimensions of HEIs' adoption of SDP have a substantial influence in predicting students' satisfaction.

In support of the above claims, it must be stated that hypotheses *H2*, *H4* and *H5* were supported, as the evidence obtained here shows statistical significance at a 95% confidence level (p Value < 0.05). Regarding *H2: The organizational dimension of SDP influences students' satisfaction directly and positively*, the results show a direct and positive relation between the "organizational dimension" and "students' satisfaction," this result being statistically significant ($t = 13.239$; $p = 0.000$) at a 1% level of significance (≥ 2.58). This result agrees with Lee, (2009), when stating that students' satisfaction is caused by different factors related to the organizational dimension of SD, such as the university image, perceived value, facilities, international opportunities, and academic and administrative services. This dimension is more easily perceived by students as it is more linked to the organizational practices they use most, such as: parking; classrooms; digital networks; sports facilities; cafeterias; elevators; exchange programs; language and learning support; administrative and academic matters; seeking job opportunities; among others (Lee, 2009), meeting students' expectations and goals (Appuhamilage & Torii, 2019).

Concerning *H4: The social dimension of SDP influences students' satisfaction directly and positively,* the results also show a direct and positive relation ($t = 3.520$; $p = 0.000$), which is statistically significant at a 1% level of significance (≥ 2.58). According to Findler et al. (2018), changes in social practices and social cohesion are fundamental aspects to be considered in collective construction of SDP in universities, not only because social conditions are the major determinants of students' satisfaction in HE (Douglas et al., 2006; Palacio et al., 2002), but also because the very social responsibility instilled in students through SDP figures among the values that most influence students' satisfaction (Moosmayer & Siems, 2012). This type of practice generally induces greater student involvement (which contributes to improving their perception), as it covers actions related to human resources, for example, policies on gender, participation and growth of sports, cultural and recreational activities, and social entrepreneurship initiatives in the field of social inclusion.

As for research hypotheses *H1* and *H3,* since there is no statistical significance supporting these relations (*H1*: $t = 1.382$; $p = 0.167$; *H3*: $t = 1.809$; $p = 0.073$), they are rejected. In relation to *H1: The economic dimension of SDP influences students' satisfaction directly and positively*, it should be noted that although students' satisfaction with universities has been positively linked to universities' economic performance (see, Moosmayer & Siems, 2012) and services and financial support (see, Appuhamilage & Torii, 2019), in this study the economic dimension of SDP was not found to be connected to their satisfaction. Since this dimension includes, for example, concern about economic performance, plans to improve energy efficiency and allocating a budget to SDP, it may be that students are not sufficiently informed about these activities or about the different ways in which SDP are implemented in universities. Therefore, additional action is necessary to spread information, to clarify actions related to the direct economic impact and financial sustainability of universities (financial situation; results; efficiency), as concluded by Aleixo et al., (2018), who add the need to produce sustainability reports, showing universities' savings and carbon footprint. For *H3: The environmental dimension of SDP influences students' satisfaction directly and positively*, the result here contradicts the study by Palacio et al., (2002). One explanation may be

related to the impacts caused by universities' environmental SDP, for example, in using natural resources for production and consumption, not being known, which agrees with the arguments advanced by Chaudhary and Dey (2021) concerning the need to reveal universities' SDP, considering students' perspective.

Concerning H5: Students' satisfaction is directly and positively related with the empowerment of a sustainable campus, a positive relationship is revealed ($t = 46.463$; $p = 0.000$), also at a 1% level of significance (≥ 2.58). Consequently, if students are satisfied with what goes on around them, in this case with their institution's SD, they will be more likely to perceive better whether their campus is sustainable or not, therefore empowering a sustainable university campus. Students' perceptions of campus sustainability differ from university to university, as in the vision of Emanuel and Adams (2011), with perception being related to the commitment to sustainability demonstrated by their university. Therefore, as stated by Teixeira, (2013), education and information about what happens in the university are fundamental aspects to ensure the empowerment of a sustainable campus (Nasibulina, 2015). As empowerment is a process enabling individuals to adopt new types of behavior (Perkins & Zimmerman, 1995), this mechanism of change serves not only to promote greater awareness and environmentally friendly behavior, individually, but also for students to acquire competences and become supporters of institutional and structural changes, collectively, in their universities (Lootens, 2017).

Answering *RQ1*: *Considering students' perception, how are the four dimensions of SDP, economic, environmental, social and organizational, separately, related to students' satisfaction?*, given the evidence from testing *H1…H4*, we may claim that only the organizational and social dimensions have a significant effect on students' satisfaction, corroborating Palacio et al., (2002), Douglas et al., (2006), Lee, (2009) and Moosmayer and Siems (2012). In the case of the organizational dimension, the implications have to do with what Aleixo et al., (2018) say about governmental transparency, which needs to be enforced via missions, visions, and values that are more focused on sustainability and inclusion, and where SDP is promoted and communicated more effectively. As advocated by Filho et al., (2023), governance is a key component for implementing SDP. Changes in both external and internal SDP, quality assurance systems, and business process management within the campus (Aleixo et al., 2018) will help to improve not only the organizational dimension, but also management and social practices, and social cohesion (Findler et al., 2018). In addition, such improvements can operate as a lever for the other aspects (economic and environmental), both in terms of relevance and practicality, making SD more unified and homogeneous, impacting student satisfaction (Moosmayer & Siems, 2012).

Answering *RQ2: How can student's satisfaction contribute to empowerment of a sustainable campus within the academic community?,* given the findings from testing *H5*, we can deduce that students' satisfaction contributes to the empowerment of a sustainable campus through students' perception of SD activities implemented at their university. As mentioned before by Nasibulina, (2015), the primary conclusions gained from the current research concern making SDP better known, and activities must be conducted in a more tangible and noticeable manner. Students will feel empowered as a result of their efforts and the propagation of more open and shared ideas in support of sustainability.

5 Conclusions

This study makes an innovative contribution, by deepening the still scarce knowledge about the relationship between SDP and students' satisfaction, as perceived by 738 full-time students at seven Portuguese universities. The empirical findings provide two highlights, that is: (i) SDP influence students' satisfaction through the organizational and social dimensions; and (ii) Students' satisfaction helps in empowering a sustainable campus.

The key insights we can draw from the article are threefold: theoretical and empirical, practical, and policy-level. First of all, the theory contributes to future developments by consolidating the empirical findings of the few studies found on the relationship between SDP and students' satisfaction, demonstrating statistical significance and a positive and direct relationship between them in the organizational and social dimensions. Some implications for empowering a sustainable campus are that this empowerment is dependent on students' satisfaction, and universities need to be continuously committed to improving the four dimensions of SDP, especially the economic and environmental ones. Considering empowerment theory, Perkins and Zimmerman (1995) underline that empowerment processes increase individuals' well-being, lessening problems and providing participants with chances to develop their knowledge and skills, emphasizing their cooperative status as collaborators, as observed in sustainable campuses based on students' satisfaction.

Secondly, the practical consequences contribute to future advances, since universities must be more inclusive and open to include students in their SDP so that, in addition to contributing, they become more educated and aware of what is happening on campus. It is not enough to educate pupils about sustainability. HEIs must be proactive rather than reactive. They must plan for the future by involving students in all campus dynamics at all levels and encouraging broader pro-environmental behavior, as the theoretical and empirical aspects of this study demonstrated that students play a primary role in integrating sustainability in universities and contributing to campus empowerment.

Finally, the policy implications highlight the need for well thought-out packages of social subsidies to support students' academic pathways, transforming them into really innovative and responsible actors for the environmental and social change necessary in society and the university's institutional environment. Education is viewed as a crucial instrument to empower the most disadvantaged (Singh & Titi, 1995) and encourage social mobility, allowing social elevation. Education systems, particularly higher education, can support and reinforce the scale of SDP, as these are regarded as central mechanisms in operating structural changes in both the socioeconomic and political spheres, and are critical to allowing the active participation of all members of the community in empowering universities, cities, regions and nations.

Appendix

See Tables A1, A2, A3,A4, A5, A6, A7, A8 and A9.

Table A1 List of constructs and respective indicators of SDP, students' satisfaction and empowerment of a sustainable campus. Source: Own elaboration

Constructs/dimensions	Indicators	Studies	Acronym
Economic dimension	Positive evolution of the financial situation	Elkington (2000); Larrán et al. (2016); Aleixo et al. (2018); Aleixo, Leal, et al. (2018)	ECO1
	Increased scientific productivity and economic valorization of the results of research		ECO2
	Reinforcing pro-efficiency orientation, reducing operating costs		ECO3
Organizational dimension	High levels of student satisfaction	Lee (2009); Chaudhry et al. (2014; Larrán et al., 2016); Aleixo et al. (2018); Aleixo, Leal, et al. (2018)	ORG1
	Providing students with value through activities		ORG2
	Being able to attract and hold on to students		ORG3
	Achieving the desired level of growth		ORG4
Environmental dimension	Reinforcing pro-sustainability orientation, reducing the environmental impact arising from activities	Larrán et al. (2016); Aleixo et al. (2018); Aleixo, Leal, et al. (2018); Tonial et al. (2019)	ENV
Social dimension	Demonstrating a social impact and openness to society	Larrán et al. (2016);Aleixo et al. (2018); Aleixo, Leal, et al. (2018); Tonial et al. (2019)	SOC
Students' satisfaction	Overall, I am satisfied with my academic and social life in my university	Elliott and Healy (2001a); Horan et al., (2019a, 2019b)	SAST1
	My university corresponds to my expectations		SAST2
	I am physically healthy in my university		SAST3
	My university is a safe place		SAST4
	Expenditure in my university is generally acceptable		SAST5
Empowerment of a sustainable campus	There are good inter-personal relations on campus	Alshuwaikhat and Abubakar (2008); Amrina and Imansuri (2015)	SC2
	The campus facilitates learning		SC3
	The campus is aesthetically pleasing		SC4
	The campus stimulates pro-sustainability activities (social, cultural, sporting, environmental, etc.)		SC5

Table A2 Characterization of HEIs and optimal sample size. Source: Own elaboration

HEIs	Region of Portugal	Weight HEIs (%)*	Sample collected	Optimal sample size**
ISCTE Instituto Universitário de Lisboa	Metropolitan Area of Lisbon	16.67	118	109
Universidade dos Açores	Autonomous Region of Açores	5.29	48	35
Universidade do Algarve	Algarve	14.61	98	96
Universidade da Beira Interior	Centre	12.86	132	84
Universidade de Évora	Alentejo	12.16	88	80
Universidade da Madeira	Autonomous Region of Madeira	5.27	35	35
Universidade do Minho	North	33.14	219	217
Total		100	738	656

*Data for the academic year of 2016/2017

**The optimal sample size of each participating HEI was determined for a 99% confidence level and considering a 5% sampling error (see, Smith 2013)

Table A3 Demographic information of students ($N=738$). Source: Own elaboration

Variable	Absolute Frequency	%
Gender		
Female	452	61.2
Male	286	38.8
Age-group		
17–25	628	85.1
26–35	52	7.0
36–45	25	3.4
46–55	22	3.0
> 55	11	1.5
Study Cycle		
Degree course	481	65.2
Master	164	22.2
PhD	42	5.7
Integrated Master	51	6.9
Area of Study (Code)*		
Arts and Humanities (2)	30	4.1
Social Sciences, Trade and Law (3)	364	49.3
Science, Mathematics & Computers (4)	48	6.5
Education (1)	28	3.8
Engineering, manufacturing and construction (5)	195	26.4
Health and social protection (7)	61	8.3
No answer	12	1.6
Total	738	100

*Code according to CNAEF - National Classification of Areas of Education and

Training

Table A4 Descriptive statistics and distribution of mean values, Kurtosis, Skewness and VIF

Indicator	Mean	Median	Min	Max	Standard Deviation	Kurtosis	Skewness	VIF
ECO1	4.539	5.000	1.000	7.000	1.377	0.193	−0.628	1.643
ECO2	4.783	5.000	1.000	7.000	1.213	0.617	−0.593	2.022
ECO3	4.579	4.000	1.000	7.000	1.146	0.788	−0.396	1.958
ORG1	4.977	5.000	1.000	7.000	1.421	0.403	−0.913	3.040
ORG2	5.110	5.000	1.000	7.000	1.331	1.243	−1.113	2.741
ORG3	5.355	6.000	1.000	7.000	1.310	1.845	−1.209	3.283
ORG4	5.035	5.000	1.000	7.000	1.327	0.784	−0.839	3.327
ENV	4.893	5.000	1.000	7.000	1.241	0.550	−0.593	1.000
SOC	5.243	5.000	1.000	7.000	1.195	1.290	−0.949	1.000
SAST1	5.377	6.000	1.000	7.000	1.403	1.209	−1.191	3.133
SAST2	5.329	6.000	1.000	7.000	1.444	0.870	−1.132	3.191
SAST3	5.431	6.000	1.000	7.000	1.349	1.207	−1.132	2.389
SAST4	5.787	6.000	1.000	7.000	1.179	1.352	−1.123	1.492
SAST5	5.129	5.000	1.000	7.000	1.388	0.303	−0.816	1.368
SC1	5.446	6.000	1.000	7.000	1.304	1.587	−1.146	1.361
SC2	5.625	6.000	1.000	7.000	1.206	2.584	−1.335	1.519
SC3	5.385	6.000	1.000	7.000	1.412	0.986	−1.059	1.467
SC4	5.159	5.000	1.000	7.000	1.443	0.783	−0.962	1.614
						Average value:		2.086

Table A5 Correlation between all the indicators

Indicator	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
ECO1	1																	
ECO2	0.666**	1																
ECO3	0.580**	0.561**	1															
ORG1	0.578**	0.617**	0.452**	1														
ORG2	0.549**	0.590**	0.480**	0.793**	1													
ORG3	0.504**	0.572**	0.419**	0.739**	0.751**	1												
ORG4	0.578**	0.605**	0.488**	0.723**	0.715**	0.746**	1											
ENV	0.540**	0.594**	0.542**	0.512**	0.522**	0.521**	0.504**	1										
SOC	0.510**	0.617**	0.488**	0.629**	0.638**	0.627**	0.586**	0.591**	1									
SAST1	0.453**	0.492**	0.319**	0.653**	0.623**	0.605**	0.545**	0.414**	0.531**	1								
SAST2	0.482**	0.504**	0.351**	0.715**	0.679**	0.646**	0.611**	0.458**	0.579**	0.802**	1							
SAST3	0.369**	0.393**	0.257**	0.560**	0.544**	0.485**	0.447**	0.360**	0.454**	0.692**	0.700**	1						
SAST4	0.163**	0.210**	0.163**	0.323**	0.336**	0.341**	0.279**	0.300**	0.372**	0.438**	0.442**	0.519**	1					
SAST5	0.272**	0.305**	0.214**	0.361**	0.394**	0.331**	0.304**	0.328**	0.312**	0.424**	0.422**	0.425**	0.433**	1				
SC1	0.301**	0.349**	0.245**	0.428**	0.432**	0.381**	0.338**	0.332**	0.397**	0.576**	0.560**	0.583**	0.451**	0.362**	1			
SC2	0.294**	0.361**	0.174**	0.504**	0.520**	0.539**	0.438**	0.344**	0.445**	0.598**	0.599**	0.539**	0.412**	0.333**	0.467**	1		
SC3	0.287**	0.280**	0.218**	0.425**	0.386**	0.401**	0.373**	0.300**	0.358**	0.462**	0.460**	0.407**	0.378**	0.316**	0.291**	0.424**	1	
SC4	0.385**	0.373**	0.282**	0.456**	0.504**	0.465**	0.448**	0.361**	0.461**	0.529**	0.535**	0.479**	0.330**	0.356**	0.410**	0.466**	0.527**	1

**The correlation is significant at the 0,01level (2 tails)

Table A6 Correlation weights, reliability estimates and convergent validity statistics

Construct	Indicator	Loading	Alpha	rho_A	CR	AVE
Economic dimension	ECO1	0.792	0.820	0.847	0.891	0.733
	ECO2	0.884				
	ECO3	0.890				
Organizational dimension	ORG1	0.898	0.921	0.925	0.944	0.808
	ORG2	0.877				
	ORG3	0.911				
	ORG4	0.910				
Environmental dimension	ENV	1000	1.000	1.000	1.000	1.000
Social dimension	SOC	1000	1.000	1.000	1.000	1.000
Students' satisfaction	SAST1	0.889	0.849	0.892	0.893	0.629
	SAST2	0.890				
	SAST3	0.857				
	SAST4	0.665				
	SAST5	0.624				
Empowerment of a sustainable campus	SC1	0.739	0.752	0.756	0.843	0.573
	SC2	0.794				
	SC3	0.709				
	SC4	0.782				

Table A7 Heterotrait–monotrait ($HTMT_{0.85}$) ratio

	1	2	3	4	5	6
1. Economic dimension	0.856					
2. Organizational dimension	0.703	0.899				
3. Environmental dimension	0.651	0.572	1.000			
4. Social dimension	0.633	0.691	0.591	1.000		
5. Students' satisfaction	0.513	0.714	0.474	0.581	0.790	
6. Empowerment of a sustainable campus	0.465	0.649	0.442	0.550	0.794	0.757

Heterotrait–Monotrait Ratio (HTMT) discriminate at HTMT < 0.85

Table A8 Heterotrait–monotrait (HTMT) ratio, using bootstrapping

Variables	Original sample (O)	Sample mean (M)	2.5% 97.5%	Original sample (O)	Sample mean (M)	Bias	2.5% 97.5%
Economic dimension → Students' satisfaction	−0.059	−0.059	[−0.144, 0.024]	−0.059	−0.059	0.000	[−0.146, 0.023]
Organizational dimension → Students' satisfaction	0.606	0.608	[0.513, 0.694]	0.606	0.608	0.002	[0.507, 0.690]
Environmental dimension → Students' satisfaction	0.073	0.072	[-0.008, 0.151]	0.073	0.072	−0.001	[−0.007, 0.153]
Social dimension → Students' satisfaction	0.157	0.156	[0.068, 0.243]	0.157	0.156	−0.001	[0.070, 0.246]
Students' satisfaction → Empowerment of a sustainable campus	0.790	0.791	[0.755, 0.823]	0.790	0.791	0.001	[0.751, 0.819]

Table A9 PLS predict results based on assessing MAE values

Indicator	PLS results		LM results	
	MAE	Q^2_predict	MAE	MAE_{PLS}—MAE_{LM}
SAST1	0.767	0.456	0.753	0,014
SAST2	0.720	0.539	0.702	0,018
SAST3	0.814	0.323	0.820	−0,006
SAST4	0.820	0.136	0.809	0,011
SAST5	0.976	0.150	0.982	−0,006
SC1	0.751	0.307	0.733	0,018
SC2	0.974	0.198	0.974	0.000
SC3	0.941	0.277	0.929	0,012
SC4	0.854	0.204	0.850	0,004

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Data availability Data available under request.

Declarations

Conflict of interest The authors declare that there is no conflict of interest. There are no financial conflicts of interest to disclose and all funding bodies are acknowledged in the submission.

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