Article

Fostering Knowledge of the Sustainable Development Goals in Universities: The Case of Sulitest

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Abstract: Improving sustainability knowledge is crucial to achieving the Sustainable Development Goals (SDGs). This article highlights the role of multi-stakeholder partnerships (MSPs) in fostering sustainable development knowledge in higher education institutions. The purpose of this study is to investigate the importance of collaboration and stakeholder engagement for the adoption and impact of an MSP. The method is based on the case-study of Sulitest: an international MSP developing open online tools to raise and map sustainability literacy. Sulitest engages different stakeholders to co-develop and disseminate online tools according to the stakeholder context. Sulitest is also a data-provider for academic research investigating the advancement of Education for Sustainable Development (ESD). This study uses a sample of 61,376 students in 33 countries having taken the Sustainability Literacy Test between September 2016 and December 2018 to estimate the advancement of students' knowledge and understanding of the 17 SDGs and their systemic nature. Factorial analysis allows to map the dimensions of sustainability literacy related to the level of engagement and collaboration in this MSP. The results show that active collaboration, stakeholder engagement, and membership in international networks act as important factors of adoption of this initiative. The analysis also highlights the role of exposure to education in order to enhance sustainability literacy and to develop a systemic perspective of sustainability.

Keywords: sustainable development goals; multi-stakeholder partnerships; sustainability literacy; higher education; stakeholder engagement

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1. Introduction

Enhancing sustainable development knowledge and building the capacity to address the complex challenges of the 21st century is a keystone of any sustainable economy or global governance system. The role of multi-stakeholder partnerships (MSPs) in addressing the complex challenges and even “wicked” problems such as those embedded in sustainable development figure increasingly in a growing body of literature [1–3]. MSPs refer to a collaborative form of governance involving mainly business actors and civil society organizations who come together to find a common approach to a complex problem affecting them all [4]. Building on the literature highlighting the importance of cross-sector partnerships to initiate deep and systemic change [5,6], MSPs develop collaborative arrangements between multiple stakeholders where collective action can provide innovative ways of conducting systemic change. The adoption of the 2030 Agenda's 17 Sustainable Development Goals (SDGs) in September 2015 and the systemic nature of the goals reinforce the expectation for MSPs to address these challenges and their multiple interlinkages. SDG 17, in particular, is a transversal objective aiming to enhance “Partnerships for the Goals”.

One of the key outcomes expected from cross-sector partnerships and MSPs is to enable learning and to foster knowledge and innovation [7,8]. Building MSPs in the context of higher education is a way to develop this objective toward sustainability knowledge and innovation. Higher education, and business schools, in particular, play a critical role in

promoting a paradigm shift toward sustainable development [9]. Numerous studies document the role of higher education in promoting sustainability [10,11] and in contributing to sustainability knowledge, skills, mindsets, and/or behaviors [12–14]. Business Schools in particular have gradually integrated business ethics, corporate social responsibility (CSR), and sustainability into their curricula [15,16] and even beyond [17]. Such schools need to establish the right balance between sustainable business education practices and their internal environments [18] and are called to “walk their talk” [19] (p. 248).

The aim of this article is to investigate how collaboration and stakeholder engagement through MSPs in higher education can enhance sustainability literacy and understanding of the SDGs and their systemic nature. Fostering sustainability knowledge and raising awareness about the systemic framework of the SDGs is a way of building a sustainability-driven culture and disseminating sustainable values in academia and beyond. This research builds on the case of Sulitest (Sustainability Literacy Tools and Community), an MSP coordinated by an NGO accredited by the UN and aiming to foster knowledge of the SDGs. This MSP uses collaboration between higher education institutions and other stakeholders to co-create online tools that raise awareness and map sustainability literacy [20]. Its main tool is an online Sustainability Literacy Test, shared by a community of more than 1000 higher education institutions and other organizations in 80 countries. This tool aims to engage different stakeholders in learning about the complex challenges of the SDGs by improving their sustainability literacy. This article uses a sub-sample of 177 higher education institutions in 33 countries, with 61,376 students having taken the test between September 2016 and December 2018 as a dataset for the research methodology.

The research methodology builds on the case study of Sulitest as an MSP for the SDGs in the context of higher education. Mining the data extracted from the Sulitest database, this research investigates the progress of sustainability literacy and SDG knowledge as an indicator of impact for this MSP. Using Multiple Correspondence Analysis, this research maps SDG knowledge in relation to categorical variables capturing collaboration, stakeholder engagement, and adoption of the Sulitest initiative. These variables include the higher education institutions’ willingness to contribute to the tools, to support the Sulitest movement, and to engage in international network sharing practices, such as the United Nations Global Compact Principles for Responsible Management Education (PRME) or the United Nations Higher Education Sustainability Initiative (HESI).

The contributions of this article are twofold. Firstly, the results contribute to the literature on the role of MSPs in advancing the SDGs, especially through higher education. Several studies emphasize the importance of sharing knowledge with external stakeholders [21] and developing mutual learning [22] and cross-sector, cross-cultural partnerships [12,23] to achieve corporate social innovation. If this field is widely documented in the corporate context, fewer research works investigate the role of MSPs in the context of higher education [24]. This research aims to fill this gap with a case study of an MSP engaging higher education institutions from different countries, UN agencies, and international networks to foster sustainability knowledge. By aligning different backgrounds, values, ideas, and resources, cross-sector partnerships and cross-cultural partnerships are able to address complex societal issues such as the UN Global Goals [25]. This study enhances the literature investigating factors facilitating the adoption of the sustainability agenda in such MSPs. It highlights the role of both collaboration and stakeholder engagement through the Sulitest case study. Secondly, this article contributes to the literature on Education for Sustainable Development (ESD) and sustainability in higher education. Research extensively documents universities’ efforts both to incorporate sustainability into their core activities and to meet current challenges [26–28]. However, few studies focus on the impact of such efforts on students’ and graduates’ sustainability literacy, with the notable exception of Ref. [29] for the University of Extremadura. This article aims to address this gap by using an original dataset providing empirical data to map sustainability awareness and question its systemic perspective. This contribution differs from previous studies by focusing more on the outcome expected from the development of education

on students' sustainability knowledge rather than on the effort put in place to develop curricula integrating sustainability.

After this introduction, Section 2 presents the literature discussing the role of MSPs and higher education in fostering both sustainability knowledge and learning to achieve the SDGs. Section 3 explains the methodology, based on the Sulitest case and on factorial analysis to map sustainability knowledge. Section 4 presents the results of the Multiple Correspondence Analysis. Section 5 discusses the study's main contributions to the literature. Section 6 concludes and suggests avenues for further research.

2. Literature Review

Multi-stakeholder partnerships (MSPs) are powerful vehicles to spur collaboration between multiple stakeholders pursuing a common purpose. In the context of the 2030 agenda, SDG 17 highlights the critical importance of MSPs in tackling wicked or intractable problems such as the SDGs and their multiple interlinkages. One important outcome expected from collaboration and partnership is the ability to transfer knowledge, facilitate learning between different stakeholders, and foster innovation. Building MSPs in the context of higher education is a way to advance sustainability knowledge, in addition to the skills and mindset necessary to building a sustainability-driven culture beyond academia by connecting to wider networks and engaging multiple stakeholders.

2.1. The Importance of MSPs to Addressing “Wicked” Problems

The context of the 2030 Agenda and the systemic nature of the SDGs raise the interest of MSPs as a form of partnership that can tackle such challenges. Theorizing MSPs builds on the burgeoning literature on the governance and impact of cross-sector partnerships [5]. MSPs are broadly defined as a collaborative form of governance involving mainly business actors and civil society organizations that come together to find a common approach to a complex problem affecting them all [4]. As a specific organizational form combining public and private actors across sectors [30], MSPs stand out in the literature on cross-sector partnerships and their ability to provide innovative solutions for deep-level changes in environmental, social, or economic systems [6]. MSPs refer to “collaborative arrangements” in which different actors from business, non-governmental organizations (NGOs), and in some cases, governments and academia, join forces to find a collective approach to complex challenges [31].

The complex and systemic nature of the SDGs provides such challenges. SDGs invite us to explore, not only the various challenges of the 2030 Agenda but also their interlinkages. “The extent to which each SDG can be effectively addressed separately, critically depends on the extent to which companies, governments and other societal stakeholders are able to understand, manage and make use of the interrelations between that and the other SDGs. Success in achieving results in one problem area is thus conditioned by actions, policies and progression in other areas” [3]. The challenges that SDGs address seem to go “beyond being complex (by being) wicked problems” [3]. Wicked problems are systemic in nature, complexly interrelated, and materialize at the interface between public-private and profit-non-profit interests. [5] propose “three key features (or dimensions) that distinguish wicked problems: (1) knowledge uncertainty, (2) value conflict among multiple stakeholders and (3) dynamic complexity, in that they have no unique and final solution(s) or outcome(s)”. The literature on wicked problems also highlights additional features of “super wicked” problems, such as climate change, including: “time is running out”, “those seeking to end the problem are also causing it”, there is “no central authority” able to address the problem, and policies are limited to present day considerations and “discount the future irrationally” [32,33].

Building partnerships with multiple stakeholders seems to be critical in the context of wicked (or super-wicked) problems as they tend to generate ideological conflicts and at the same time require collective action, engaging a large diversity of stakeholders, which can be considered “not to be a curse, but the cure” [34]. Knowledge uncertainty

in the context of wicked problems, as well as potential value conflicts and trade-offs between multiple stakeholders, can generate a lack of consensus around the societal goals of the MSP and the relevant knowledge and information to achieve these goals [35]. Collaborative arrangements in MSPs enable collective action as a way to “harness wicked problems” [5]. Collective action makes it possible to unleash “societal triangulation” between governments (state), firms (market), and citizens (communities), where “each of the societal sectors ‘have’ and ‘take’ responsibilities” [3]. Organizing collective action between multiple stakeholders results in potentially more complex forms of governance and, at the same time, enables learning and disseminating innovative solutions needed to achieve a paradigm shift toward sustainability.

2.2. MSPs to Accelerate Learning and Innovation

The ability to build partnerships with multiple stakeholders such as businesses, public authorities, and civil society has been widely documented as a strong factor to foster knowledge and innovation [8]. The business literature emphasizes the importance of sharing knowledge through partnerships with external stakeholders, alongside organizational factors, such as corporate culture, organizational structure, and R&D capabilities [21]. Acquiring tacit knowledge from external stakeholders and developing mutual learning are the first steps towards corporate social innovation [22]. They rely on facilitators of learning in cross-sector and cross-cultural partnerships [7,23].

Such partnerships can take the form of communities of practice within and between organizations, entities that stimulate social learning, and the creation and sharing of knowledge [36]. These communities create a dynamic of problem solving and innovation, particularly in the context of knowledge management practice, such as in higher education institutions. Communities of practice constitute an ideal ecosystem for developing disruptive innovations based on combinations of their members’ complementary skills and resources [37]. One of the benefits of participating in a community of practice is the access to strategic, contextualized, and up-to-date information, expertise in the field, and accurate responses to complex issues [38,39]. According to the authors of [40] (p. 209), to improve the way learners acquire knowledge, they should adopt a different perspective and place learning “in the context of our lived experience of participation in the world”.

It is interesting to link the expected advantages of communities of practices documented in the literature on knowledge management and innovation with the expected advantages of collective action in MSPs involving higher education to disseminate sustainability knowledge and values beyond academia [24]. This is especially the case of business schools in the context of responsible management education, business ethics, and CSR [15,16,41,42]. The Global Compact’s Principles for Responsible Management Education (PRME) coordinates the efforts of a wide range of universities and business schools to educate responsible managers. PRME’s primary impact lies in its facilitating capacity and in the ability of active faculty members to use this capacity [43]. The authors of [9] state that by teaching sustainable development, business schools can challenge the “dominant economic-driven world view in order to cultivate business students with sustainability-driven values”. The launch of the Globally Responsible Leadership Initiative (GRLI) in 2005, which promotes partnerships between higher education and businesses to advance global responsibility, is a good example of an MSP pursuing these objectives. The GRLI involves institutional stakeholders such as the UN Global Compact and EFMD, as well as companies and business schools to address hands-on the question of how to develop a generation of globally responsible leaders. Sharing good practices, learning from other stakeholders, fostering sustainability leadership, and testing potential answers to complex challenges using collective action all enhance the role of higher education in the context of the 2030 Agenda.

2.3. Holistic Change in and through Higher Education: Fostering Sustainability Literacy and Systems Thinking

Higher education is a strong enabler of knowledge and innovation, especially through partnerships with multiple stakeholders [8]. Higher education institutions are thus able to act both as accelerators for learning and innovation in sustainability and as a way of building partnerships between multiple stakeholders.

The contribution of higher education to the sustainability agenda relies on the field of Education for Sustainable Development (ESD). The development of this field is intertwined with the institutional UN agenda, including the UN Decade of Education for Sustainable Development 2005–2014 [27]. The 2012 United Nations Conference on Sustainable Development (UNCSD), also known as Rio+20, constituted a major turning point for partnerships in higher education with the launch of the Higher Education Sustainability Initiative (HESI). HESI is an MSP between eight UN agencies, several international networks, and higher education institutions. It provides higher education institutions with “a unique interface to engage in teaching sustainable development across all disciplines of study, encouraging research and dissemination of sustainable development knowledge, greening campuses and supporting local sustainability efforts, and sharing information with international networks” (<https://sustainabledevelopment.un.org/sdinaction/hesi>, last access 25 November 2021).

Implementing sustainability in higher education faces multiple challenges [44,45] as it is complex and relies on multiple and interconnected dimensions across disciplines [10,11]. The authors of [26] state that higher education should promote sustainability in the following ways: “collaborating with other universities; fostering transdisciplinarity; making sustainable development an integral part of the institutional framework; creating on-campus life experiences; and Educating-the-Educators”. Collaboration enables the holistic changes needed both in and through higher education to tackle sustainable development challenges. Focusing on business schools, [17] (p. 738) call for a “systemic institutional integration of sustainability . . . where sustainability is displayed in and through an organization’s ethics, social, governance and environmental performance”. Implementing a holistic approach to integrating sustainability into higher education goes beyond teaching and curricula. It requires a set of common objectives, rethinking the expected learning outcomes, and the ability to collaborate between universities and external stakeholders to achieve these objectives [46,47].

Knowledge and awareness are key outcomes expected from the assimilation of sustainable development into higher education. In acquiring sustainability knowledge, students increase their cognitive competence [48], which should enable them to apply ethical decision-making strategies [49]. Transitioning toward sustainability implies a paradigm shift and cultural change, involving innovative knowledge, competencies, and practices. Tackling complex or wicked problems also relies on the need for a deeper understanding of the nature of the problems to be addressed [50]. Improving sustainability knowledge and awareness should facilitate the development of new skills and competencies and should affect behavior and action to initiate and conduct change [12,13,51]. Engaging students in more holistic learning is a way to “undergo both the cognitive and emotional learning needed to manage businesses sustainably” [52]. The authors of [14] state that “student environmental attitude serves as a powerful influence on their sustainability intention, which in turn affects behavior”. The combination of all these dimensions forms the concept of “Sustainability Literacy”, defined as the “knowledge, skills, and mindsets that help compel an individual to become deeply committed to building a sustainable future and allow him or her to make informed and effective decisions to this end” [20].

This concept encompasses key competencies to expect when incorporating sustainability into higher education [53,54], including the ability to overcome the specialization of one’s academic major, to face complexity and develop systems thinking [55,56]. In practice, this means enabling students to develop critical, holistic, systemic, interdisciplinary thinking [57–60]. Developing sustainability literacy is expected to develop systems thinking

by addressing complexity and multiple nexuses, such as the ones embedded in the SDGs framework. Students should be able to link the different SDGs and the challenges they encompass. Fostering sustainability literacy through higher education helps to develop a systemic mindset, providing students with knowledge and awareness of the interlinkages between the individual, organizational, and wider systemic levels. Sustainability literacy is a way to facilitate individual engagement and to prepare the micro-foundations of partnerships for sustainability [61].

This paper builds on the case of an international MSP that uses collaboration in international networks and stakeholder engagement to improve sustainability literacy and to map its systemic nature.

3. Materials and Methods

The research methodology uses Multiple Correspondence Analysis (MCA) in order to identify associations between the main factors of engagement in the MSP and its main outcomes in terms of sustainability literacy. The data come from the case study of Sulitest. This initiative is an MSP using collaboration through institutional networks and engagement of different stakeholders to contribute to the 2030 Agenda by enhancing sustainability knowledge. This initiative also provides the academic community access to its database to collect empirical indicators to estimate the progress of sustainability literacy and of the understanding of the systemic nature of the SDGs.

3.1. Data: Sustainability Literacy through the Case Study of the Sulitest MSP

The empirical data used in this article come from the Sulitest database. Sulitest is an international MSP led by an NGO accredited by the UN and coordinating a community of different stakeholders: UN agencies, academic and professional networks, universities, and corporations. Sulitest defines its core mission as expanding the sustainability knowledge, skills, and mindset that motivates individuals to build a sustainable future and that allows them to make informed and effective decisions to this end. To fulfill this mission, Sulitest is developing online tools to raise awareness and improve sustainability literacy. The main tool, the *Test*, is an online *Sustainability Literacy Test* designed to enhance and map knowledge of a broad range of sustainability topics covering the 17 SDGs. It consists of an *International Core Module* addressing global challenges, country-specific modules developed through a network of collaborative regional/national committees, and SDG-specific modules developed in collaboration with experts from different UN agencies.

By providing open online tools to a large community of academic institutions and other organizations (more than 1000 from 80 countries at the time of writing this) eager to improve sustainability awareness and to monitor its progress, Sulitest aims to build sustainability-driven values. More than 220,000 people have already taken the *Test* at the time of writing since its inception in 2014. This article is based on a sub-sample of 61,376 students from 177 Universities in 33 countries who took the *Test* between September 2016 and December 2018. This sub-sample is from an extraction of the Sulitest database conducted for the purpose of this research. The sampling procedure consists of covering more than two full academic years in order to ensure a sufficient number of universities from a wide range of disciplines and countries while integrating only universities with test sessions of 10 students minimum. The students were recruited by their own university. They were asked to take the test online as a part of the pedagogical activities included in their curriculum.

Three main characteristics led to the choice of Sulitest as a case study for this research.

Firstly, this MSP leverages collaboration as a way to maximize interactions and mutual learning between higher education institutions and other stakeholders such as UN agencies, organizations, and institutional networks supporting the 2030 Agenda. It is thus a case study of multiple stakeholder engagement in the context of higher education.

Secondly, this MSP allows one to question the role of stakeholder engagement at different levels: using tools to contribute to the improvement of sustainability literacy of

their students, staff, or other stakeholders (“users”); creating content and/or co-developing the tools through intellectual contributions (“contributors”); supporting the MSP through in-kind or financial contributions (“partners”).

Thirdly, setting up access to the database of the test for academic researchers, Sulitest provides empirical data to estimate the correlation between the level of engagement of higher education institutions in this MSP and its expected outcome in terms of sustainability knowledge.

3.2. A Multiple Correspondence Analysis (MCA) to Link Higher Education

The research methodology uses factorial analysis to disentangle the correlation between different levels of engagement at the organization level (e.g., higher education institution), and the main outcomes pursued by the MSP (e.g., enhanced sustainability literacy). The variables of interest of the analysis are:

- The three levels of engagement in the Sulitest community: being a “Premium User” means purchasing a premium membership to customize its own modules to develop its uses of the Sulitest tools, being a “contributor” means creating content for the tools through intellectual contribution, being a partner means supporting the NGO through in-kind or financial contribution;
- The membership in institutional networks supporting the Sulitest core mission such as the UNGC Principles for Responsible Management Education (PRME) or the UN Higher Education Sustainability Initiative (HESI);
- The subject majors taught in the higher education institution (using the ISCED classification from UNESCO, 2013);
- A quantitative indicator of impact with the number of test-takers reached in each university;
- A detailed impact indicator estimating the level of sustainability literacy with the average score obtained by test-takers in each of the 17 SDGs (using the Sulitest international core module, which relies on the same question bank and algorithm of topics covered regardless of the country).

The detailed list of variables appears in Appendix A. Most of the variables are categorical, except for those measuring the scores obtained for the Core Sulitest module and for each topic covered by the test. The researchers recoded the scoring variables in four categories corresponding to the quartiles of the quantitative scores: Q1 (0–25%), the individual score is one of the 25% lowest scores in the sample; Q2 (25–50%), between 25% and 50%; Q3 (50–75%) between 50% and 75%; and Q4 (75–100%), the individual score is one of the 25% highest scores in the sample. The qualitative data require the use of Multiple Correspondence Analysis (MCA). This inductive approach is a generalization of Correspondence Analysis for categorical variables [62–65]. It measures associations between several variables and factors from the dataset, represented as nominal categorical data, and identifies stable patterns in the data. The purpose is to identify the relative importance of the variables, represented as axes, and the groupings of individuals, denoted by clusters in the analysis of the indicator matrix.

In an MCA, eigenvalues are vitally important for interpreting the general form of the cloud, and to indicate which axis is most significant. They are used to determine the amount of explained variance. However, these proportions often provide a pessimistic indication of fit and are uninterpretable. Therefore, this study uses the inertia adjustment [63,64], which produces a better indication of which axis should be used for the analysis. This adjustment does not affect the contributions, which remain calculated in relation to the original eigenvalues. The adjusted eigenvalues are 0.43 and 0.22. The corrected percentages of inertia for the first two dimensions are 75.16% and 15.73% (Appendix A). They give an accurate expression of the importance of each factor. As the cumulated inertia of these two factors is 90.89%, the study only retained the first two axes for the analysis.

Finally, non-parametric tests sharpen the interpretation of the MCA results, given the qualitative nature of the variables: a Chi-square test confirmed the strength of the

correlation between the main variables of interest for the interpretation and discussion of the results. Table 1 presents the results of these independent tests.

Table 1. Chi-square test for independence between the adoption variable “Number of students having taken the test” and variables representing collaboration and engagement.

Significant Variables	Chi-Square Test
Dependent variable: “Number of students having taken the test”	
Signatory of the HESI	14.06 ***
Signatory of PRME	8.53 *
Contributor to Sulitest	10.15 **
Partner—Supporter of Sulitest	22.78 ***

* significant at the 10% level, ** significant at the 5% level, *** significant at the 1% level.

4. Results

The results of the MCA consist of mapping the association and clusters between variables and estimating the relative contribution of these variables to the formation of the different axis. To interpret the MCA, it is necessary to calculate the absolute contributions and squared correlations for each axis [64]. Appendix A presents the basic numerical results of the MCA analysis for the first two dimensions (i.e., factors or axes). The contributions are coefficients of determination giving the explained variance for each variable per axis or factor. Appendix B shows the MCA map created by combining the first two axes of inertia, representing a cloud of modalities.

The exercise consists of clustering and grouping modalities. The first two-dimensional map (represented in Appendix B) alone explains 90.89% (75.16% + 15.73%) of the total inertia of the active variables. To interpret the map, the researchers examine the positions of the points in a given cloud, relative to an axis. If two such points are close on the map, they will have a similar profile. Graphically, the further a point is from the origin, the smaller its marginal weight, and the greater its contribution to inertia. Similarly, the smaller the distance between a point and an axis, the closer to 1 is its squared correlation on that axis.

In Appendix B, no quadrant is empty, and many modalities are positioned at the ends of the axes, indicating that several of the variables enable us to discern the sample population. Using Appendix A to identify the important points in the map, we see that the first two factors clearly highlight how the average test scores obtained for the 17 SDGs contribute to distinguishing between the universities. The score variables provide the highest contributions to the variance explained by both axes. The map in Appendix B shows that the first axis captures a contrast between the lowest and highest average scores (Q1 and Q4, respectively). Meanwhile, the second axis contrasts scores closer to the median (Q2 and Q3) and “extreme” scores (Q1 and Q4), whether low or high. The variable “number of students taking the test”, representing adoption of the initiative also contributes significantly to the formation of this second axis. Finally, the universities’ characteristics are captured in this second axis, although the contributions of these variables are lower. More specifically, in Appendix B, Business and Engineering Schools seem to correlate with the cluster characterized by a high degree of adoption and an average test score between 50% and 75% (Q3). HESI and PRME signatories, along with being engaged in Sulitest as active contributors or as partners, are close to the same cluster. Using Appendix A, the contribution of engagement in the Sulitest MSP, whether it is as a contributor or as a partner, is slightly higher than the contribution of being PRME or HESI signatories.

The Multiple Correspondence Analyses (MCA) highlights three main results.

1. The first result characterizes the pursued outcome of the Sulitest MSP: the level of sustainability literacy estimated by the score obtained to the test and its distribution among the scope of the 17 SDGs. Appendix B identifies four homogenous clusters corresponding to the four quartiles of the average scores obtained by students for each SDG in the universities of the sample. Both the homogeneity of these clusters

in the map and the contributions of these variables in Appendix A show a strong homogeneity in the distribution of scores obtained for the 17 SDGs. In other words, if the average score for one SDG is among the 25% lowest scores (Q1), the score will be comparable for the 16 other SDGs. On the contrary, if the university's average score is among the 25% highest scores (Q4) for one of the SDGs, the score will be comparable for the 16 other SDGs. We might have expected some specialization effects if, depending on the major taught, some students from universities achieved among the highest average scores for economically oriented SDGs, but lower scores for social or environmental SDGs, and if others had achieved the opposite. This is not the case in this sample: the distribution of scores among the 17 SDGs seems homogenous. This suggests that the awareness level, whether low or high, covers the whole range of SDGs, supporting the idea of a systemic pattern for sustainability awareness, rather than a focus or specialization on specific SDGs.

2. The second main result highlighted by the MCA deals with the correlation between the indicators of engagement in the MSP, the membership in an international network, and the number of tests takers interpreted as an indicator of the expected impact of the Sulitest MSP. The MCA and the non-parametric tests reveal that both membership in international networks representing communities of practice, such as HESI and PRME, and the level of engagement in the Sulitest MSP, as a contributor or as a partner, seem to correlate with the number of test-takers, and thus the adoption of the initiative in universities. Appendix B identifies a correlation between these variables and the universities with the highest number of students having taken the test. This result suggests that being involved in sustainability-driven networks and being engaged in MSPs such as Sulitest correlate with the number of students taking the test. As the contributions of these variables to the axes are lower than those of the test scores, we conducted non-parametric Chi-square tests to confirm this result, observed in Appendix B. Table 1 presents the results of the Chi-square tests with the statistically significant variables, which therefore depend on the variable "Number of students having taken the test". The test confirmed that being a HESI or PRME signatory or a Sulitest contributor or partner significantly correlates with the number of students having taken the test in the university.
3. The third result discusses the relative importance of the variables measuring the involvement in international networks (PRME and HESI) and the variables measuring active engagement in the Sulitest MSP (as either a contributor or a partner). The relative contribution of these variables to the formation of axis 2 in Table 1 suggests that the correlation is slightly higher for the active engagement in the MSP than that for being a member of an international network. However, this result must be interpreted with caution because the MCA is an explanatory analysis, highlighting correlation and not causal relationship, and because both variables are statistically significant in the Chi-square test.

5. Discussion

Collaborating in networks, communities of practices, and multi-stakeholder partnerships (MSP) are expected to help face the challenges of integrating sustainability into higher education. Collaboration between multiple stakeholders and cross-cultural partnerships between countries should act as an enabler in order to improve sustainability knowledge. Using the case study of the Sulitest MSP and mining the dataset of the test-takers in a broad sample of universities, the Multiple Correspondence Analysis conducted in this article makes two main contributions to the literature.

1. The results contribute to the literature on education for sustainable development by providing insight into the impact of the adoption of an MSP on the student's sustainability knowledge, rather than the effort put in place to integrate sustainability into the curriculum. The results support the systemic view of sustainability literacy expected in the literature with empirical indicators. Sulitest's online tools are designed

to cover topics on all 17 SDGs, and this study's mapping covers a broad sample of students, identifying a variety of sustainability awareness levels. The results suggest a systemic pattern for students' sustainability awareness, with homogeneous clusters for all 17 SDGs. It should contribute to building a common foundation of knowledge for addressing the complex issues inherent in the SDGs.

2. Collaboration in an MSP and stakeholder engagement in higher education correlate with the dissemination of sustainability-driven values. The results of the Multiple Correspondence Analysis and non-parametric tests together highlight the correlation between collaboration through international networks and active contribution and engagement through financial or in-kind support and the adoption of the Sulitest initiative. Business and engineering schools appear to be particularly active stakeholders in this area compared to multidisciplinary universities in our sample. This result supports the potential of collective learning and collaboration through stakeholder engagement in such initiatives to develop answers to the SDGs.

However, the results of this study may be interpreted with caution for several reasons. They call for additional research to confirm this explanatory study. Firstly, this research uses an exploratory analysis, with an MCA highlighting correlations between variables and stable patterns in the data. It is not sufficient to conclude a causal relationship between the variables. Secondly, data limitations must be acknowledged. The data estimating the level of engagement in the MSP and in international networks are limited. They could be sharpened by additional dimensions such as qualitative studies exploring the different forms of engagement and their impact on achieving sustainability literacy through the 17 SDGs. Finally, the factors explaining the systemic pattern of sustainability literacy mapped in the analysis could be sharpened by collecting additional indicators on individual test-takers and their learning pathways.

Nevertheless, the database and sample used in this study are original and provide promising results in the correlation between collaboration in MSP and students' understanding of the SDGs.

6. Conclusions

This article investigates the role of higher education in fostering sustainability knowledge through the case of a multiple-stakeholder partnership (MSP), Sulitest. This initiative co-creates open online tools to raise sustainability literacy and collect empirical indicators of its progress. This study investigates Sulitest as a multi-stakeholder partnership fostering sustainability knowledge and as a case of collaboration and stakeholder engagement. The study addresses the lack of empirical data to estimate the progress of sustainability knowledge and not only the efforts of the university to integrate sustainability into the pedagogy. It also contributes to the literature investigating the engagement in an MSP in the context of higher education. Factorial analyses are conducted to identify the correlations between stakeholder engagement, membership in international networks, and the expected impact of an MSP toward sustainability literacy.

The Multiple Correspondence Analysis shows that cooperation and active contribution in the MSP correlate with a greater number of students impacted by the MSP. Membership in institutional networks working toward education for sustainable development, such as HESI or the UNGC PRME, also correlate with this engagement.

The mapping also confirms students' systemic perspective of sustainability knowledge across all 17 Sustainable Development Goals. This result supports the idea that sustainability learning enables systems thinking and the capacity to deal with complex issues.

This article has both practical and social implications. It provides tools and guidelines for accelerating and mapping sustainability literacy progress as an enabler of corporate social innovation and sustainable values. Higher education institutions and other organizations could replicate these results in various contexts to raise sustainability awareness of their students, or to train their staff to adopt socially innovative values for the achievement of the 2030 Agenda.

The article also provides theoretical implications by linking stakeholder engagement to the adoption of an MSP in the context of higher education and by supporting the assumption of a systemic perspective of sustainability knowledge formulated in the literature.

Future research could strengthen the results of this article in different directions. Firstly, the data covering the determinants of stakeholder engagement could be sharpened with qualitative studies to explore motivation and the forms of engagement. Secondly, exploring the systemic pattern of SDG knowledge linked to individual characteristics and education pathways could be used to identify factors driving the adoption of sustainability knowledge.

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Conflicts of Interest: The authors declare no conflict of interest. However, it is relevant to indicate that the corresponding author is the co-founder of the Sulitest initiative, in addition to its academic position as a researcher. The authors confirm that Sulitest was used as a case study and a data provider in the context of a research project conducted by the authors on a separate affiliation. All ethical standards have been applied when extracting the dataset and conducting the sampling procedure and the analysis.

Appendix A. Eigenvalues. Contributions and Square Correlations for the MCA

	Axis	
	1	2
Eigenvalue	0.43	0.22
Adjusted eigenvalue	0.17	0.03
Corrected percentage of inertia	75.16	15.73
Contributions (%)		Contributions (%)
Higher Education Institutions (HEIs) characteristics		
Major Taught (Source: ISCED 2013, UNESCO)		
Business, administration, and law	0	0.33
Engineering, manufacturing, and construction	0.01	0.31
Multi-disciplinary	0	0.11
TOTAL	0.01	0.76
Is the HEI a member of the UNGC Principles for Responsible Management Education (PRME)?		
Non_PRME	0.01	0.12
PRME	0.03	0.27
TOTAL	0.04	0.39
Is the HEI a signatory of the UN Higher Education Sustainability Initiative (HESI)?		
HESI		
Non_HESI	0.01	0.02
TOTAL	0.04	0.08
Is the HEI a Sulitest partner or supporter?		
Non_Partner	0	0.01
Partner	0.03	0.33
TOTAL	0.03	0.35

Is the HEI an active contributor to Sulitest		
Contributor	0.13	0.17
Non_Contributor	0.03	0.03
TOTAL	0.16	0.2
Has the HEI purchased premium access to the Sulitest platform to expand use of the tools?		
Non_Premium	0	0
Premium	0.02	0.08
TOTAL	0.02	0.08
Number of students having taken the test between September 2016 and December 2018		
1000+	0	0.2
500 to 1000	0.22	0.13
170 to 500	0.04	0.15
40 to 160	0	0.05
10 to 40	0.13	0.26
TOTAL	0.39	0.8
Quartiles of university-level average scores (%) for the 17 SDGs		
Quartiles of university-level average scores (%) obtained for SDG1		
% SDG1 1	1.62	1.31
% SDG1 2	0.42	0.17
% SDG1 3	0.06	2.39
% SDG1 4	2.98	0.86
TOTAL	5.07	4.73
Quartiles of university-level average scores (%) obtained for SDG2		
% SDG2 1	0.62	0.21
% SDG2 2	1.16	0.06
% SDG2 3	0.15	1.77
% SDG2 4	2.12	0.42
TOTAL	4.05	2.46
Quartiles of university-level average scores (%) obtained for SDG3		
% SDG3 1	1.37	0.81
% SDG3 2	0.31	0.17
% SDG3 3	0.01	1.97
% SDG3 4	2.26	0.7
TOTAL	3.95	3.65
Quartiles of university-level average scores (%) obtained for SDG4		
% SDG4 1	2.71	2.14
% SDG4 2	0.7	1.26
% SDG4 3	0.48	2.24
% SDG4 4	3.35	1.36
TOTAL	7.24	7
Quartiles of university-level average scores (%) obtained for SDG5		
% SDG5 1	1.13	1
% SDG5 2	0.21	0.69
% SDG5 3	0	0.88
% SDG5 4	2.43	0.58
TOTAL	3.77	3.14
Quartiles of university-level average scores (%) obtained for SDG6		
% SDG6 1	1.09	0.43
% SDG6 2	0.52	0.29
% SDG6 3	0.08	0.96
% SDG6 4	2.29	0.77
TOTAL	3.98	2.45
Quartiles of university-level average scores (%) obtained for SDG7		
% SDG7 1	2.4	2.31
% SDG7 2	0.39	1.7
% SDG7 3	0.17	1.35
% SDG7 4	3.17	0.92
TOTAL	6.13	6.28
Quartiles of university-level average scores (%) obtained for SDG8		
% SDG8 1	3.01	2.13
% SDG8 2	0.52	1.43
% SDG8 3	0.32	2.16
% SDG8 4	3.61	1.56
TOTAL	7.46	7.29

Quartiles of university-level average scores (%) obtained for SDG9		
% SDG9 1	2.73	1.86
% SDG9 2	0.47	0.89
% SDG9 3	0.31	3.05
% SDG9 4	3.26	1.69
TOTAL	6.76	7.5
Quartiles of university-level average scores (%) obtained for SDG10		
% SDG10 1	1.8	1.33
% SDG10 2	0.29	0.12
% SDG10 3	0	2.72
% SDG10 4	3.38	0.65
TOTAL	5.47	4.82
Quartiles of university-level average scores (%) obtained for SDG11		
% SDG11 1	3.04	1.88
% SDG11 2	0.34	0.79
% SDG11 3	0.2	3.09
% SDG11 4	3.79	1.84
TOTAL	7.38	7.59
Quartiles of university-level average scores (%) obtained for SDG12		
% SDG12 1	3.18	2.63
% SDG12 2	0.53	1.52
% SDG12 3	0.57	2.6
% SDG12 4	3.01	1.48
TOTAL	7.29	8.22
Quartiles of university-level average scores (%) obtained for SDG13		
% SDG13 1	2.67	2.43
% SDG13 2	0.64	1.33
% SDG13 3	0.44	2.37
% SDG13 4	3.08	1.48
TOTAL	6.83	7.62
Quartiles of university-level average scores (%) obtained for SDG14		
% SDG14 1	1.58	0.6
% SDG14 2	0.17	0.37
% SDG14 3	0.01	1.59
% SDG14 4	2.72	1.34
TOTAL	4.48	3.91
Quartiles of university-level average scores (%) obtained for SDG15		
% SDG15 1	1.45	0.42
% SDG15 2	0.41	0.05
% SDG15 3	0.03	2.47
% SDG15 4	2.97	1.38
TOTAL	4.86	4.31
Quartiles of university-level average scores (%) obtained for SDG16		
% SDG16 1	2.71	1.64
% SDG16 2	0.5	1.18
% SDG16 3	0.46	1.85
% SDG16 4	2.9	1.47
TOTAL	6.57	6.13
Quartiles of university-level average scores (%) obtained for SDG17		
% SDG17 1	3.5	3.4
% SDG17 2	0.47	2.19
% SDG17 3	0.45	2.73
% SDG17 4	3.59	1.91
TOTAL	8.02	10.24

Appendix B. MCA Results, Plan 1–2

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