An Overview of Research Trends on Sustainability in Higher Education – An exploratory study

Submitted 03-Aug-2022

Revised 07-Oct-2022

Abstract

Purpose: This study aims to investigate the main areas in which researchers are focusing their efforts in terms of sustainability in higher education (curriculum, campus greening, research, governance, or outreach), the format in which this research is performed (in terms of individual or combined efforts) and the primary research focus (in terms of local or global issues).

Design/methodology/approach: Trends on sustainability research were investigated by means of an online survey - the World Survey on Sustainability Publishing and Research in Higher Education (WSSSP-HEI), which was disseminated among members of the European School of Sustainability Science and Research (ESSSR) and the Inter-University Sustainable Development Research Programme (IUSDRP).

Findings: The survey collected responses from 103 researchers across over 40 countries. Three trends emerged: despite the intrinsic value of sustainability research in higher education, this area is not as mature as one could expect; the range of themes covered is wide and address a variety of areas; and individuals working alone is the most common means of doing research, whereas research at the university, department and faculty level, appears to be less common.

Originality: The paper outlines some measures via which higher education institutions may be able to take more advantage of the many opportunities sustainability research offers to them.

Keywords

Sustainability Research; Sustainability in Higher Education; Research on Higher Education; International Study; Opportunities for Sustainability

1. Introduction: Sustainability Research in Higher Education

The acceptance of the Sustainable Development Goals (SDGs) in 2015 (United Nations, 2015), and the worldwide roll-out thereof, emphasize the urgent need to address the challenges associated with the 20th-century environmental crisis (Steffen et al. 2015). It also shows the need to implement transformed future pathways to safeguard the planet´s life-support systems (Griggs et al., 2013). Since higher education institutions (HEIs) are recognised as change agents (Ramos et al., 2015; Franco et al., 2019; Fadeeva and Mochizuki, 2010), their critical role in the journey towards a sustainable future is not contested (Lozano et al., 2015). Various initiatives can be identified through which HEIs are engaging with sustainability, frequently presented in terms of the following main spheres: (1) Discipline-based sustainability research; (2) Teaching and learning for sustainability; (3) Outreach and external operations linked to sustainability; (4) Campus operations, greening and sustainability, and (5) Leadership and governance (Sterling, 2013).

The spectrum of publications on sustainability in higher education is wide, with a scientific inquiry taking different forms and pathways (Beringer and Adomßent, 2008). Although sustainability research has made significant progress, expanding rapidly in the last ten years, diversifying in terms of topics and geographical applications, and deepened concerning theories and methods (Koehler et al., 2019), it remains a challenge in the higher educational context (Hugé et al., 2016). According to Leal Filho et al. (2018a) further steps still need to be taken to reinvigorate sustainability research and promote innovation at HEIs.

Sustainability research in the scope of HEIs offers several opportunities to be explored (Bolger, 2021; Ceulemans and Severijns, 2019). Universities may gain the advantage of achieving greater sustainability, becoming more attractive to students, and better serving their communities as a consequence of research initiatives conducted; it is necessary to reorientate higher education towards sustainability (Wright et al., 2016). The breadth of opportunities for research and the advantages that accrue to some institutions are illustrated in the literature (see, for example, Leal Filho, 2012). However, while the number of publications about sustainability initiatives in universities has increased, with evidence provided of the variety of projects being taken forward to focus on universities as 'Living Labs' for sustainable development (Leal Filho et al., 2019a), there are fewer research endeavours that particularly focus on sustainability research, within the university context (Alam and Lin, 2022; Waas et al., 2010).

The literature evidences, instead, a large array of descriptive research papers about sustainable development in universities (often single-site case studies) but few papers

particularly focus on research for advancing sustainability, within the university context (McMillin and Dyball, 2009). Numerous papers address the critical role that higher education is playing regarding sustainable development, with important challenges and advances being reported around the world (e.g., Reza, 2016; Ugbaja, 2018; Benayas and Blanco-Portela, 2019); others address the specific parts of the agenda such as education for sustainability (Jones et al., 2010; Ryan and Cotton, 2013), campus greening (Leal Filho et al., 2015) or the relevance of leadership (Lozano et al., 2013). However, the majority of HEIs address sustainability issues in a compartmentalised and limited way.

The result is that sustainability education is included only in some courses; most of the time, education is separate from research and often has no connection with institutional operations (Barth and Rieckmann, 2016; Mintz, and Tal, 2018). Empirical and descriptive studies of specific educational and operational approaches dominate the literature whereas the focus on the research dimension is weak (Stephens and Graham, 2010). In sum, theoretical frameworks to enhance sustainability in research need further attention (Wooltorton et al., 2015). There are gaps and therefore opportunities, both to theorise and to develop more rigorous and novel methods of sustainability research (White, 2013).

While it is widely acknowledged that sustainability research in higher education offers important support in demonstrating the academic excellence of HEIs and their societal impacts, there is a paucity of literature that specifically evaluates how this work is being done. This study is therefore dedicated to investigating the main areas in which researchers are focusing their efforts in terms of sustainability in higher education (curriculum, campus greening, research, governance, or outreach), the format in which this research is performed (in terms of individual or combined efforts) and the primary research focus (in terms of local or global issues). In order to address these needs, the European School of Sustainability Science and Research (ESSSR) and the Inter-University Sustainable Development Research Programme (IUSDRP) have undertaken the World Survey on Sustainability Publishing and Research in Higher Education (WSSSP-HEI). This paper focuses on the results of the research section of the WSSSP-HEI and provides an overview of international trends. The survey collected information on the ways sustainability research is perceived and practiced in various countries. The contribution of this paper to the literature is twofold. Firstly, the data provide an overview of the worldwide situation related to sustainability research in higher education, especially in the last five years. Secondly, it outlines some measures through which higher education institutions can take advantage of the many opportunities offered by sustainability research.

2. Methodology

The present research consists of an exploratory study with the goal of providing an overview of trends on sustainability research at universities. It was organised by the ESSSR and IUSDRP using an online survey. Based on the need to collect data on the current status of sustainability research and the relative lack of information on this topic in higher education, the authors developed a set of questions focused on:

a) The perceived activity in research on sustainability in higher education;

b) The areas (university dimensions) and focus (local to global) in which research is being performed;

c) How research is being performed (e.g., individual or team efforts) and the existence of specific research programmes;

d) Expectation in terms of the future development of sustainability research in higher education.

The final survey instrument was also composed of general questions, such as university name, number of students, department/centre/unit, and country.

The questions pertaining to the study were initially pre-tested (Hair et al., 2011) by five professors and researchers working on social and environmental sciences, and with expertise in sustainability in higher education (Leal Filho et al., 2021b). These colleagues received the initial version of the questionnaire for checking all questions, submitting their responses, and providing comments on the comprehensiveness of the survey. Their insights were helpful to revise the wording of questions and response options. Table 1 presents the final list of questions that were part of the survey.

Table 1. Survey questions

Question	Categories
Age group	a) 18-25 b) 26-35 c) 36-45 d) 46-59 e) 60+
Gender	a) Male b) Female
Respondent background	a) Education b) Social Sciences in general (including politics, economics, arts, and languages) c) Natural Sciences d) Engineering & Technology e) other, which:
How active is your team/organisation in respect to research on sustainability in higher education?	a) Very active b) Quite active

	c) Moderately active d) Little active
In which areas of this topic do you perform your research? (multiple answers possible)	a) Curriculum b) Campus greening c) Research d) Governance e) Outreach f) Other, which:
How is the research work performed?	a) Via my individual efforts b) As part of a research Centre at the Department level c) As part of a research Centre at the Faculty level d) As part of a research Centre at the University level e) Other, which:
What is your primary research focus? (multiple answers possible)	a) Local/regional issues b) National issues c) International issues d) Global issues (e.g. the SDGs) e) Other, which:
Does the organisation pursue a specific research programme focusing on the SDGs?	a) Yes b) No
How would you expect your research on sustainability in higher education to develop in the coming years?	a) It is likely to increase b) It is likely to remain at the same level c) It is likely to decrease

The online survey was disseminated via Google Forms and shared with institutions members of IUSDRP and ESSSR. IUSDRP has approximately 140 members distributed over 50 countries around the world (https://www.haw-hamburg.de/en/ftz-nk/programmes/iusdrp/), and ESSSR has 65 members across 22 European countries (https://esssr.eu/members/) (some of HEIs are members of both networks). The participants that receive the communications are representatives of administrative sectors or researchers/professors with involvement in sustainability-related issues at their HEIs. Simple descriptive statistics were used to summarise and discuss the collected data (Leal Filho et al., 2021b).

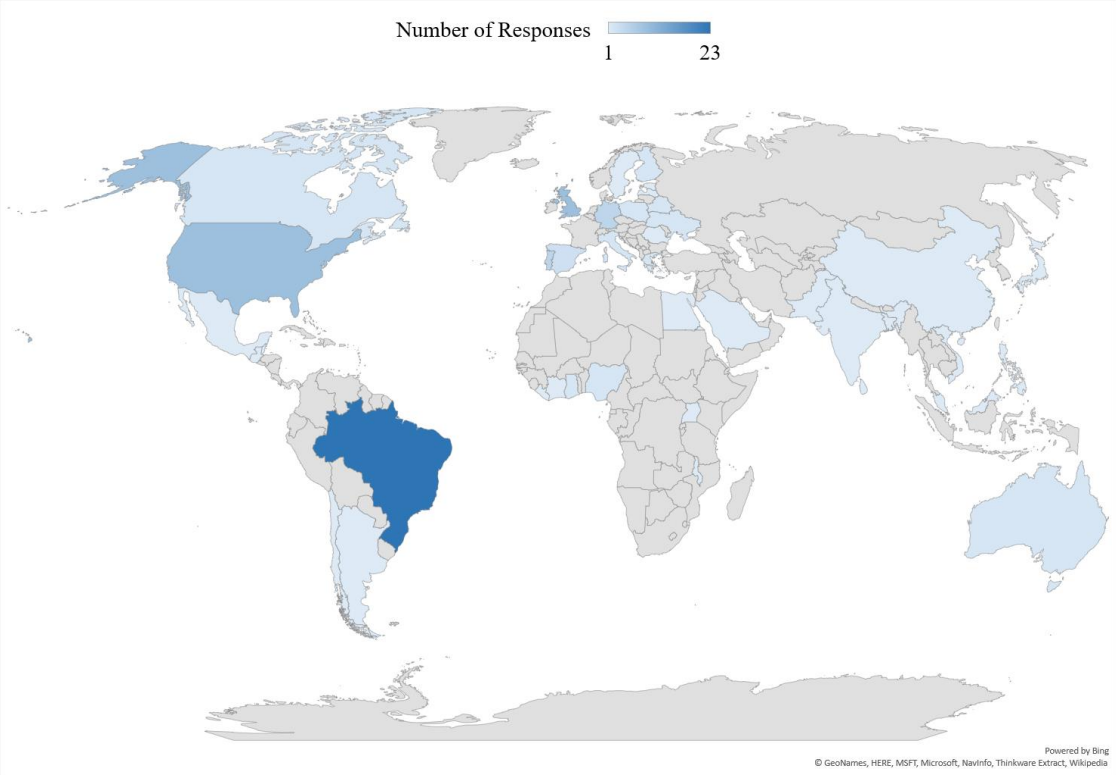
3. Results

The survey collected a sample of 103 responses from 43 countries, as indicated in Figure 1. The country with the highest participation rate was Brazil (with 23 respondents), followed by the UK and USA, each with 9 respondents.

Most respondents (66%) are between the age groups 36-59 years old, and the sample is quite balanced in terms of gender. The majority of the survey participants are from the Social Sciences (42%), and Engineering & Technology (24%). In addition to these areas, other backgrounds added by the respondents include Sustainability, Law, Architecture, and

Multidisciplinary/Interdisciplinary areas, among others. These results are summarised in Table 2.

Figure 1. Countries and frequency of respondents



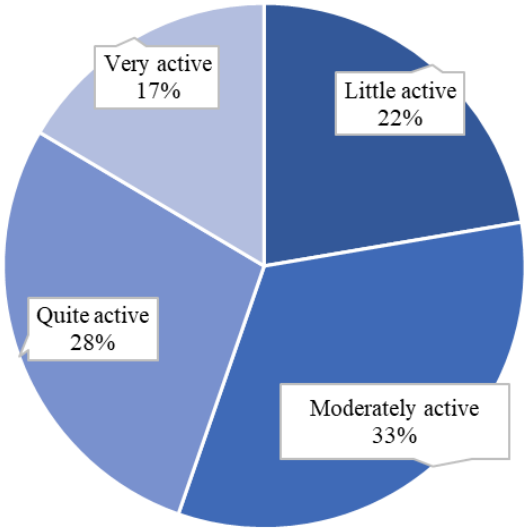
Note: List of participant countries – Argentina, Australia, Bahamas, Bangladesh, Belarus, Belize, Brazil, Canada, Chile, China, Cote d'Ivoire, Egypt, Estonia, Finland, Germany, Ghana, Greece, Guatemala, Hong Kong, India, Italy, Japan, Latvia, Liberia, Malawi, Malaysia, Malta, Mexico, Nigeria, Pakistan, Philippines, Poland, Portugal, Romania, Saudi Arabia, Spain, Sri Lanka, Sweden, Uganda, UK, Ukraine, USA, Vietnam.

Age group	**% of respondents**
18-25	4%
26-35	18%
36-45	29%
46-59	37%
60+	12%
Gender	**% of respondents**
Female	51%
Male	46%
Not informed	3%
Background	**% of respondents**
Social Sciences	42%
Engineering & Technology	24%
Education	9%
Natural Sciences	8%
Others	17%

Table 2. Sample demographic details (N=103)

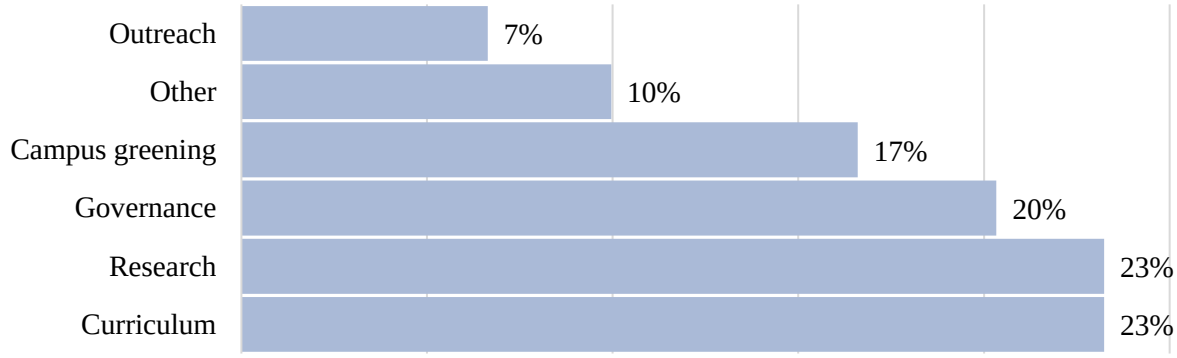
In terms of having a team active in sustainability research in higher education, the sample responses are quite well divided. As indicated in Figure 2, just more than half of the respondents (55%) indicated that their teams or organisations are a little active or moderately active; the other fraction (45%) is considered more active, with 17% of respondents indicating to be very active.

Figure 2. Team activity in sustainability research



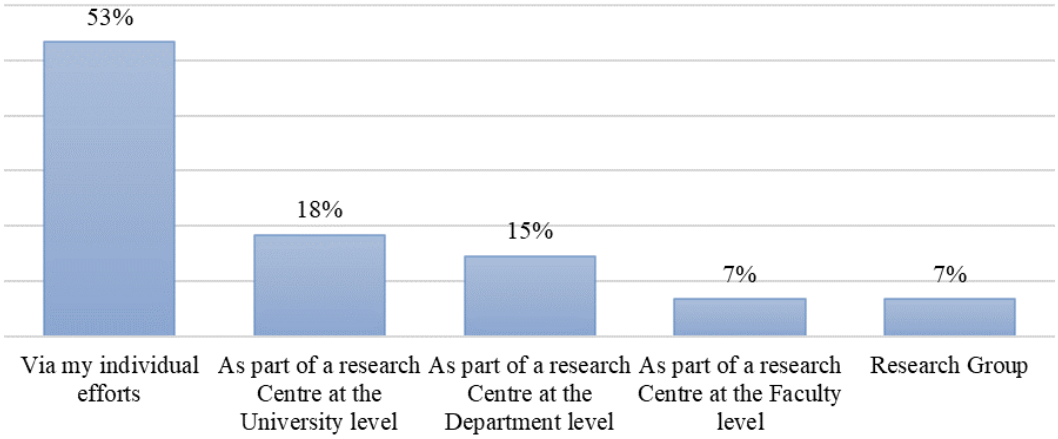
Among the five indicated topics of research, the most researched topics are curriculum and research, each with 23%, as indicated in Figure 3. The second topic most researched is governance (20%), followed by campus greening (17%), outreach (7%), and other topics (10%). These other topics include sustainability issues in general (environmental sustainability, alternative energy, green and sustainable retailers, sustainable performance and improvements in universities), behaviour (behaviour change, consumer behaviour), learning process (competencies, sustainable human development, indoor environmental in learning institutions, teaching practice, academic research, discourse, students, knowledge-based area development, cultural studies, philosophy, environmental humanities) and administration issues (social innovation/entrepreneurship, assessment, system innovation towards sustainable development and management).

Figure 3. Research topics



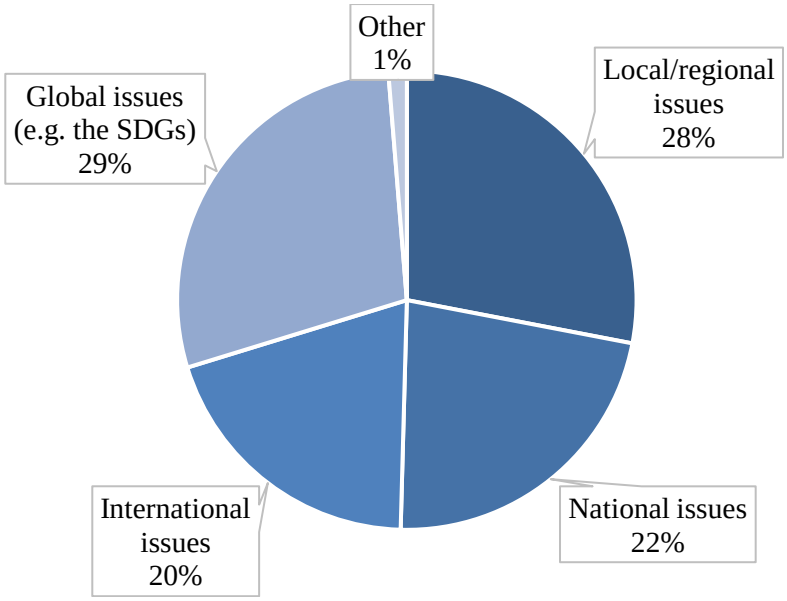
According to the sample, the research work performance is mainly attributed to individual efforts (53%), as indicated in Figure 4. Other responses indicate performance associated with university level (18%), department level (15%), faculty level (7%), and research group (7%).

Figure 4. Research work performance



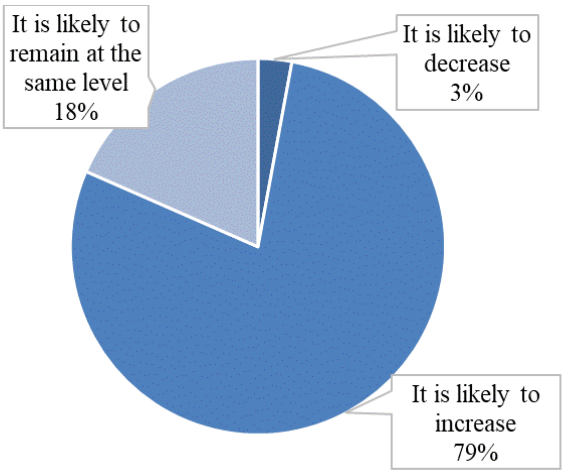
The two main research foci (Figure 5) are local/regional issues and global issues (e.g. the SDGs), resulting in 57% of the sample selections. National issues and international issues combined result in 42% of the responses. Other issues researched are aging society (n=1), rural entrepreneurship (n=1), actor-centred analysis of the incentives/impediments with regard to behavioural change (n=1), and sectoral studies (n=1).

Figure 5. Research focus



When asked if the organization they work at pursues a specific research programme focusing on the SDGs, 52% of the respondents indicated that their organizations do have such a programme. Also, a substantial portion of the respondents (79%) indicated they expect sustainability research in higher education to increase in the future (Figure 6), whereas 18% expect it to remain at the same level, and only 3% believe it will decrease.

Figure 6. Development of future sustainability research in higher education



4. Discussion

The results indicate that research on sustainability in higher education is focusing much more on curricula, research, and governance-related issues rather than on outreach. According to Adomssent et al. (2014), measuring learning outcomes, reporting on different contexts, and

understanding organisational change are among the areas with special importance for the future of sustainability research in higher education. Leal Filho et al. (2019b) also showed the relevance of curriculum changes about sustainable development. Indeed, these authors highlight that these changes as well as their planning are important and need to be performed in various courses. The theme "governance", in turn, focuses on the management of HEIs. The main role of governance in this context is not contested. There are authors (e.g. Vargas et al., 2019) that argue for the relevance of governance to ensure that sustainability is embedded in higher education. In other studies, however, (e.g. Singh and Segatto, 2020), governance is pointed out as a barrier to the implementation of methodologies towards sustainability teaching. This kind of debate shows the need to increase studies on this theme, to cater for a better understanding of its context and related aspects.

The major focus of sustainability initiatives in HEIs tend to concentrate on "on-campus" actions, therefore risk jeopardizing the attention given to outreach (Shawe et al., 2019), which reflects also in research studies in diverse areas (Salvia and Brandli, 2020; Salvia et al., 2020). Additionally, even within the area of sustainability curricula implementation, there is an imbalanced availability of case studies around the world (Weiss and Barth, 2019), representing an opportunity for further investigations and the need for more attention to regions such as Latin America and Africa.

The format in which the research is performed also allows for some important considerations. The fact that the performance is mostly associated with individual efforts might be associated with the general challenges for the implementation of sustainability in higher education. Studies commonly report the impacts of lack of support from administrations and lack of interest from colleagues as challenges for sustainability in higher education (Leal Filho et al., 2019c), suggesting that individual efforts are continuing to develop the research agenda despite the challenges associated with them. For Blanco-Portela et al. (2017), individual behaviour and lack of interdisciplinary are also challenges for sustainability, which may hinder efforts for research in this area.

On the other hand, the research focus had balanced results – between local, national international, and global issues, which imply in a more positive finding of this study. Both approaches are interesting for giving general overviews or proposing trends on a topic when global analyses are concerned (Salvia et al., 2019), and for contributing to local communities (Leal Filho et al., 2019d), for example, when the university's role in sustainability is applied to local issues. A positive example of such initiatives is the Jeffrey Sachs Center on Sustainable

Development established at Sunway University (Malaysia) to promote the SDGs and pursue research and outreach activities (Woo et al., 2020).

Since many studies have been focusing on sustainability in higher education from many varied perspectives, there seems to be indeed a tendency for an increase in research in the coming years, especially considering some works that indicate how to overcome challenges and increase the impact of sustainability research (McManners, 2019; Rau et al., 2018). On the other hand, a better perspective could be expected if more efforts were seen in improving the work performance of researchers using the development of integrated research centres. Participation in sustainability networks is also a key strategy to leverage the potential of researching and publishing on sustainability (Leal Filho et al., 2021b).

Although exploratory in nature, the present study allows the establishment of several insights. Despite the growing importance of sustainability in international research (Borges et al., 2018; Koehler et al., 2019), its insertion in a higher education context remains under-explored (Hugé et al., 2016). Regardless of this fact, it is possible to observe that researchers believe in the expansion of knowledge in this subject area, although most of their organizations are not in pursuit of a specific research programme focusing on the SDGs. This may explain why most of the respondents indicate that their research performance is due to their individual efforts. The lack of support from top management at universities is also pointed out in the literature as a barrier faced for including sustainability, especially in areas such as engineering education (Holgaard et al., 2016; Rampasso et al., 2018; Sivapalan et al., 2016).

Finally, developing a strong theoretical underpinning for the research agenda is an important opportunity to further strengthen this research field. The advantages of sustainability research extend far beyond those that accrue to the individual researcher through publication, funding, and attracting further doctoral students. The outcomes could have a positive impact on institutional performance, the student experience, the sector more widely, and society in general.

The benefits of sustainability research in higher education, as highlighted earlier in this paper are quite clear. Indeed, sustainability research may be a cornerstone of future developments. If properly supported, it may not only lead to new knowledge and new insights but may also lead to transformative approaches which may help to implement the principles of sustainability into practice.

The study has indirectly revealed various, further opportunities for research. For instance, research on how best to integrate sustainable development within interdisciplinary

studies, or on how to address the gaps between teaching practices and learning outcomes. Further areas may be research on the role of partnerships, the contribution of project-based learning, or on evaluation of students´ engagement, among others.

It is also noted that further research is needed to foster a greater understanding of the theory and practice of sustainable development, and how these may be mutually complementary. The data gathered through this survey suggests that much of the research is largely reliant on individuals. There is thus a need to identify mechanisms that may help to scale up individual efforts, through the establishment of research teams, both within departments and across a given institution. Indeed, adequate support and the provision of funding may continuously support sustainability research, making it more central to an organisation, rather than being treated as an isolated item.

This work has some limitations. Firstly, reaching a greater number of participants in the online survey would have added an additional robustness to the study, especially since it could have allowed a broader diversity in respect of perspectives. Participation from administrators -and not only from academic staff- would have provided an additional understanding of their positions and opinions on how research is supported. However, the usual difficulties in engaging participants in similar studies were also observed here. Whereas there is no such a thing as an ideal sample size, the fact that 103 participants from universities in 43 countries were involved, and bearing in mind the sample entailed representatives from industrialised and developing countries means that it caters to a rough profile that shows the extent to which sustainability research is perceived. It thus provides a welcome addition to the literature on sustainability research, providing a current snapshot of the status quo.

5. Conclusions

This study has revealed several trends based on the studied sample and authors' inferences on the topic:

Trend 1: it seems that the emphasis given to sustainability research is not as strong as one could expect. The fact that many respondents indicated that their teams or organisations are little or moderately active with respect to sustainability research in higher education, means that there is much room for improvement. This finding indicates that those who are active realise the many benefits that sustainability research brings about albeit that progress is down to individual efforts.

Trend 2: as far as the thematic focus is concerned, it is encouraging to note that the range of themes covered (from curriculum to governance, campus greening, and outreach, among others) is wide and addresses a variety of areas.

Trend 3: in respect of the modalities of research performed, it has become clear that individuals working alone are the most common means of doing research, whereas research at the university, department, and faculty level, appears to be less common. Research in groups accounts for less than 10% of the total.

Based on a review of the findings, a cross-check with the previous literature, and the opinion of the authors based on their experiences in various countries, there are some measures that may be adopted in the future, to allow a greater emphasis on sustainability research by higher education institutions, the following may be mentioned:

- Measure 1- a balanced focus on applied sustainability research, as opposed to attention to only basic aspects;
- Measure 2- institutionalising efforts to support research initiatives, by providing funding and other non-cash incentives for research;
- Measure 3- greater links between sustainability research and teaching, to allow the latter to also benefit from the former;
- Measure 4- stronger emphasis on the Sustainable Development Goals (SDGs) as themes, or as subjects to research. By ensuring research is geared towards the attainment of the SDG Targets, its social relevance can be increased.

In some cases, it may be helpful if university leadership was engaged in fostering the capability of staff in their organisations, to perform research using internal grants, provision of additional time allowance, or access to training on how to write research proposals. There is a paucity of training initiatives that may equip university staff to perform sustainability research, so support in this area could lead to substantial benefits

In respect of the implications for theory and practice, this study shows that there are some discrepancies between the discourse on sustainability research and practice. Whereas some may believe that sustainability research in higher education is well developed, the reality is that it still struggles to handle problems that were identified many years ago. Despite this, some interesting evidence were drawn from the sample. For instance, it shows that whereas some higher education institutions are indeed adding a greater emphasis on sustainability research, this is not a uniform trend. Despite the perceived value of and advantages associated with sustainability research, some organisations still do not regard it as a priority. Also,

engaging research teams in research efforts need a continuous and coordinated effort since "ad hoc" research does not usually have the same impact as a systematic approach to conducting studies.

This study demonstrates that a greater understanding of research processes is still necessary since not all universities seem to fully appreciate the value of sustainability research. Yet, this understanding and appreciation is a pre-condition that, if fulfilled, may lead to an increase -both qualitatively and quantitatively- in the number of studies at a given university. Also, whereas the complexity inherent to sustainability research makes the execution of research projects a rather complex task, the robustness of studies means that they may guide and support the implementation of policies. Moreover, working together in research teams offers a good opportunity for collaboration among national and international partners, leading to greater robustness of the work performed.

There are many opportunities for research in the context of thematic analysis of the literature, specific studies on evaluation methods, or how to mobilise stakeholders from within universities, to engage in integrated sustainability efforts. Future investigations can also collect qualitative data to complement this study and provide further insights into how sustainability research would develop in the coming years in higher education and which SDGs are being addressed. If duly supported, sustainability research can support transformation, leading to a co-creation of knowledge that can help to address current problems and better understand future trends.

Acknowledgements

This paper is part of the "100 papers to accelerate the implementation of the UN Sustainable Development Goals" initiative.

References

Adomssent, M., Fischer, D., Godemann, J., Herzig, C., Otte, I., Rieckmann, M., and Timm, J. (2014). 'Emerging areas in research on higher education for sustainable development–management education, sustainable consumption and perspectives from Central and Eastern Europe'. *Journal of Cleaner Production*, Vol. 62, pp. 1-7. https://doi.org/10.1016/j.jclepro.2013.09.045

Alam, M., and Lin, F. R. (2022). "Internalizing Sustainability into Research Practices of Higher Education Institutions: Case of a Research University in Taiwan." *Sustainability*, Vol. 14 No. 15, pp. 9793.

Barth, M. and Rieckmann, M. (2016). State of the art in research on higher education for sustainable development. In Barth, M., Michelsen, G., Rieckmann, M. and Thomas, I. (Eds), *Routledge Handbook of Higher Education for Sustainable Development*, Routledge, London, pp.100-113.

Beringer, A., and Adomßent, M. (2008). 'Sustainable university research and development: inspecting sustainability in higher education research. *Environmental Education Research,* Vol. 14 No. 6, pp. 607-623. https://doi.org/10.1080/13504620802464866

Benayas, J., and Blanco-Portela, N. (2019). Evolution of the actions of Latin American universities to move toward sustainability and SDGs. In: Azeiteiro, U.M.D.M., Davim, J.P. (Eds.), Higher Education and Sustainability: Opportunities and Challenges for Achieving Sustainable Development Goals. CRC Press. https://doi.org/10.1201/b22452

Blanco-Portela, N., Benayas, J., Pertierra, L. R., and Lozano, R. (2017). 'Towards the integration of sustainability in higher education institutions: a review of drivers of and barriers to organisational change and their comparison against those found of companies'. *Journal of Cleaner Production, Vol. 166*, pp. 563-578. https://doi.org/10.1016/j.jclepro.2017.07.252

Bolger, P. (2021), "Delivering on the promise: how are sustainability research institutes enabling interdisciplinary research?", *International Journal of Sustainability in Higher Education*, Vol. 22 No. 8, pp. 167-189. https://doi.org/10.1108/IJSHE-10-2020-0415

Ceulemans, G. and Severijns, N. (2019), "Challenges and benefits of student sustainability research projects in view of education for sustainability", *International Journal of Sustainability in Higher Education*, Vol. 20 No. 3, pp. 482-499. https://doi.org/10.1108/IJSHE-02-2019-0051

Borges, M. L., Anholon, R., Cooper Ordoñez, R. E., Quelhas, O. L. G., Santa-Eulalia, L. A., and Leal Filho, W. (2018). 'Corporate Social Responsibility (CSR) practices developed by Brazilian companies: an exploratory study'. *International Journal of Sustainable Development & World Ecology, Vol. 25 No.* 6, pp. 509-517. https://doi.org/10.1080/13504509.2017.1416700

Fadeeva, Z., and Mochizuki, Y. (2010). 'Higher education for today and tomorrow: university appraisal for diversity, innovation and change towards sustainable development'. Sustainability Science, Vol. 5 No. 2, pp. 249-256. https://doi.org/10.1007/s11625-010-0106-0

Franco, I, Saito, O., Vaughter, P., Whereat, J, Kanie, N. and Takemoto, K. (2019). 'Higher education for sustainable development: actioning the global goals in policy, curriculum and practice'. Sustainability Science, Vol. 14, pp. 1621-1642. https://doi.org/10.1007/s11625-018-0628-4

Griggs, D., Stafford-Smith, M., Gaffney, O., Rockstrom, J., Ohman, M.C., Shyamsundar, P., Stffen, W., Glaser, G., Kanie, N. and Noble, I. (2013). 'Sustainable development goals for people and planet', *Nature,* Vol. *495*, pp. 305-307.

Hair, J., Celsi, M. W., Money, A. H., Samouel, P., and Page, M. J. (2011). *Essentials of business research methods* (2nd ed.). M.E. Sharpe.

Holgaard, J. E., Hadgraft, R., Kolmos, A., and Guerra, A. (2016). 'Strategies for education for sustainable development–Danish and Australian perspectives'. *Journal of Cleaner Production, Vol. 112*, pp. 3479-3491. https://doi.org/10.1016/j.jclepro.2015.09.063

Hugé, J., Block, T., Waas, T., Wright, T., and Dahdouh-Guebas, F. (2016). 'How to walk the talk? Developing actions for sustainability in academic research'. *Journal of Cleaner Production, Vol. 137*, pp. 83-92. https://doi.org/10.1016/j.jclepro.2016.07.010.

Jones, P., Selby, D. and Sterling, S. (2010). Sustainability Education: Perspectives and Practice across Higher Education. Earthscan: London & New York.

Koehler, J., Geels, F. W., Kern, F., Markard, J., Onsongo, E., Wieczorek, A., ... and Fünfschilling, L. (2019). 'An agenda for sustainability transitions research: State of the art and future directions'. *Environmental Innovation and Societal Transitions, Vol. 31*, pp. 1-32. https://doi.org/10.1016/j.eist.2019.01.004.

Leal Filho, W. (2012). Sustainable Development at Universities: New Horizons. Umweltbildung, Umweltkommunikation und Nachhaltigkeit/Environmental Education, Communication and Sustainability. Volume 34. Peter Lang, Frankfurt.

Leal Filho, W., Azeiteiro, U., Alves, F., Pace, P., Mifsud, M., Brandli, L., Caeiro, S. and Disterheft, A. (2018a). 'Reinvigorating the sustainable development research agenda: the role of the sustainable development goals (SDGs)'. *International Journal of Sustainable Development & World Ecology, Vol. 25 No.* 2, pp. 131-142. https://doi.org/10.1080/13504509.2017.1342103.

Leal Filho, W., Salvia, A., Pretorius, R.W., Brandli, L., Manolas, E., Alves, F., Azeiteiro,U., Rogers J., Shiel, C., Paco, A. (Eds.). (2019a). Universities as Living Labs for Sustainable Development:

Supporting the Implementation of the Sustainable Development Goals. Word Sustainability Series. Springer International Publishing.

Leal Filho, W., Shiel, C., do Paço, A., and Brandli, L. (2015b). Putting sustainable development in practice: campus greening as a tool for institutional sustainability efforts. In *Sustainability in Higher Education* (pp. 1-19). Chandos Publishing. https://doi.org/10.1016/B978-0-08-100367-1.00001-9.

Leal Filho, W., Skanavis, C., Kounani, A., Brandli, L. L., Shiel, C., do Paço, A., ... and Salvia, A. L. (2019b). 'The role of planning in implementing sustainable development in a higher education context'. *Journal of Cleaner Production, Vol. 235*, pp. 678-687. https://doi.org/10.1016/j.jclepro.2019.06.322

Leal Filho, W., Vargas, V. R., Salvia, A. L., Brandli, L. L., Pallant, E., Klavins, M., ... and Ayanore, M. A. (2019d). 'The role of higher education institutions in sustainability initiatives at the local level'. *Journal of Cleaner Production, Vol. 233*, pp. 1004-1015. https://doi.org/10.1016/j.jclepro.2019.06.059

Leal Filho, W., Wall, T., Salvia, A. L., Frankenberger, F., Hindley, A., Mifsud, M., Brandli, L., and Will, M. (2021b). 'Trends in scientific publishing on sustainability in higher education'. *Journal of Cleaner Production,* Vol. 296, pp. 126569. https://doi.org/https://doi.org/10.1016/j.jclepro.2021.126569

Leal Filho, W., Will, M., Salvia, A. L., Adomssent, M., Grahl, A., and Spira, F. (2019c). 'The role of green and Sustainability Offices in fostering sustainability efforts at higher education institutions'. *Journal of Cleaner Production, Vol. 232*, pp. 1394-1401. https://doi.org/10.1016/j.jclepro.2019.05.273.

Lozano, R., Ceulemans, K., Alonso-Almeida, M., Huisingh, D., Lozano, F. J., Waas, T., ... and Hugé, J. (2015). 'A review of commitment and implementation of sustainable development in higher education: results from a worldwide survey'. *Journal of Cleaner Production, Vol. 108*, pp. 1-18. https://doi.org/10.1016/j.jclepro.2014.09.048.

Lozano, R., Lukman, R., Lozano, F.J., Huisingh, D., Lambrechts, W. (2013). Declarations for sustainability in higher education: becoming better leaders, through addressing the university system. *Journal of Cleaner Production*, Vol. 48, pp. 10-19. https://doi.org/10.1016/j.jclepro.2011.10.006.

McManners, P. J. (2019). 'Increasing the impact of sustainability research—A new methodology'. *Journal of Sustainability Research, Vol. 1 No.* 1. https://doi.org/10.20900/jsr20190008.

McMillin, J., and Dyball, R. (2009). 'Developing a whole-of-university approach to educating for sustainability: Linking curriculum, research and sustainable campus operations'. *Journal of Education for Sustainable Development, Vol. 3* No. 1, pp. 55-64. https://doi.org/10.1177/097340820900300113.

Mintz, K., and Tal, T. (2018). 'The place of content and pedagogy in shaping sustainability learning outcomes in higher education'. *Environmental Education Research, Vol. 24 No.* 2, pp. 207-229. https://doi.org/10.1080/13504622.2016.1204986.

Ramos, T. B., Caeiro, S., Van Hoof, B., Lozano, R., Huisingh, D., and Ceulemans, K. (2015). 'Experiences from the implementation of sustainable development in higher education institutions: Environmental Management for Sustainable Universities'. *Journal of Cleaner Production, Vol. 106*, pp. 3-10. https://doi.org/10.1016/j.jclepro.2015.05.110.

Rampasso, I. S., Anholon, R., Silva, D., Ordoñez, R. C., Quelhas, O. L. G., Leal Filho, W., and Santa-Eulália, L. A. (2018). 'An analysis of the difficulties associated to sustainability insertion in engineering education: Examples from HEIs in Brazil'. *Journal of Cleaner Production, Vol. 193*, pp. 363-371. https://doi.org/10.1016/j.jclepro.2018.05.079.

Rau, H., Goggins, G., and Fahy, F. (2018). 'From invisibility to impact: Recognising the scientific and societal relevance of interdisciplinary sustainability research'. *Research Policy, Vol. 47 No.* 1, pp. 266-276. https://doi.org/10.1016/j.respol.2017.11.005

Reza, M.I.H. (2016). "Sustainability in higher education: Perspectives of Malaysian higher education system." *Sage Open,* Vol. 6 No. 3, p.2158244016665890. https://doi.org/10.1177/2158244016665890

Ryan, A. and Cotton, D. (2013) Times of change: shifting pedagogy and curricula for future sustainability. In Sterling, S, Maxey, L. and Luna, H. (Eds) The Sustainable University: Progress and prospects, London & New York: Routledge/Earthscan, pp 151-168.

Salvia, A. L., and Brandli, L. L. (2020). Energy sustainability at universities and its contribution to SDG 7: a systematic literature review. In *Universities as Living Labs for Sustainable Development* (pp. 29-45). Springer, Cham.

Salvia, A. L., Leal Filho, W., Brandli, L. L., and Griebeler, J. S. (2019). 'Assessing research trends related to Sustainable Development Goals: Local and global issues'. *Journal of Cleaner Production, Vol. 208*, pp. 841-849. https://doi.org/10.1016/j.jclepro.2018.09.242.

Salvia, A. L., Londero Brandli, L., Leal Filho, W., Gasparetto Rebelatto, B. and Reginatto, G. (2020), "Energy sustainability in teaching and outreach initiatives and the contribution to the 2030 Agenda", International Journal of Sustainability in Higher Education, Vol. 21 No. 7, pp. 1607-1624. https://doi.org/10.1108/IJSHE-05-2020-0180

Shawe, R., Horan, W., Moles, R., and O'Regan, B. (2019). 'Mapping of sustainability policies and initiatives in higher education institutes'. *Environmental Science & Policy, Vol. 99*, pp. 80-88. https://doi.org/10.1016/j.envsci.2019.04.015.

Singh, A. S., and Segatto, A. P. (2020). 'Challenges for education for sustainability in business courses'. *International Journal of Sustainability in Higher Education, Vol. 21 No.* 2, pp. 264-280. https://doi.org/10.1108/IJSHE-07-2019-0238

Sivapalan, S., Clifford, M. J., and Speight, S. (2016). 'Engineering education for sustainable development: using online learning to support the new paradigms'. *Australasian Journal of Engineering Education, Vol. 21 No.* 2, pp. 61-73. https://doi.org/10.1080/22054952.2017.1307592

Steffen, W., Richardson, K., Rockström, J., Cornell, S. E., Fetzer, I., Bennett, E. M., ... and Folke, C. (2015). 'Planetary boundaries: Guiding human development on a changing planet'. *Science*, Vol. 347, No. 6223, pp. 1259855. https://doi.org/10.1126/science.1259855

Stephens, J. C., and Graham, A. C. (2010). 'Toward an empirical research agenda for sustainability in higher education: exploring the transition management framework'. *Journal of Cleaner Production, Vol. 18 No.* 7, pp. 611-618. https://doi.org/10.1016/j.jclepro.2009.07.009.

Sterling, S. (2013). The sustainable university: Challenge and response. In Sterling, S., Maxey, L. and Luna, H. (Eds) The Sustainable University: Progress and Prospects, Earthscan from Routledge: Oxon & New York, pp. 17-50. https://doi.org/10.1177/0973408214526494

Sterling, S., Maxey, L. and Luna, H. (2013) The Sustainable University: Progress and Prospects. Routledge: Oxon & New York. https://doi.org/10.1177/0973408214526494

Ugbaja, S. C. (2018). "Management practices towards the incorporation of sustainability in African universities." *European Journal of Business and Management*, Vol. 10 No. 8, pp. 92-107.

United Nations (2015), *Transforming Our World: the 2030 Agenda for Sustainable Development*, Resolution Adopted by the General Assembly on 25 September 2015, A/RES/70/1, United Nations, New York. Available at: https://sustainabledevelopment.un.org/content/documents/21252030%20Agenda%20for%20Sustainable%20Development%20web.pdf. Last accessed: May 9th, 2020.

Vargas, V. R., Lawthom, R., Prowse, A., Randles, S., and Tzoulas, K. (2019). 'Sustainable development stakeholder networks for organisational change in higher education institutions: A case study from the UK'. *Journal of Cleaner Production, Vol. 208*, pp. 470-478. https://doi.org/10.1016/j.jclepro.2018.10.078

Waas, T., Verbruggen, A., Wright, T. (2010). University research for sustainable development: definition and characteristics explored. *Journal of Cleaner Production, Vol. 18, No. 7*, pp. 629-636. https://doi.org/10.1016/j.jclepro.2009.09.017

Weiss, M. and Barth, M. (2019), "Global research landscape of sustainability curricula implementation in higher education", International Journal of Sustainability in Higher Education, Vol. 20 No. 4, pp. 570-589. https://doi.org/10.1108/IJSHE-10-2018-0190

White, R. M. (2013). Sustainability Research: a novel mode of knowledge generation to explore alternative ways for people and planet. In Sterling et al (Eds) *The Sustainable University: Progress and prospects*. London: Earthscan from Routledge: Abingdon.

Woo, W. T., Koh, H. L., and Teh, S. Y. (2020). Achieving Excellence in Sustainable Development Goals in Sunway University Malaysia. In *Universities as Living Labs for Sustainable Development* (pp. 265-282). Springer, Cham.

Wooltorton, S., Wilkinson, A., Horwitz, P., Bahn, S., Redmond, J., and Dooley, J. (2015). 'Sustainability and action research in universities'. *International Journal of Sustainability in Higher Education, Vol. 16 No.* 4, pp. 424-439. https://doi.org/10.1108/IJSHE-09-2013-0111

Wright, T., Waas, T., Hugé, J. (2016). Sustainable higher education. The why and how of (re)orienting higher education towards sustainability. In https://www.handbook-internationalisation.com/de/handbuch/gliederung/?articleID=359#/Beitragsdetaiansicht/190/359/Sustainable-higher-education---The-why-and-how-of-(re)orienting-higher-education-towards-sustainability. Accessed 02/07/2021.