


Research

Fostering students' participation in the implementation of the sustainable development goals at higher education institutions

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Received: 13 November 2023 / Accepted: 26 February 2024

Published online: 04 March 2024

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Abstract

Students are central actors at Higher Education Institutions (HEIs). Whereas much can be achieved by the active participation of students in sustainability affairs, it is unclear what is the current level of students' knowledge and engagement regarding the United Nations (UN) Sustainable Development Goals (SDGs) around the world, as well as which initiatives are being undertaken by HEIs on this matter. In order to address this research gap, this study investigated the current status of students' knowledge and participation in initiatives aimed at the implementation of the UN SDGs. A comprehensive research methodology was carried out by means of a bibliometric analysis, case studies, and a survey involving a sample of 602 students from 53 countries. For the bibliometric analysis, data were analysed with the support of the VOSviewer software, while quantitative data analysis was performed with the support of IBM SPSS Statistics. The study shows that the participation of students in SDGs activities is associated with the commitment level of the HEIs to the implementation of the SDGs. In addition, the fact that students have taken a course or have a discipline related to the SDGs, plays a significant role in the SDGs implementation process. Moreover, the findings reveal that graduate students are more familiar with the SDGs than their undergraduate peers. The analysed HEIs case studies also demonstrate the commitment to sustainable development (SD) through different initiatives being pursued at different levels and scopes. Based on the results, the study provides recommendations on a set of specific measures that may be implemented to increase HEIs students' interest and engagement in SD.

Keywords Sustainable Development Goals (SDGs) · Higher Education Institutions (HEIs) · Students · Survey · Bibliometric analysis · Case studies

Supplementary Information The online version contains supplementary material available at <https://doi.org/10.1007/s43621-024-00204-7>.

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1 Introduction

Sustainable development (SD) has evolved significantly throughout the last four decades. Whereas the early conceptions of SD in the 1980s focused on the economy, society, and environment, they have now been expanded with provisions to encourage and guide governments and institutions around the world to achieve sustainability [1]. The 17 United Nations (UN) Sustainable Development Goals (SDGs) that were introduced in 2015 as part of the 2030 Agenda for SD, represent globally the sustainability objectives of “unprecedented scope and significance” [2]. Never before have countries accepted such an encompassing sustainability framework on a global scale. As such, the SDGs and the 169 targets aim to stimulate sustainability action and complete what the Millennium Development Goals did not achieve [2]. Among these, SDG 4, entitled Quality Education, aims to “ensure inclusive and equitable quality education and promote lifelong learning opportunities for all” [3]. The SDGs, therefore, target all educational levels to instil a culture of sustainability among learners and explicitly mention the importance of Education for Sustainable Development (ESD) in target 4.7.

Schools and universities are among the institutions that should be at the forefront of integrating the SDGs in their teaching, research, campus operations, and outreach. This claim is substantiated by well-developed approaches that have been enacted through efforts of educational institutions such as Higher Education Institutions (HEIs) [4]. Therefore, HEIs play a pivotal role in shaping the skills, resilience, and values of future leaders in SD [5]. Some authors [6] argued that to prepare the new generation of professionals, a systemic approach to education reform is necessary. Making education for sustainability transformative and ubiquitous in curricula would equip learners with the necessary skills to cope with the challenges and uncertainties of the Anthropocene. Students’ empowerment through service learning was recommended in an evaluation study at the University of Catalunya, Spain, where the authors assessed to what extent the principles of SD were employed in curricula [7].

However, new trends in ESD also emphasise multidisciplinary study programmes, by using a well-adjusted mixture of courses across the curriculum, aimed at optimising learners’ experience through a multitude of strategies that should be framed within an eco-centric curriculum model [8, 9]. A multidisciplinary education for spurring SD has also been advocated by others [10], together with a visual scheme for engaging faculty in strategic planning and policymaking at HEIs [11]. Nonetheless, students remain the keystone resource at universities because although transient, most are knowledgeable about current crises and the consequences of inaction looming over their own future if the SDGs are not implemented. Several among those students have become passionate activists catalysing many other social groups to rally in support of a plethora of causes that affect the multifaceted dimensions of SD: from climate justice to gender issues, inequalities, food security, pollution and more [7]. Therefore, engagement and activism could be explained also as students’ passion for ‘wanting to make a difference’ in the world, while seeking community and institutional belonging from universities. These can demonstrate being supportive of students’ dreams and hopes by cherishing their participation and fostering inclusivity for all their students, starting from their first semester. When a university campus is conceived as a living laboratory, its open space will offer distinctive learning opportunities that increase personal wellness, a sense of community, and sustainable living experiences that can become transformative, while aligning with tangible approaches to achieve sustainability [12, 13].

Regretfully, the COVID-19 pandemic of 2020 led to significant, negative impacts on the overall implementation of the SDGs [14], on SD teaching [15] and on students’ mental health, as described by [16] and [17]. Lockdown conditions enhanced a huge reliance on technology, which educational staff and institutions on different levels have been adopting since then to maintain teaching, albeit in an online format. However, [18] pointed out that learning cannot occur in seclusion from people or nature. If sustainability is the overarching framework of the campus culture, then HEIs should be compelled to enhance students’ participation in institutional governance and decision-making. This includes fostering curricula with programs that begin (even through a simple freshman seminar), at the undergraduate level for all students, irrespective of the main field of their academic studies. This and similar approaches encourage inclusivity, diversity, community building, and lifelong learning in sustainability [8], as foreseen in SDG 4.

In the context of HEIs, students play a pivotal role in shaping the trajectory of SD. Recognising the potential impact of students’ active involvement in sustainability initiatives, it becomes imperative to gauge the extent of their awareness and engagement concerning the UN SDGs globally. Despite the significance of student participation, there is a notable research gap regarding the understanding of the students’ knowledge levels and the initiatives undertaken by HEIs in fostering SDGs awareness and implementation. The existing literature lacks a systematic exploration of the global landscape concerning students’ awareness of the UN SDGs and their active involvement in initiatives aimed at translating these goals into actionable practices. The scope and diversity of initiatives by HEIs to integrate SDGs into their academic

and extracurricular activities also remain largely unexplored. Addressing this research gap, the present study delves into the nuanced dynamics of students' knowledge and engagement in initiatives aligned with the UN SDGs. By conducting a thorough investigation into the current status of students' awareness and participation, the study seeks to provide valuable insights that contribute to the filling of this research void.

Therefore, the purpose of this study consisted of investigating the current status of students' knowledge and participation in sustainability initiatives taking place at universities worldwide, that is, to assess the extent to which students are currently contributing to the implementation of the UN SDGs while identifying barriers that could hamper this effort. Data gathered from a bibliometric analysis of the literature about this topic were triangulated with those derived from an analysis of selected case studies and a survey involving a sample of 602 students from 53 countries around the world. The findings are poised not only to shed light on the existing scenario but also to inform future strategies and policies aimed at enhancing student involvement and HEI initiatives in advancing the global sustainability agenda. These findings enabled us to recommend specific measures, which may be implemented to increase interest in engaging students on initiatives about matters related to SD, a step further.

2 Literature review on students' role within the context of the United Nations sustainable development goals at higher education institutions

Since the agreement to implement the UN SDGs, HEIs around the world have been making a concerted effort to incorporate sustainability into their practices. This has been carried out through the development of declarations, the design of new curricula, sustainable campus practices, and the establishment of partnerships at a regional and global level, among other practices [19–21]. However, one of the most powerful tools at universities is student engagement. Consistent with this reality, many universities are constantly studying and developing ways to adequately prepare students to engage in sustainability [22].

Students are vastly considered agents of change in various fields. Therefore, through education for SD, they can develop knowledge, skills, and attitudes towards sustainability issues. Furthermore, students acquire traversal competencies that can be applied in scenarios outside of their future professional world. This allows for active and critical citizenship that benefits the planet and people [23].

Some researchers have pointed out that universities should do more to raise awareness about 'green issues' among students. This allows students to be more conscious of actions on campus, and thereafter translate the same consciousness when in the workplace. This is particularly beneficial as some students will take up work in legislation and governance and then be able to promote sustainability at a local, national, and global level [24]. Therefore, many universities are actively involving students in sustainability-related actions. For example, in Brazil, some universities have set up Green Campus Initiatives to engage students to develop strategies to produce a more sustainable campus or a greener campus environment. Such campaigns ensure the dissemination of SD concepts at campuses and improve students' knowledge and proactivity in terms of sustainability. This has significantly increased sustainability outputs [25].

Another example derives from the waste produced by HEIs, which greatly contributes to global carbon emissions. Here, students are often major contributors to waste production at universities. Therefore, it is helpful to develop effective waste management strategies and encourage students to ensure that the recycling and reuse of products are being implemented [26]. By creating zero-waste projects, universities can reduce the contribution to landfill waste, while assisting to achieve a decarbonisation of their campuses. Students can significantly contribute to the success of such initiatives. Although some institutions have already adopted this approach, many have not yet fully engaged students in waste management plans [26, 27]. Actually, students may also support sustainability efforts through a transformation of their campus operations. This includes greening operations to ensure an environmentally friendly campus [28]. This can be significantly enhanced by student engagement especially in clean transportation, recycling, waste management, water usage, and food wastage [29–31].

Students are also able to bridge the gap between the university and the community, often without the need for formal engagement of central management. Furthermore, they can develop stronger community-university partnerships and advance sustainability transitions as most students are from these communities [32].

Moreover, travel is an essential component of university life. Apart from university staff, students from foreign countries travel to international institutions for education. They also travel internationally and locally to attend conferences and other related programmes. This increases the number of carbon emissions and adversely affects the SDGs [33]. Promoting

the use of online systems for education and conferences, as complements to presence-based schemes may significantly reduce the amount of air travel associated with students and positively affect the SDGs [33]. On a smaller scale, students should be encouraged to use intercampus shuttles, cycle, or walk when possible. Other means such as encouraging carpooling and the use of clean energy in transportation, will promote sustainability and decarbonisation [34].

Furthermore, HEIs face many financial constraints while implementing sustainability and going green. Considering students are a large percentage of the campus network, their financial contributions by means of fees (or donations), may considerably assist with activities. A recent study has indicated that students' willingness to financially contribute to campus greening initiatives ranges between US\$13 and US\$15 to US\$10 and US\$18 [35]. Collectively, these contributions can significantly assist in the execution of sustainable programmes. They also allow students to have a greater voice in sustainability affairs, in shaping the agenda of universities, and help staff and students work more closely to create a green campus and community.

3 Methods

3.1 Theoretical foundation

The theoretical foundation underpinning this study draws on several key concepts from the fields of Higher Education, Sustainability Education, and Institutional Commitment. The study revolves around the premise that students are central actors within HEIs. This aligns with the student-centred learning approach, emphasising the active role of students in shaping their educational experiences and broader engagement with societal issues, adopting a theoretical framework that underscores the pivotal role of HEIs in fostering sustainable development [36]. Institutional commitment to the UN SDGs is considered a driving force influencing the level of student participation in sustainability affairs [37]. This aligns with theories on organisational behaviour and commitment within the context of sustainability initiatives. In addition, this study implies a theoretical underpinning related to knowledge transfer and educational impact. It suggests that students' engagement with SDGs is influenced by their exposure to courses or disciplines directly related to the SDGs, aligning with theories of knowledge acquisition and transformative learning [36], suggesting that formal education can significantly impact individuals' attitudes and behaviours, especially in the context of sustainability. The adoption of a mixed methodology approach combines qualitative and quantitative research methods, reflecting a pragmatist theoretical perspective. This approach allows for a comprehensive understanding of the issues being addressed, acknowledging the multifaceted nature of the phenomena under investigation. The complementary use of bibliometric analysis introduces elements of scientometrics and information visualisation, aligning with theories related to the quantitative analysis of academic literature and providing a broader context for understanding the global landscape of research on students' engagement with the UN SDGs. By integrating these theoretical elements, the study aims to provide a nuanced understanding of the complex relationships between students, HEIs, and the UN SDGs, contributing to the broader discourse on sustainability in the context of HEIs.

3.2 Research approach and design

The research objective of this study is to assess the extent to which students are currently contributing to the implementation of the UN SDGs while identifying barriers that could hamper this effort. In order to achieve the proposed goal, the first methodological approach consisted of a bibliometric analysis based on the keywords co-occurrence, aiming to unveil the links between HEIs and the efforts undertaken to involve students in the implementation of the SDGs. This technique can reduce the complexity involved in searching a specific research topic, allowing to obtain clear links between the possible research streams explored. The analysis was carried out using the Scopus database and VOSviewer software, a commonly used software for bibliometric analysis [38]. Data collection was performed on 18th October 2022. The keywords used for data collection covered the research topics, related to sustainability, SDGs, HEIs, and students.

The configured search string was the following: (TITLE ("sustainability" OR "sustainable" OR "sustainable development" OR "sustainable development goal*" OR "SDG*" OR "2030 Agenda") AND TITLE-ABS-KEY ("HEI" OR "HEIs" OR "Higher Education Institution*" OR "Higher Education" OR "Universit*")) AND TITLE ("student*" OR "alumn*" OR "scholar*" OR "graduate*" OR "undergrad*" OR "learner*" OR "pupil*").

A total of 1174 documents were found, covering all areas and all periods. Then, the search was limited to articles, book chapters, reviews, and the English language and a final result of 938 publications were gathered. The keywords co-occurrence analysis returned five clusters that are described in the fourth section.

The second method approach was an anonymised survey involving students from various HEIs in Europe, America, Africa, Asia, and Oceania. The survey was developed based on the literature gathered from the bibliometric analysis stage and then assessed by 10 experts from different countries and fields of knowledge related to sustainability. The survey was initially prepared in English language (Online Appendix A) and then translated into Spanish and Portuguese by native speakers. After a pre-test, the final version was disseminated via GoogleForms and distributed via email messages, allowing the collection of responses for six weeks. Through a snowball methodology, the instrument was shared with the Inter-University Sustainable Development Research Programme (IUSDRP), and subsequently further disseminated through a set of relevant academic list servers. The estimated response time was 10 min, and no incentives were offered for completing the questionnaire. In total, 602 students from 53 countries participated in the survey. Data analysis was performed with the support of IBM SPSS Statistics 23.

The survey aimed to explore the extent to which students are familiar with the 2030 Agenda and the SDGs and their engagement in SDG initiatives promoted by their universities. Moreover, it tested some assumptions derived from the literature review and bibliometric analysis, described below:

1. The institution's commitment to SDGs is associated with student participation in SDG-related initiatives.
2. Having taken a subject related to the SDGs is associated with student participation in initiatives aimed at the SDGs.
3. The fact that the institution offers initiatives related to the SDGs is associated with participation in disciplines focused on the SDGs.
4. There is a significant difference in the average between undergraduate and postgraduate students about familiarity with the SDGs.
5. There is a significant difference in average between students who had a subject related to the SDGs and those who did not, in terms of familiarity with the SDGs.
6. There is a significant difference in average between students from institutions that promote initiatives related to the SDGs and those that do not in terms of familiarity with the SDGs.
7. There is a significant difference in average between students who participate in initiatives related to the SDGs and those who do not participate in terms of familiarity with the SDGs.
8. There is a significant difference in average between students from different regions about familiarity with the SDGs.
9. There is a significant difference in average between students from different areas of knowledge about familiarity with the SDGs.
10. There is a significant difference in average between students of different ages about familiarity with the SDGs.
11. Having subjects related to the SDGs influences students' familiarity with the SDGs.
12. The institution's commitment to implementing the SDGs influences students' familiarity with the SDGs.
13. Students' participation in initiatives related to the SDGs influences their familiarity with the SDGs.
14. Students' region of origin influences their familiarity with the SDGs.
15. The area of knowledge influences students' familiarity with the SDGs.
16. The level of education influences students' familiarity with the SDGs.
17. The institution being public or private influences students' familiarity with the SDGs.
18. Gender influences students' familiarity with the SDGs.
19. Age influences students' familiarity with the SDGs.

Assumptions 1 to 3 were tested by conducting the chi-square test. Assumptions 4 to 7 were tested by using the Student's *t*-test. Assumptions 8 to 10 were tested by using the ANOVA test. Assumptions 11 to 19 were tested by using linear regression analysis.

Finally, based on [39], the research employed a meticulous approach to scrutinise ten thoughtfully chosen case studies, aiming to unravel the intricate ways in which HEIs contribute to the UN SDGs through student involvement. The classification of these case studies as "Type I," following Yin's framework, was underpinned by the adoption of a comprehensive analytical lens. Within this methodological paradigm, each case study stood as an autonomous and self-contained unit, fostering an exhaustive examination of the strategies implemented by HEIs to surmount the challenges entailed in realising the SDGs. This analytical framework not only permitted an in-depth exploration of individual cases but also facilitated the extraction of overarching insights into the multifaceted landscape of HEI contributions to the SDGs. The typology ensured that each case

study received due attention and scrutiny, enhancing the study's ability to distil nuanced and context-specific information regarding the role of HEIs in advancing the SDGs through student engagement.

An extensive literature review allowed the methodological approach triangulation used in this study and proved to be important to illustrate the several initiatives carried out by different HEIs to foster the connection between students and HEIs to achieve a successful implementation of the SDGs. The case studies were selected based on criteria of relevance and evidence collected by scientific publications. Thus, the case studies were meticulously selected from a diverse range of universities globally, each with a distinguished track record of active involvement in the implementation of the UN SDGs. These universities were strategically chosen to represent various geographic regions, cultural backgrounds, and levels of economic development. The rationale for adopting this multifaceted approach is rooted in the imperative to comprehensively document and disseminate a broader international spectrum of experiences and practices related to the UN SDGs, thereby fostering a richer understanding of global sustainability initiatives. Selecting universities from different regions is intended to capture the unique contextual factors, challenges, and successes that have arisen within distinct geographical and socio-cultural contexts. This approach not only enriches the understanding of the global effort towards SD but also facilitates the dissemination of ideas and best practices among diverse regions. Furthermore, it aligns with the spirit of the UN SDGs, which emphasise the universality of these goals and the need for collaborative efforts across borders. Through this research strategy, a robust and inclusive knowledge base that transcends borders can be shared, offering insights that can inform policy and practice, not only within individual institutions but also at a broader international level. By showcasing the experiences and strategies of universities committed to the UN SDGs across different regions, it is possible to inspire and empower other HEIs worldwide to engage actively in sustainability initiatives and contribute to the global pursuit of a more sustainable and equitable future. The specific inclusion criteria employed for the selection of case studies were as follows:

- Selection was based on initiatives implemented by universities to support students in contributing to the SDGs.
- Case studies were chosen from universities in diverse geographic locations to capture a broad range of approaches and contexts.
- The chosen case studies were deemed relevant for a comprehensive analytical approach, allowing for an in-depth exploration of strategies employed by HEIs in addressing SDGs implementation challenges.
- The initiatives showcased in the case studies were aligned with the overall strategic goals and plans of the respective universities, demonstrating a commitment to sustainability and the SDGs.
- The case studies were selected based on their potential implications for students' engagement and contribution to the SDGs, emphasising initiatives that have a measurable impact.
- The credibility and significance of each case study were considered by reviewing relevant publications and references associated with the initiatives, ensuring a solid foundation for analysis.
- A diverse range of initiatives, including educational programs, sustainability plans, indicator panels, and interdisciplinary projects, were included to showcase various ways universities are supporting SDGs.
- Initiatives that demonstrated strong ties to local communities and marginalised areas, contributing to social inclusion and community development, were included, emphasising overall commitment of communities.
- Case studies featuring innovative approaches, such as digital platforms, international conferences, and living labs, were included to highlight the importance of innovation and collaboration in sustainability efforts.
- Efforts by universities to integrate sustainability into study programs and courses, fostering a deeper understanding of climate change and sustainability, were emphasised in the selection process.

These criteria ensured a diverse and representative collection of case studies, offering insights into the varied strategies employed by HEIs to support students in addressing the challenges posed by the UN SDGs.

4 Results and discussion

4.1 Multifaceted dimensions of sustainability integration in higher education

The bibliometric analysis shows that the number of publications on the topic had increased over time (2000–2022), reflecting that the research on the topic is growing in general, with a significant volume of publications in 2021 (148 publications) and 2022 (198 publications). Figure 1 shows the trend.

Fig. 1 Publications on students' participation in the implementation of the sustainable development goals in higher education (2000–2022)

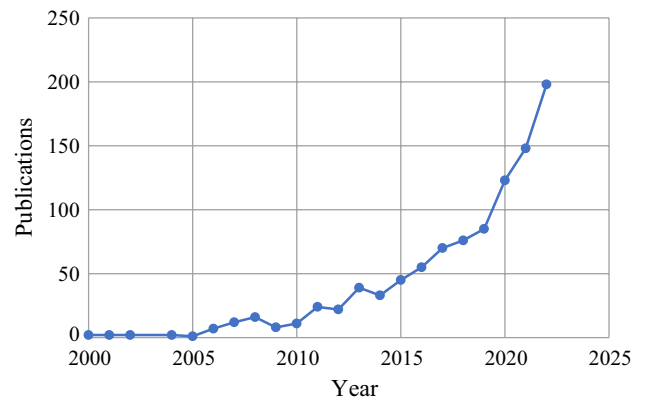
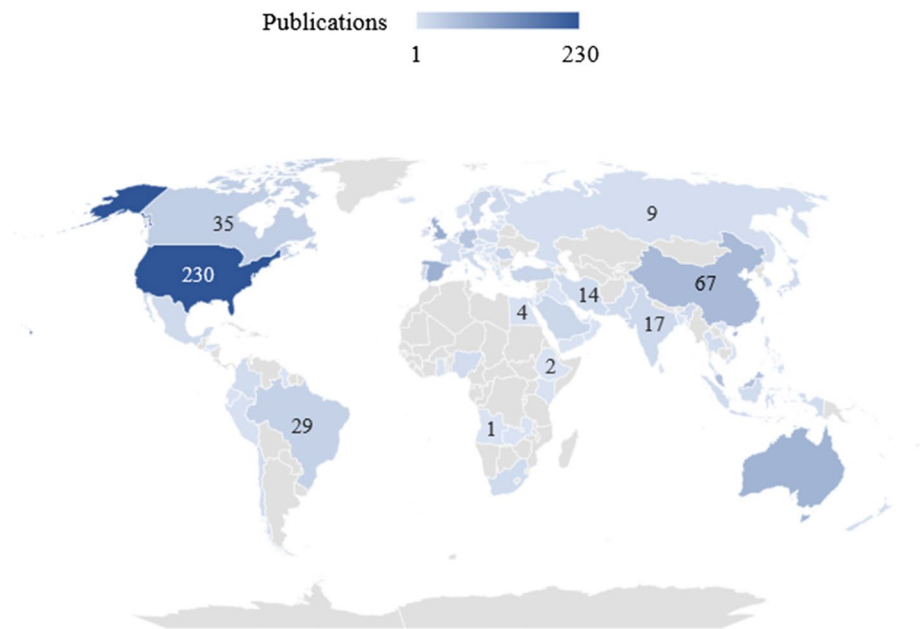


Fig. 2 Publications' distribution by country



The publications on the topic are distributed in 148 journals or books. The most productive journal identified is *Sustainability*, with 196 publications. *International Journal of Sustainability in Higher Education* ranks 2nd with 98 publications, followed by the book *World Sustainability Series*, with 55 publications, the *Journal of Cleaner Production* (34 publications) and the *Environmental Education Research* (17 publications).

Regarding the countries, Fig. 2 shows that the United States is the most productive country on the topic, with 230 publications, followed by the United Kingdom (88 publications), Spain, (82 publications), Australia (77), China (67), Malaysia (56), Germany (48), Canada (35), Brazil (29), and others.

In the sequence, the popular keywords on the topic were identified through a co-occurrence analysis (Fig. 3), grouped into five clusters. The *red* cluster refers to themes such as SD, students, education, training, climate change, ethics, environmental protection, competencies, and skills, among others. To face the current and future global challenges experienced by humankind, HEIs worldwide are taking on the responsibility for citizens' education by giving priority to developing sustainability competencies [40]. In this regard, researchers are increasingly investigating how best to integrate sustainability into HEIs' curricula to enable students to actively engage with problematic or complex situations similar to reality [41–43] claim that the SDGs should be included in all courses since society needs experts with professional knowledge but also citizens with the ability to identify the consequences of their actions.

The *green* cluster discusses topics such as higher education, education for ESD, learning, active learning, environmental education, interdisciplinarity, experiential learning, transformative learning, project-based learning, leadership, etc. The literature has shown that SDGs teaching requires new pedagogical and transdisciplinary approaches,

Themes such as sustainability, university, student, attitude, behaviour, knowledge, and the different approaches (strategic, stakeholder, participatory, partnership) are associated through the *purple* cluster. At this point, it is necessary to reflect not only on the provision of information and knowledge via courses and/or training but also on the students' attitudes. HEIs can encourage students' behaviour towards sustainability by using different approaches, but from an agency perspective, it also depends on students' motivations to take part in sustainability initiatives and develop competencies for their professional and personal lives [23]. Nevertheless, stimulating and communicating SD concepts on campuses helps to increase students' knowledge and proactivity in terms of sustainability [29].

The bibliometric analysis allowed the identification of the most relevant literature and provided a basis for the interpretation of the results, outlined in the conclusions section.

4.2 Students' global awareness, engagement, and challenges in SDGs initiatives

The survey was answered by 602 students from 53 countries around the world (Fig. 4). The countries with more answers were Germany (197 respondents) and Brazil (90 respondents). Regarding the participants' backgrounds (Table 1), most of them are undergraduate students (43.90%). However, 30.60% are master's (MSc, MA, Med) students, 4.50% are MBA students, 17.90% are PhD students, and 4.20% are postdoctoral students. Most of the participants study in public HEIs (86.00%), are female (59.60%), are between 18 and 24 years old (42.00%), and are from the fields of Business, administration, and law (20.80%) and Engineering, manufacturing, and construction (20.10%).

Table 2 shows the students' knowledge and engagement regarding the SDGs. Most of the participants (80.90%) replied to be aware of the 2030 Agenda and the UN SDGs. Among the students who are not aware, 85.20% would be willing to learn more about them. The other questions were asked only for those students who know the 2030 Agenda and the UN SDGs (487 participants). Considering those students, 60.60% of them already had a subject or discipline related to the SDGs. Moreover, on a scale of 1 (very little extent) to 5 (very large extent), 37.20% of the respondents claimed to be

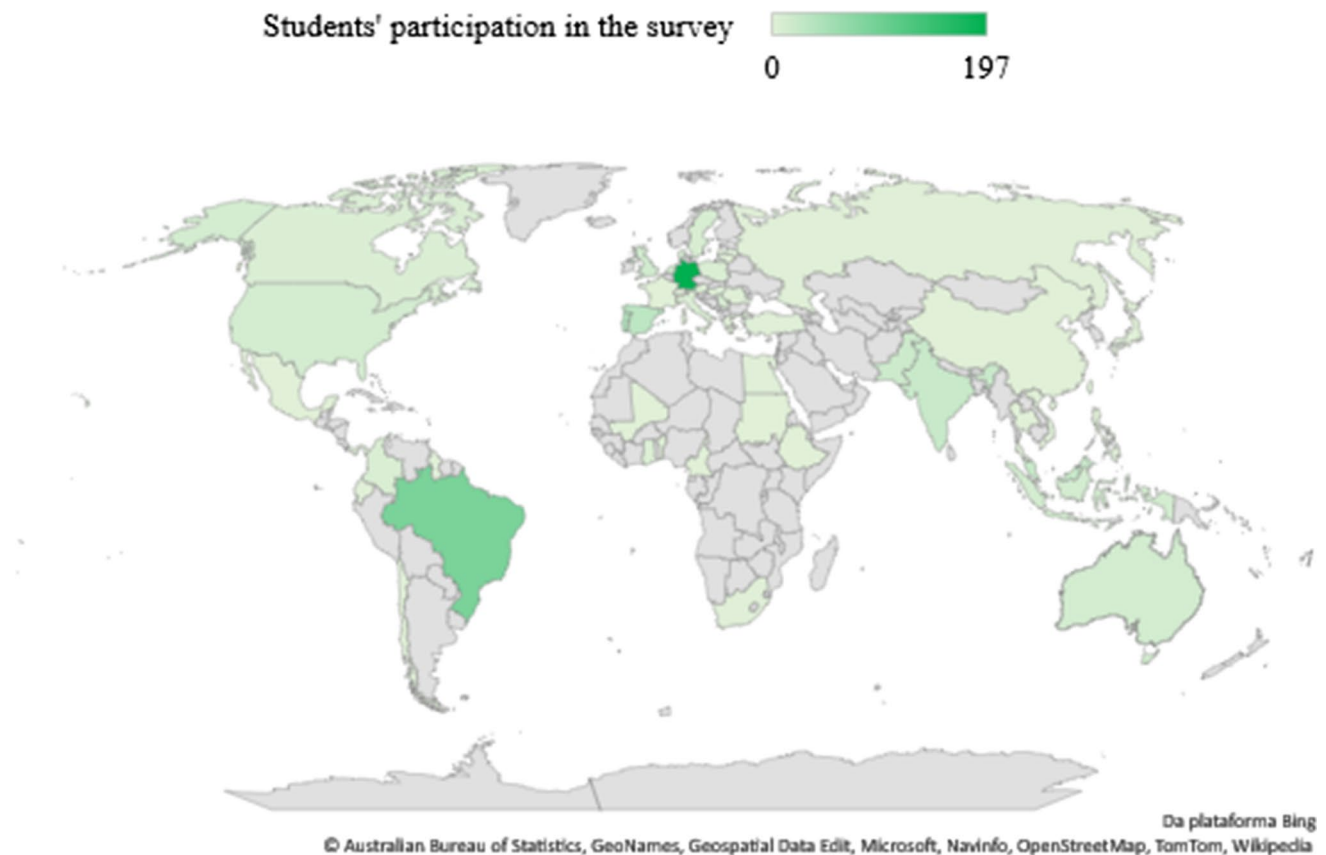


Fig. 4 Respondents' distribution by country

Table 1 Participants' background information

Variable	Category	Frequency	%
Position	Undergraduate student	264	43.90
	Master's (e.g. MSc, MA, MEd) student	184	30.60
	MBA student	27	4.50
	PhD student	102	16.90
	Postdoctoral student	25	4.20
Institution	Public Higher Education Institution	518	86.00
	Private Higher Education Institution	84	14.00
Gender	Female	359	59.60
	Male	227	37.70
	Other	8	1.30
	Prefer not to say	8	1.30
Age	18–24 years	253	42.00
	25–30 years	161	26.70
	31–40 years	127	21.10
	41–49 years	33	5.50
	50 years or more	28	4.70
Field of knowledge	Agriculture, forestry, fisheries, and veterinary	18	3.00
	Arts and humanities	36	6.00
	Business, administration, and law	125	20.80
	Education	53	8.80
	Engineering, manufacturing, and construction	121	20.10
	Health and welfare	71	11.80
	Information and communication technologies	27	4.50
	Natural sciences, mathematics, and statistics	58	9.60
	Services	11	1.80
	Social sciences, journalism, and information	82	13.60

familiar with the SDGs to a large extent and 30.40% are to some extent familiar. Furthermore, 56.30% of the students stated that their HEIs conduct activities to promote the SDGs and 43.70% do not.

Among the students who study at HEIs that carry out SDGs initiatives (274 participants), 52.60% stated that the commitment level of their HEIs with the SDGs implementation is high, 29.60% answered that it is low, and only 17.90% answered that it is very high. When asked about their participation in SDGs initiatives promoted by their HEIs, most of the students (57.70%) replied that they do not take part in it.

Subsequently, students who are aware of the SDGs were asked where they have learned about them. As Fig. 5 shows, most of the students have learned about the SDGs at university (77.00%) or through media (42.00%). This trend is similar to the ones obtained by [45] on Spanish university students' awareness of the SDGs. In contrast, other investigations have shown the bigger potential of the media in informing about sustainability and climate change in comparison to university settings [23, 46, 47]. Although social media strategies have been increasingly used for learning purposes [48, 49] the survey findings show universities' potential in embracing their role as a key source of knowledge on the topic.

Moreover, students who participate in SDGs initiatives promoted by their HEIs were asked in which kind of initiatives they usually take part. As Fig. 6 shows, most of the students engage in lectures or events to learn more about the topic, in educational activities during class time, or in conducting research. These results are consistent with recent trends in higher education since a growing number of institutions and educators are organising activities to engage students in sustainability-related issues [50–52]. Nevertheless, as reported by other studies, lower levels of engagement are seen in outreach-related initiatives [47, 53, 54]. The sample investigated in this study does not seem keen to contribute to SDG initiatives by means of financial donations, possibly indicating challenges in the implementation of green fees [35].

Regarding the motivations to get involved in SDGs initiatives (Fig. 7), contributing to the environment and a better society are the most important reasons listed by the students.

Related to students' participation in specific SDGs initiatives at their HEIs (Fig. 8), SDG 11 (sustainable cities and communities) and SDG 4 (quality education) seem to be the most addressed by the students, like results from previous studies

Table 2 Students' knowledge and engagement on the SDGs

Variable	Category	Frequency	%
Do you know the 2030 Agenda and the United Nations Sustainable Development Goals (SDGs)? / Have you learned anything about them?	No	115	19.10
	Yes	487	80.90
During the current course you are taking, have you had any subject/discipline related to the SDGs?	No	192	39.40
	Yes	295	60.60
On a scale of 1 to 5, where 1 means "very little extent" and 5 means "very large extent", how familiar are you with the SDGs?	Very little extent	20	4.10
	Little extent	58	11.90
	Some extent	148	30.40
	Large extent	181	37.20
	Very large extent	80	16.40
Does your higher education institution have initiatives to promote the SDGs?	No	213	43.70
	Yes	274	56.30
In your opinion, which category best describes the commitment level of your university/college to the SDGs implementation?	It is low, there are few initiatives to promote the SDGs in my institution	81	29.60
	It is high, there are several initiatives to promote the SDGs in my institution	144	52.60
	It is very high, there are many initiatives to promote the SDGs in my institution	49	17.90
Do you often participate in SDG initiatives promoted by your university?	No	158	57.70
	Yes	116	42.30

Fig. 5 Reported students' source of knowledge regarding the SDGs

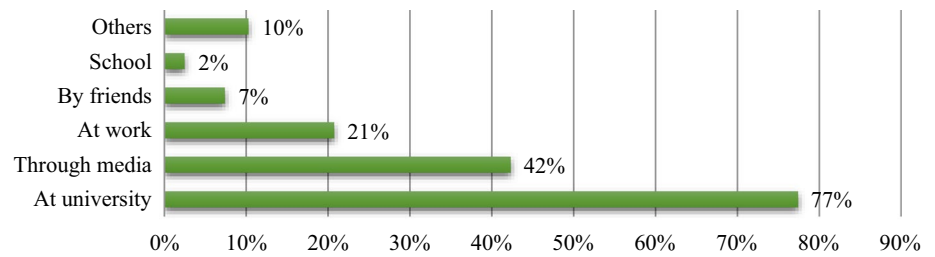


Fig. 6 Type of SDGs initiatives in which students take part in

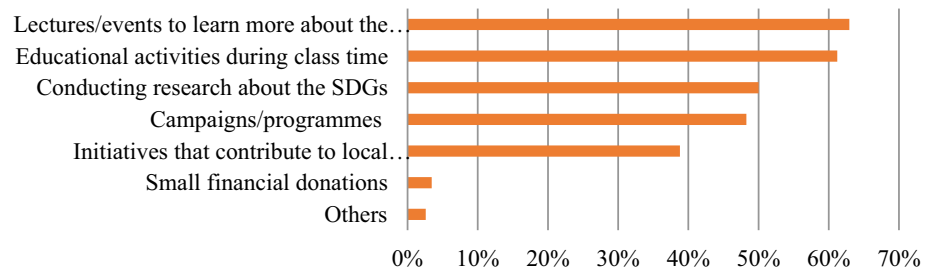
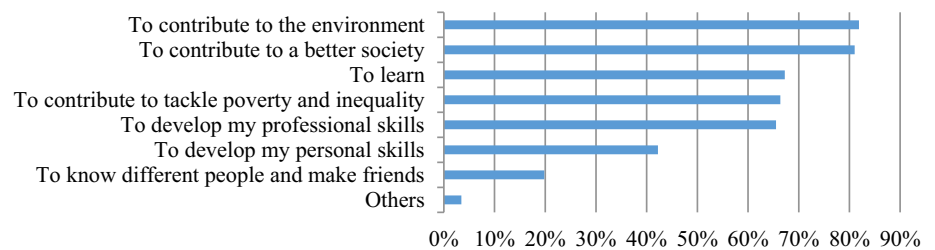


Fig. 7 Students' motivations to get involved in SDGs initiatives



[55, 56]. However, regarding the future initiatives to be approached by their HEIs, students would like to engage in SDG 2 (zero hunger), SDG 1 (no poverty), and SDG 17 (partnerships for the goals). These results are aligned with the findings of international studies that pointed out the prevalence of SDGs 4 and 11 among the most researched globally in university settings [57] and the potential of symbiotic relations between universities and cities for SD [58]. In this regard, several initiatives are currently being developed to enhance this approach from a wider perspective [59]. On the other hand, the interest of students in engaging in goals more related to the social cause supports the potential of outreach and community engagement initiatives [60]. This confirms that students perceive social engagement as relevant to their education [61], and highlights the increasing demand for multidisciplinary and cross-disciplinary training [62].

Understanding the challenges and barriers that students and institutions may face to enhance ESD is crucial [55]. In this regard, the challenges faced by the students participating in SDGs initiatives, 'Lack of time' was the most highlighted by the participants, followed by 'Lack of integration with my course content' and 'Lack of knowledge'. These results confirm previous findings that suggest that an increasing number of students have pro-environmental behaviour, but lack enough knowledge about sustainability topics [63].

By comparing the profile of students who participate in SDGs initiatives promoted by their HEIs and those who do not, it is possible to observe that in terms of familiarity with the SDGs, students who do not engage in SDGs activities are less familiar than students that are engaged. For instance, among those who do not engage, 39.20% of the students claimed to be to some extent familiar with the SDGs and 32.90% to a large extent familiar. On the other hand, among students who are engaged, 49.10% are to a large extent familiar with the SDGs and 37.90% are to a very large extent (Fig. 9).

Moreover, students who are engaged in SDGs activities better assess the commitment level of their university with the SDGs implementation than those who are not engaged. Furthermore, it was observed that among the students who are engaged in SDGs practices, most of them are PhD students (34.50%), while undergraduate students are less engaged in SDGs activities (43.00%). In terms of the field of knowledge, students from Engineering, manufacturing and construction, and Health and welfare are the least engaged, while business, administration and law, social sciences, journalism, and information are the most engaged in SDGs activities. Finally, in terms of age, students between 25 and 40 years are the most engaged, while students between 18 and 24 years old are the least.

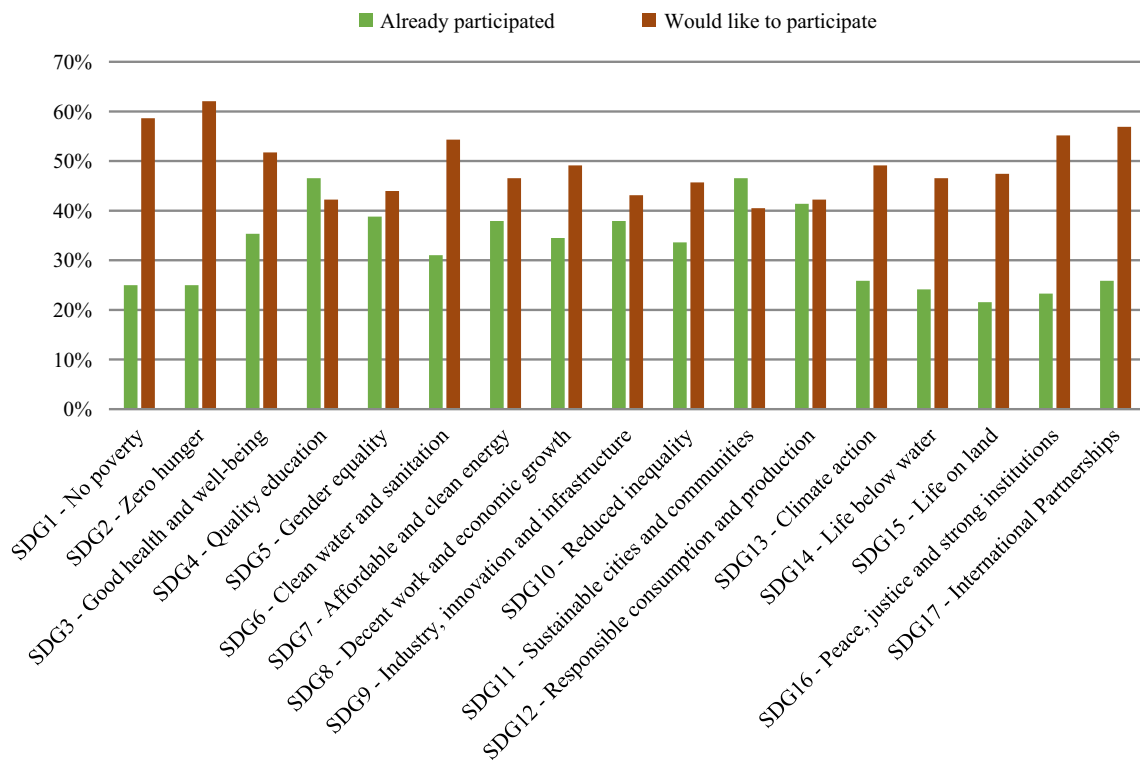
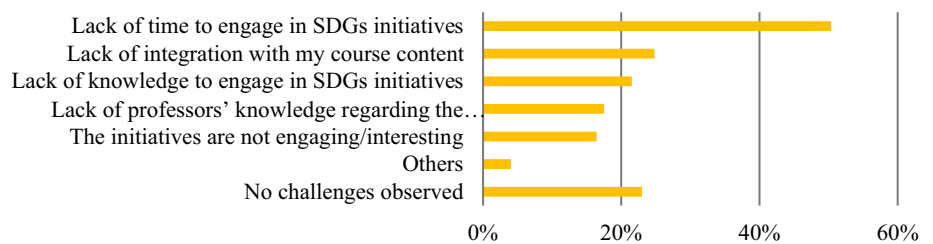


Fig. 8 Students' willingness participation in SDGs initiatives

Fig. 9 Challenges hindering students' participation in SDGs initiatives



Considering these results, the chi-square test was performed to analyse the associations between the variables. Then, it was found that the participation of the students in SDGs activities is associated with the commitment level of the HEIs with the SDGs implementation ($p < 0.05$). The participation of students in SDGs activities is associated with having any discipline or subject related to the SDGs ($p < 0.01$). Moreover, it was found that the offer of initiatives related to the SDGs by the institution is associated with students' participation in disciplines focused on the SDGs ($p < 0.01$).

In order to understand whether there was a significant average difference in the students' familiarity with the SDGs between groups of two categories, the Student's *t*-test (a type of statistical analysis used to compare the averages of two groups) was conducted for the following variables: position (undergraduate and graduate students), institution (public and private), gender (female and male), discipline (already had and never had), HEIs initiatives to promote the SDGs (no and yes), participation in SDG initiatives (no and yes). Table 3 shows the value and significance of the *t*-test for the variables.

According to Table 3, considering a $p < 0.01$, the variable 'Position' presented a significant average difference for the 'Undergraduate student' and 'Graduate students' (Master's/MBA/PhD/postdoctoral students) categories. The findings show that graduate students are more familiar with the SDGs (3.701) than undergraduate students (3.217). For the 'Institution' variable, the average difference between students from public and private HEIs was not significant ($p > 0.05$). Likewise, there was no significant average difference between female and male means. The 'Discipline' variable, on the other hand, presented a significant average difference between the students who

Table 3 Student's *t*-test for students' familiarity with the SDGs

Variable	Category	Mean	<i>t</i>	<i>p</i> -value
Position*	Undergraduate student	3.217	− 5.239	0.000
	Graduate students (Master's/MBA/PhD/postdoctoral students)	3.701		
Institution	Public Higher Education Institution	3.500	0.055	0.956
	Private Higher Education Institutions	3.493		
Gender**	Female	3.554	1.356	0.176
	Male	3.420		
Discipline	No	3.135	− 6.534	0.000
	Yes	3.736		
HEI initiatives to promote the SDGs	No	3.174	− 6.377	0.000
	Yes	3.752		
Participation in SDG initiatives	No	3.405	− 7.979	0.000
	Yes	4.224		

*The graduate students group was created due to the small number of some categories of the position variable

**The other categories of the gender variable were disregarded in this test due to the small number of respondents

had already taken some discipline related to the SDGs and those who had not. Students who had already taken a course are more familiar (3.736) with SDGs than those who had never taken a subject (3.135).

Moreover, students who study in HEIs that promote initiatives related to the SDGs presented a higher familiarity with the SDGs (3.752) than those who study in HEIs that do not promote such initiatives (3.174). Finally, students who participate in SDG initiatives have a higher familiarity with the SDGs (4.224) than those who do not take part in them (3.405).

In order to understand whether there was a significant average difference in the students' familiarity with the SDGs between groups of more than two categories, the analysis of variance (ANOVA) was conducted for the following variables: region, the field of knowledge, and age. Table 4 shows the mean of the ANOVA for the variables.

By analysing the mean difference between the 'region', 'field of knowledge', and 'age' variables for the 'familiarity with the SDGs', it was observed that the region and the 'field of knowledge' did not show a significant difference among the groups ($p > 0.05$). However, there was a significant difference for the 'age' category, in which students aged 41 years or older had greater familiarity (mean = 3.872) than those aged between 18 and 24 years (mean = 3.356).

Finally, in order to understand the influence of the categories on familiarity with the SDGs, an analysis of linear regression was conducted preceded by the Kolmogorov–Smirnov Test (nonparametric test). The estimated model is presented in Table 5.

By analysing the coefficients that express the magnitude and direction of the relationship of each of the independent variables on the dependent variable, it was found that the variables 'Participation', 'Discipline', and 'Position' have a positive influence on familiarity with the SDGs. Moreover, the 'Participation' factor has the greatest impact (standardised coefficient of 0.309). The other variables were not significant in the model.

The nine assumptions tested were largely matched by the data gathered. This was not always the case. Of the 19 assumptions presented in the methods section, 12 were confirmed (1, 2, 3, 4, 5, 6, 7, 10, 11, 12, 13, and 16) and 7 did not seem to correspond with reality (8, 9, 14, 15, 17, 18, 19).

4.3 Insights from case studies empowering students driving SDGs implementation in HEIs

More than ever, HEIs are significant players in the promotion of sustainability and SD, spurred on by societal demand, international declarations [64, 65], and governmental policies. Higher education has an even greater responsibility in developing highly skilled professionals for a sustainable world [59], and education is seen as the cornerstone for creating one [66].

Table 4 ANOVA test for students' familiarity with the SDGs

Variable	Category	Mean
Region*	Africa	3.571
	America	3.505
	Asia and Oceania	3.768
	Europa	3.415
Field of knowledge**	Agriculture, forestry, fisheries and veterinary / Natural sciences, mathematics and statistics	3.464
	Arts and humanities / Education	3.591
	Engineering, manufacturing, and construction / Information and communication technologies	3.362
	Health and welfare / Services	3.459
	Social sciences, journalism, and information / Business, administration and law	3.583
Age***	18–24 years	3.356
	25–30 years	3.574
	31–40 years	3.510
	41 years or more	3.872

*Asia and Oceania were grouped due to the number of respondents in each group

**The different fields of knowledge were grouped as presented

***The age groups of 41–49 years and 50 years and over were grouped

Table 5 Linear regression for students' familiarity with the SDGs

Variable	Standardised coef- ficients	t	p-value	VIF
Dummy participation	0.309	6.835	0.000	1.212
Dummy discipline	0.194	4.386	0.000	1.157
Dummy commitment	0.018	0.424	0.672	1.057
Dummy Country 1	0.021	0.186	0.852	7.546
Dummy Country 2	0.033	0.341	0.733	5.433
Dummy Country 3	0.034	0.372	0.710	4.790
Dummy Area 1	0.096	1.477	0.140	2.510
Dummy Area 2	0.080	1.403	0.161	1.944
Dummy Area 3	0.055	0.852	0.395	2.431
Dummy Area 4	0.036	0.642	0.521	1.900
Dummy Position	0.172	3.494	0.001	1.429
Dummy Institution	−0.072	−1.520	0.129	1.335
Dummy Gender	−0.039	−0.862	0.389	1.212
Dummy Age 1	−0.038	−0.480	0.632	3.733
Dummy Age 2	−0.050	−0.721	0.471	2.847
Dummy Age 3	−0.080	−1.238	0.216	2.501

Dependent Variable: On a scale of 1 to 5, where 1 means "very little extent" and 5 means "very large extent", how familiar are you with the SDGs?

One of the initiatives carried out during the COVID-19 crisis was the enhancement of "Digital learning for sustainable development" [15] an important platform created by the Hamburg University of Applied Sciences (HAW), in Germany [67]. In accordance with the UN SDGs and, in particular, SDG 4 [19], the Research and Transfer Centre "Sustainability and Climate Impact Management" (FTZ-NK) at HAW can promote ESD across themes and borders actively. This open-access platform endorses the faster acquisition of sustainability knowledge and skills, encouraging more integrated approaches to research and teaching. Being incorporated into academic programs, the SDGs may present a chance to significantly advance international efforts to create a more sustainable future. The same University has several initiatives supporting SD and SDGs, especially through the FTZ-NK, a research and technology transfer centre

for sustainability and climate change management, which trains students and scientists on climate change through courses and a wide range of publications [15, 68, 69]. The Manchester Metropolitan University, in England, actively engages students with a societal response to climate change through specific climate literary training initiatives [69, 70]. Since 2013, the training has evolved to external stakeholders, beyond the boundaries of the University in Manchester [70].

In Tanzania, the University of Dar es Salaam, is an excellent example of dedication to climate change sustainability, with teaching and learning practices aimed at allowing all students to reach an understanding of climate change and SD [69, 71]. The supportive role of the University of Dar es Salaam governance organs is emphasised by [71] in a study involving in-depth interviews with university lecturers, administrators, and undergraduate and postgraduate students, an important contribution to advancing the SDGs in Africa. The University of Bologna's dedication to sustainability in Italy is demonstrated by its most recent Strategic Plan, directed at addressing the SDGs [72]. Assessment and reporting of sustainability programmes, still in the early stages [73] and actions carried out within the University scope significantly contribute to transparency and further dissemination of knowledge [72]. They constitute social responsibility documents that inform multiple stakeholders, as demonstrated by the Bari, Bologna, and Perugia state universities, in Italy [73]. Accordingly, reports constitute important mechanisms to advance the SDGs, creating a sustainability culture that affects how students, teaching staff, administrative staff, and particularly university management and government bodies face sustainability [72, 73] and act as important drivers of sustainability orientation at the institutional level [73].

The University of the Basque Country (UPV), in the Basque Country, created the EHU/UPV Agenda 2030 plan, an indicator panel and roadmap for the period 2019–2025, aiming to assess SD achievement within this University. It mainly focuses on 12 of the 17 SDGs and comprises three axes (Equality, Inclusion, and Planet Campus) [74]. Among others, the main objectives of this initiative aim to incorporate the local efforts of students, faculty, researchers, and staff in the SDGs consistently, and implement the 2030 Agenda [19] as a shared, interconnected task, to be merged into all activities at the university, as well as measured, monitored and communicated in the specified timeframe [74].

Collaborative projects among different HEIs can result in significant outcomes. Examples are reported by [66] about the collaboration of HEIs in international conferences. Through this kind of activity, HEIs can spread sustainability knowledge, good practices, and awareness among the community and stakeholders, while simultaneously involving the students. Encouraging the students' participation and engagement in SD has proven to be an outreach of fundamental significance in the conferences, which have the potential of promoting interdisciplinary and multidisciplinary strategies for tackling issues related to global sustainability, through a range of expertise areas. This international cooperation is crucial to the successful implementation of the SDGs, as advocated by [64, 65, 75].

In specific regions of the globe, the role of HEIs in contributing to SDGs is constrained and the support for SDGs needs to go beyond the path used in conventional universities. It is the case of the University of Veracruz, in Mexico, which focuses on SDG 4 [19] and other SDGs, such as the ones related to environmental preservation, health, sustainable livelihoods, and gender equality, by facilitating access to marginalised populations [76]. In Serbia, an analysis of the University of Belgrade showed that efforts are being made to improve the educational process in order to accelerate the inclusion of concepts such as interdisciplinarity and teaching competencies by linking theory to practice and institutional policies [77]. Austria has developed a university professional development course for university teaching staff on ESD and innovation in teaching [78]. At the Technical University in Ukraine, in Ukraine, aiming to facilitate interdisciplinarity and sustainability values in curricula, a range of "Ecomposition, placed-based learning, and interdisciplinary project-based learning" is proposed, contributing to raising students' awareness of environmental issues [79].

The above findings are summarised in Table 6. The case studies report a diverse range of several different HEIs' initiatives and practices, not limited to a specific region, and with a different focus, intending to illustrate the diversity of strategies developed in HEIs, aiming to assist the progress of ESD within the context of the UN SDGs in various universities around the world.

The case studies highlight the important role of HEIs in promoting SD. The HEIs described in the case studies have implemented a variety of initiatives, including:

- Digital learning platforms for sustainability education
- Climate literacy training programs for students and stakeholders
- Strategic plans that are directed at addressing the SDGs
- Assessment and reporting of sustainability programs
- Collaborative projects with other HEIs

Table 6 Case studies on initiatives taken by universities to support students' efforts towards the SDGs

University	Initiative	Implications	References
Austria universities (National level)	University professional development course (BINE), addressing education for sustainable development	Austria has developed the BINE course for teachers in higher education, focusing on ESD and innovation in teaching. Participants found the sustainability topic complex but valuable. The course aims to improve teaching practices and, consequently, student learning	[78]
University of Bologna (Italy)	Innovative path 'Report on U.N. Sustainable Development Goals', classifying and reporting all activities towards SDGs	The university has incorporated sustainability into its Strategic Plan, aligning it with the UN SDGs. The institution assesses and reports on its sustainability programs, contributing to transparency and knowledge dissemination. Reports act as important mechanisms for advancing the SDGs and cultivating a sustainability culture within the university	[72, 73]
University of the Basque Country (Basque Country)	EHUagenda 2030 plan of the University of the Basque Country (UPV/EHU), an indicator panel to assess SD	This university has created the EHUagenda 2030 plan to assess sustainable development efforts comprehensively. It focuses on 12 of the 17 SDGs and involves students, faculty, researchers, and staff in its implementation	[74]
Hamburg University of Applied Sciences (Germany)	Platform 'Digital Learning for Sustainable Development' with modules on the SDGs to support students' training	The university has developed an open-access platform called "Digital Learning for Sustainable Development" that actively promotes education for sustainability in line with UN SDG 4. This platform integrates sustainability into academic programs, facilitating the faster acquisition of sustainability knowledge and skills	[15]
University of Dar es Salaam (Tanzania)	Development and implementation of study programs and courses on climate change and sustainability at undergraduate and postgraduate levels	The university is dedicated to teaching and learning practices focused on climate change and SD. It plays a vital role in fostering an understanding of these critical issues in the region, as emphasised by in-depth interviews with university stakeholders	[71]
University of Veracruz (Mexico)	'Intercultural Management for Development' teaching programme, with strong ties to the local communities and marginalised areas with restricted access to higher education	This university prioritises providing access to higher education for marginalised communities, primarily focusing on SDG 4 but contributing to various other SDGs, including environmental preservation, health, gender equality, and sustainable livelihoods	[76]
University of Belgrade (Serbia)	'Sustainability courses', directed at education for SD	Efforts are being made to enhance the educational process in this region, emphasising concepts like interdisciplinarity, teaching competencies, and linking theory to practice. There is a need for transparent document reporting at the institutional level to measure progress effectively	[77]
Manchester Metropolitan University (England)	Carbon Literacy Living Lab	The university engages students in addressing climate change through specific climate literacy training initiatives. These initiatives have expanded beyond the university boundaries to involve external stakeholders	[69, 70]

Table 6 (continued)

University	Initiative	Implications	References
Technical University in Ukraine (Ukraine)	'Ecocomposition, placed-based learning, and interdisciplinary project-based learning,' fostering sustainability awareness in students	Ukrainian universities prioritise ESD, emphasising interdisciplinarity and sustainability values in curricula. Approaches like "Ecocomposition," place-based learning, and interdisciplinary project-based learning contribute to raising environmental awareness and language learning	[79]
Hamburg University of Applied Sciences (Germany); Bolivian Catholic University (Bolivia); University of Southern Santa Catarina (Brazil); University of Chile (Chile)	International Conferences 'Renewable Electricity Generation in South America' (REGSA) and 'Linkages between Energy, Food and Water Consumption in the Context of Climate Change Mitigation Strategies' (LINKS) promoting sustainability and environmental awareness	Collaboration among HEIs through international conferences is highlighted as a means to spread sustainability knowledge, best practices, and awareness. Students' participation in these conferences promotes interdisciplinary strategies for addressing global sustainability issues	[66]

- Initiatives to promote sustainability in specific regions of the globe
- Professional development courses on ESD

The above-described initiatives are helping to raise awareness of sustainability issues, build capacity for sustainability action, and contribute to the implementation of the SDGs. On the other hand, the addressed case studies also highlight some of the challenges that HEIs face in promoting SD. Some examples can be given:

- The need for interdisciplinarity in sustainability education
- The need for more data and metrics to track progress on sustainability goals
- The need to engage with stakeholders from all sectors of society
- The need to overcome cultural and institutional barriers to change

Despite these challenges, the case studies show that HEIs are playing an increasingly important role in promoting SD. By continuing to innovate and collaborate, HEIs can make a significant contribution to building a more sustainable future.

5 Conclusions

This study reports on a study aimed at investigating the level of engagement from university students on matters related to SD. To this purpose, a bibliometric analysis and a survey involving a sample of 602 students from 53 countries around the world were undertaken, complemented by some case studies.

The results gleaned from the bibliometric analysis underscore the pervasive influence of sustainability and its associated issues across a spectrum of clusters. Notably, the concept demonstrates multifaceted implications within the fields of both natural and social sciences. This signifies the interdisciplinary nature of sustainability, highlighting its relevance and interconnectedness across diverse academic disciplines. Concurrently, the survey outcomes reveal a commendable level of awareness among the surveyed students regarding the 2030 Agenda and the UN SDGs. Even among those who expressed less than full awareness, there exists a notable eagerness to deepen their understanding. This positive inclination reflects a willingness among students to engage with and contribute to the global sustainability agenda. Furthermore, the survey brings to light the pivotal role universities play as primary sources of information on sustainability. This underscores the significance of HEIs in disseminating knowledge and shaping perceptions on the subject. It is noteworthy that, following universities, the media emerges as the second most influential source of information, signifying the broader societal role in shaping awareness and discourse on sustainability issues. In essence, the combined findings from the bibliometric analysis and survey not only emphasise the pervasive nature of sustainability across academic domains but also underscore the crucial role of educational institutions and media in shaping the discourse and fostering awareness among the upcoming generation of professionals and citizens.

The 10 case studies revealed a variety of initiatives being undertaken by universities from different regions of the world, which are actively engaged in informing their students on sustainability issues, across study programmes and informal initiatives. Many HEIs have established digital learning platforms to deliver sustainability education to a broader audience. They facilitate access to educational resources and materials related to SD and environmental issues. HEIs have recognized the importance of climate literacy and have initiated training programs aimed at enhancing the knowledge and awareness of students and various stakeholders. Programs typically focus on climate change mitigation and adaptation strategies. HEIs are aligning their strategic plans with the UN SDGs to ensure their activities contribute to broader global sustainability objectives, guiding actions and investments in SD. HEIs are implementing assessment and reporting mechanisms to measure the impact of their sustainability programs, which involves tracking progress, evaluating outcomes, and transparently communicating results to stakeholders. Collaborative efforts among HEIs are becoming more common, with multiple institutions working together on research, education, and projects related to sustainability and SDGs. Some HEIs are tailoring their initiatives to address the unique sustainability challenges of specific regions. This localised approach allows them to have a more significant impact in addressing regional environmental and social issues. HEIs are offering professional development courses for educators and professionals interested in ESD. The courses equip individuals with the knowledge and skills to incorporate sustainability principles into teaching and work. These case studies collectively demonstrate the diverse ways in which HEIs are actively engaging with and contributing to the UN SDGs, addressing different goals and emphasising interdisciplinary approaches, transparency, and student involvement, as previously discussed and further summarised.

These initiatives often intersect and complement each other, creating a holistic approach to sustainability within the higher education sector.

In consideration of the imperative to expedite the realisation of the SDGs and its implications, it becomes increasingly crucial for more HEIs to actively participate in and contribute to this transformative process. HEIs play a pivotal role as knowledge hubs and catalysts for societal change. Their engagement in the SDGs is paramount, not only for fostering ESD but also for driving research, innovation, and community outreach initiatives aligned with the SDG targets. By integrating the SDGs into their curriculum, research agendas, and institutional practices, HEIs can instil a sense of responsibility and sustainability among students, equipping them to become future leaders committed to addressing global challenges. Furthermore, HEIs can serve as testing grounds for sustainable practices, influencing local communities and serving as models for broader societal adoption. As influential entities with the capacity to shape attitudes, policies, and practices, HEIs stand as key actors in advancing the SDGs and fostering a collective commitment to a more sustainable and equitable future. As this study has shown, students are increasingly interested in engaging in initiatives related to SD. This is also demonstrated by the rise in the number of student-led environmental initiatives, such as the Global Student Network, Fossil Free, and the Green Team, among many others. These initiatives often focus on raising awareness of environmental issues, working to reduce carbon footprints, and pushing for governmental and corporate action on sustainability issues. As these initiatives become more popular, more students are joining them, both in their communities and across the world. This increased engagement shows a growing commitment to making a positive impact on the environment and to creating a sustainable future.

This paper has some limitations. The bibliometric analysis focused on themes of direct relevance to sustainability and the results may not be generalizable to other thematic settings. The survey did not include some specific questions which could offer additional insights into the phenomenon under investigation, namely awareness, and engagement in SD. The study did not include any longitudinal data which could provide insight into differences in opinions or information levels, over time. The sample size, while significant, i.e., 602 students from 53 countries, may not be regarded as representative of the student population at large, worldwide. Notwithstanding the inherent limitations, this paper has achieved a remarkable feat by successfully garnering student data from a diverse cohort spanning 53 countries. This inclusivity positions the study as one of the most comprehensive examinations on the addressed topic to date. The global scope of the dataset not only broadens the geographical representation but also contributes significantly to the existing body of literature. By shedding light on how students from various cultural and educational backgrounds are navigating matters related to SD, the study transcends regional boundaries. The truly international nature of the dataset not only enhances the study's credibility but also offers a unique and valuable perspective on the extent of student engagement with SD issues. As such, this research serves as a noteworthy and welcomed addition to the literature, providing insights that contribute to a more nuanced understanding of the global landscape of student involvement in SD.

Some recommendations that may assist in increasing the students' interest to engage in initiatives on matters related to SD may include the following ones:

- Involve students in activities such as field trips and volunteer opportunities, allowing them to see first-hand the benefits of SD.
- Connect students with mentors who are actively engaged in SD initiatives.
- Give students the opportunity to create their initiatives and present them to their peers and community. Here, methods such as "problem-based learning" or "project-based learning" may help.
- Hold regular debates and discussions about SD so that students can express their views and learn from their peers.
- Organise competitions and awards for students who create and develop their own SD projects.
- Invite guest speakers to present on topics related to SD and its importance.
- Involve students in initiatives that have a direct impact on their community, such as creating a community garden or a recycling program.
- Give students the opportunity to research and present their own SD solutions.
- Utilise technology as a tool to help students understand the global impact of SDt.
- Encourage students to join clubs and organisations dedicated to SD.

While not exhaustive, this list delineates key areas necessitating proactive measures. Implementation of these measures holds the potential to catalyse substantial positive changes. Beyond instilling a heightened awareness of SD among HEIs students, these initiatives have the capacity to revolutionise the training of future professionals. By integrating SD principles into the educational fabric, students are not only equipped with theoretical knowledge but also gain practical

insights and skills that are indispensable in navigating the complexities of sustainability challenges. The holistic incorporation of SD themes in curricula and professional training ensures that future professionals emerge with a robust understanding of sustainability, empowering them to seamlessly integrate sustainable practices into their respective fields. The envisioned outcome is a cohort of professionals well-versed in sustainability issues, poised to lead transformative changes and contribute meaningfully to building a more sustainable and resilient global society.

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

Author contributions CRediT author statement: WLF Conceptualisation, Formal analysis, Writing - Original Draft, Writing - Review & Editing, Supervision. LVT Methodology, Investigation, Software, Formal analysis, Writing - Original Draft, Writing - Review & Editing. MAPD Methodology, Investigation, Formal analysis, Writing - Original Draft, Writing - Review & Editing. NU Investigation, Formal analysis, Writing - Original Draft. AP Investigation, Formal analysis, Writing - Original Draft. BB Investigation, Formal analysis, Writing - Original Draft. JS Investigation, Formal analysis, Writing - Original Draft. AS Methodology, Investigation, Formal analysis, Writing - Original Draft, Writing - Review & Editing

Funding The study was not supported by any funding agency.

Data availability All data generated or analysed during this study are included in this article.

Declarations

Competing interests The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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