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The impacts of the COVID-19 lockdowns on the work of academic staff at higher education institutions: an international assessment

Walter Leal Filho[1,2] · Tony Wall[3] · Amanda Lange Salvia[2] ·
Claudio Ruy Vasconcelos[5,6] · Ismaila Rimi Abubakar[7] · Aprajita Minhas[2] ·
Mark Mifsud[8] · Valerija Kozlova[9] · Violeta Orlovic Lovren[10] ·
Hossein Azadi[11] · Ayyoob Sharifi[12,24] · Marina Kovaleva[2] · Todd LeVasseur[13] ·
Johannes Luetz[14,15,16] · Luis Velazquez[17] · Priyatma Singh[18] · Rudi Pretorius[19] ·
Noor Adelyna Mohammed Akib[20] · Tamara Savelyeva[21] · Luciana Brandli[4] ·
Nandhivarman Muthu[22] · Patrizia Lombardi[23]

Abstract

The COVID-19 pandemic severely disrupted the life of millions of people around the world and brought changes in many contexts. In higher education institutions, teaching staff had to quickly adapt their teaching and research practices and revisit learning and student engagement strategies. In this context, this paper aimed to report on how the lockdowns influenced the work and lives of academic staff at universities. The methodology consisted of an online survey that collected 201 responses across 39 countries worldwide, and the results were explored using descriptive and exploratory modelling analyses. The findings reveal that the main positive aspect of the work-from-home experience during the lockdowns was the reduction of time spent on commuting, while the inability to disconnect and difficulties in work–life balance were the most commonly indicated negative aspects. The principal component analysis indicated that the pandemic had a moderate power in boosting academic staff towards sustainability, and an important potential of revising academic curricula and teaching–learning relationships. Based on the evidence gathered, recommendations to allow academic staff to better cope with the influence of future pandemics include the increased use of digital resources and new teaching styles, curricula revision for encouraging educators to include more issues related to sustainable development in their teaching and greater institutional support to reduce stressful conditions and improve productivity.

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1 Introduction

The challenges caused by the coronavirus disease (COVID-19) have affected millions at a global level (Al Mamun et al., 2020; Enokela, 2023), and evidence has indicated the significant risk of remote working, working at home and flexible working arrangements, as a result of the pandemic (Berg et al., 2021; Leal Filho et al., 2022).

Higher education institutions (HEIs) are among the organizations affected by COVID-19 in their overall operations and in the teaching of sustainable development in particular. However, it is unclear how the pandemic has affected sustainability education. Universities have historically played an important role in transforming societies through educating decision-makers, leaders and entrepreneurs (Vahdati et al., 2023). According to McCowan (2016), universities have been assigned a crucial role, namely in the post-2015 development agenda and the accomplishment of the Sustainable Development Goals (SDG). This position will become much more important in the post-COVID-19 era. According to Karatzoglou (2013), "universities continue to cope effectively and sustainably with the dynamic nature of sustainability by displacing obstacles, altering teaching paradigms, increasing social competences, communication skills, and community interactions".

The governmental response around the world has enforced preventive measures at universities, such as temporary closure and rapid movement to online learning platforms for virtual classes and distance learning (Edelhauser & Lupu-Dima, 2020; Moralista & Oducado, 2020; Salleh et al., 2023; Sun et al., 2020). To give a sense of scale, at the beginning of April 2020, the number of university learners who were required to stay at home due to the closure of their educational institution was predicted to be 1.598 billion across 194 countries (Amanor-Mfoafo et al., 2020).

Research into the effects of the pandemic on workers across industries indicates how it has challenged them emotionally, physically and financially (Carr et al., 2021; Forsythe et al., 2020; Gazzeh et al., 2022; Pereira, 2021). New living and working patterns, especially when living with others (Kniffin et al., 2021) and adapting to digitalization and new teaching methods (Tettamanzi et al., 2023), have been associated with psychological problems such as stress, anxiety and depression, attributed largely to the threat of unemployment (Ali et al., 2020).

Academics were among the main groups whose professional activities were affected by the pandemic. They are responsible for the education of millions of university students around the world, so it is important to ascertain how the pandemic impacted their work since this also affected the students (Marelli et al., 2021). The literature, even though emerging, indicates mixed results regarding the impacts of the COVID-19 pandemic on academic work and routines. Salazar et al. (2021), for example, reported the negative impacts of the pandemic on academic labour productivity and health (women academics and those working in laboratories are more affected than male academics and those whose research work rely less on experiments). Some academics have reported increased research productivity during the pandemic, which they attribute to having more time away from the conventional academic environment, while others had more difficulties in coping with the lockdown challenges. This contradiction indicates the significance of revisiting the subject of how the pandemic influences university academics (Knight et al., 2021).

In this regard, this study provided here assesses how the COVID-19 lockdowns influenced the work and lives of academic staff at universities. Two main research questions guided this investigation: (a) How do academic staff perceive the impacts of the COVID-19 pandemic on the work they perform, especially in respect of teaching and research?

and (b) Is the pandemic representing an opportunity for revision of teaching/research to cover sustainability aspects? In terms of gaps being explored, this research sheds light on the subjective constructions that staff members who work in HEIs throughout the world have developed in response to the imposed isolation, especially in terms of the opportunities around sustainability education. This study also highlights important policy implications for teaching and learning strategies in the growing environment of increased reliance on social contact and digital learning, the requirement to guarantee all students' access to technology and the well-being of staff.

The structure of the paper is as follows: the following section presents a literature review covering the impact of the lockdowns in the educational sector and changes in work patterns; then the methodology is described, including the survey implementation process and the descriptive and exploratory modelling analyses; followed by results and discussions. The final section is dedicated to concluding remarks, limitations and recommendations.

2 Literature review

As recommended by the World Health Organization, governments throughout the world implemented social contact restrictions in response to the coronavirus pandemic in February and March 2020. This affected nearly all business sectors and government activities, including education. Higher education institutions all across the world were obliged to adapt to a new circumstance after the announcement of constraints (Lau et al., 2020). Due to concerns about the rapid spread of the virus, universities around the world quickly postponed or cancelled all university-related activities, including teaching, laboratory research, examinations, sports, leisure activities and conference activities. These procedures were put in place to protect students and faculty from the virus by preventing or decreasing the spread of illness at universities (Sahu, 2020).

In addition to the quick institutional responses to educational provision, there is increasing evidence that many people have been forced to deal with the multiple problems and effects of the lockdown. Many overseas students were stranded because of travel restrictions, and some of them were left without housing or had to deal with unforeseen expenses (Cheng, 2020). Many academic staff members were forced to work out of pocket since they had already paid for conferences and airline tickets that had become worthless owing to travel restrictions.

It has been demonstrated that changing contemporary work patterns have an impact on the social well-being of academic staff. Despite the concept that "high-performance work systems" or "high-commitment workplaces" produce intrinsic staff motivation, Boreham et al. (2016) reveal significant negative repercussions of such current work practices on social well-being. They discover that there is no complete distinction between social and occupational well-being, with cross-cutting relationships between workload pressure, stress and effects on quality of life.

The COVID-19 effects have been felt globally in every sector, which has led to an increase in stress among academic staff. However, studies on heightened stress as a result of the current epidemic indicates that the pandemic's consequences may cause considerable harm to staff's physical and mental health (Nayak et al., 2022). This might be caused by the epidemic itself. Staff in institutions and universities have been shown to experience significant levels of stress as a result of the nature of their work, since they come into close touch with a diverse group of people (Guppy et al., 2022). This also implies that they are more prone to contract the virus,

and the employee's stress may manifest itself in a number of different ways. According to a number of studies (e.g. Mishra et al. (2020); De Man et al. (2021); Gamede et al. (2022)), the COVID-19 pandemic continues to have a negative and unanticipated impact on people's health, notably occupational stress and job performance. These studies found that job stress is caused by the workplace environment and has a detrimental influence on employee performance. The working environment and employee performance are also clearly correlated, with a good working environment resulting in higher employee performance and vice versa.

In a study done by Brooks et al. (2020), those who were locked up because of the COVID-19 virus displayed indicators of stress, anxiety and even anger. Workplace challenges such as role overload, role conflict and role ambiguity because work processes to be interrupted. It is clear that in the present COVID-19 settings, especially in the academic environment, work stress and its more serious conditions are becoming more common. High-stress academic staff members are more likely to exhibit low commitment and well-being at work, which makes it difficult for them to focus on their primary tasks and reduces their productivity. Vindegaard and Benros (2020) revealed that COVID-19 has raised general population levels of sorrow, anxiety and poor sleep, as well as having an influence on the workplace, in a recent systematic analysis on the pandemic and mental health. Academic staff will be aware of these problems and stresses, balancing their strong dedication to their profession and identification within a demanding working environment with the need to attend to life beyond the academy (Franco-Santos & Doherty, 2017). Shen and Slater (2021) discovered that academic staff had a propensity towards increased stress that was noticeably bigger than that of other UK occupations in their study. Students are prone to stress, anxiety and depression, especially postgraduate students. Universities are aware of these problems, and a number of Internet resources, including research on higher education policy, are also available to them. It is probable that the longer-standing workplace pressures will be overshadowed by the overwhelming necessity of a quick deployment of the social lockdown. Although the pressure of lockdown is less now, it still exists in some workplaces, and its stressors compound existing work stressors and add new ones.

The present study utilizes a questionnaire survey design to assess the impacts of COVID-19 lockdowns on academic staff in HEIs and explore the potential for integrating sustainability aspects into higher education. Sustainability education holds significant importance as it empowers students with the knowledge, skills and values needed for the sustainable development of our communities and socioeconomic activities (Bizerril et al., 2018). By fostering awareness of the interrelationships between environmental, social and economic systems, sustainability education enables individuals to understand and mitigate the impacts of human actions on the ecosystem and society, thus paving the way for a more sustainable future (Karatzoglou, 2013). Moreover, it equips students with critical thinking, problem-solving abilities, systems thinking and a sense of shared responsibility, enabling them to contribute to achieving sustainable development goals and devising innovative solutions to global environmental and socioeconomic challenges such as climate change, pollution, hunger and inequality (Leal Filho et al., 2021b).

3 Methods

A questionnaire survey was created to explore the perception of academic staff regarding the effects of the lockdowns on their overall work and their ability to fulfil their roles as educators. This section will first describe the research methods and analysis techniques

employed. Subsequently, it will provide details about the dataset and present the results of statistical tests that support the developed modelling.

Based on the research questions and including aspects and challenges covered in the literature (e.g. Leal Filho et al., 2021a, 2021b), the questionnaire was developed with 38 questions (with sections on background, impacts on work, positive and negative impacts of the home office experience, work–life balance and well-being, and opportunities and lessons learned). Different question formats have been applied (e.g. Likert-like scales and multiple choices, correspondingly to the variables assessed). Concerning the item development, a consistent questionnaire was not found to measure the perception of academic staff on the impacts of the lockdowns on their overall work and ability to fulfil their tasks as educators. Therefore, the authors developed the following described instrument using contributions from similar previous studies (Koff, 2021; Leal Filho et al., 2021a, 2021b; Paliwal & Singh, 2021; Trevisan et al., 2020). The survey was developed by the authors and was structured along with the key sets of information it aimed to gather. Surveys are known to be reliable data collection tools, which in this case the reliability was assured by a pretest. The validity is based on the adequacy of the questions and the fact that respondents were scientists who are expected to provide accurate answers.

After the pretest phase, which consisted of minor adjustments in questions and options, proposed by a set of academic staff partners of the Inter-University Sustainable Development Research Programme (IUSDRP), the final version was disseminated online via SurveyMonkey and is presented in Appendix 1. The invitation to participate in the survey was then shared with scientific mailing lists and with the networks of partners of the IUSDRP, which cover over 140 member universities. The research team fully protected the privacy of the respondents, by not gathering or storing any personal information, hence fully complying with the European Data Protection Regulations (GDPR), the legal instrument which regulates this component.

The collected data were analysed basically through two statistical approaches. The first consisted of descriptive statistics used to explore the data distribution in terms of mean and percentages. The second perspective employed was the principal component analysis (PCA). PCA is a multivariate analysis technique that aims to reduce the dimensionality of a database composed of a large number of interrelated variables while retaining as much variation as possible in the database (2014b; Field, 2018; Hair Jr. et al., 2014a; Harrington, 2009). In simpler terms, it organizes the original variables into a model composed of clusters known as principal components, which are uncorrelated and ordered in such a way that the few principal components capture most of the variation present in the original variables.

In the case under consideration, PCA enabled the grouping the 15 observable variables, adapted from the literature, into four latent variables that enhance our understanding of the impact of COVID-19 lockdowns on the work of academic staff. The statistical grouping of the variables is achieved through a correlation matrix that brings closer variables with higher correlations while separating those with lower correlations, resulting in the creation of the four latent variables in the model. PCA modelling simplifies the explanation of the resulting model by condensing the information from 15 observable variables into four latent ones.

Figure 1 illustrates the conceptual model designed to assess, through PCA, the perception of academic staff regarding the impacts of the lockdowns on their overall work and their ability to fulfil their roles as educators.

The survey collected 201 responses from 39 countries between March and May 2021. As shown in Fig. 2, the survey covered all continents (Australia $n=3$, Austria $n=1$, Brazil
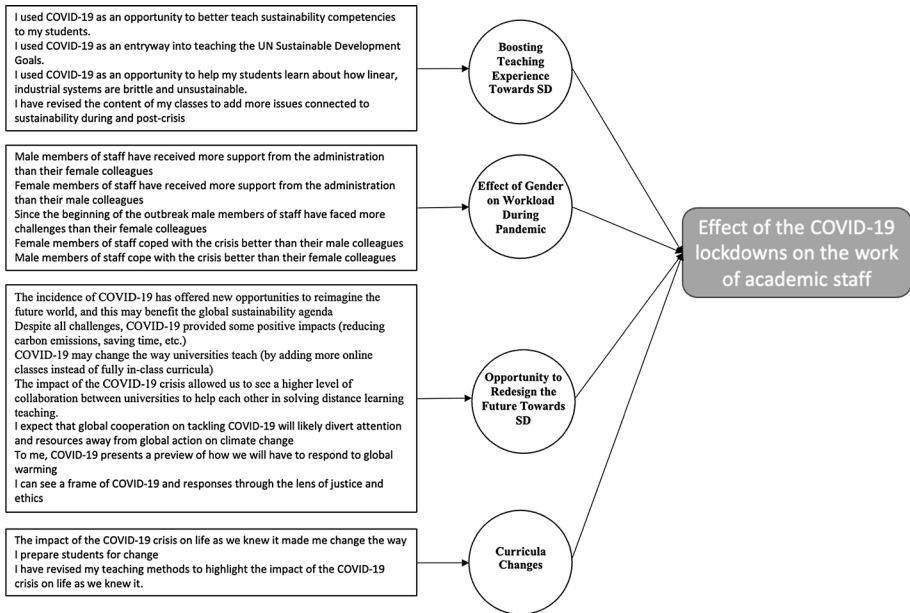
Fig. 1 Conceptual model do access the effect of the COVID-19 lockdowns on the work of academic staff
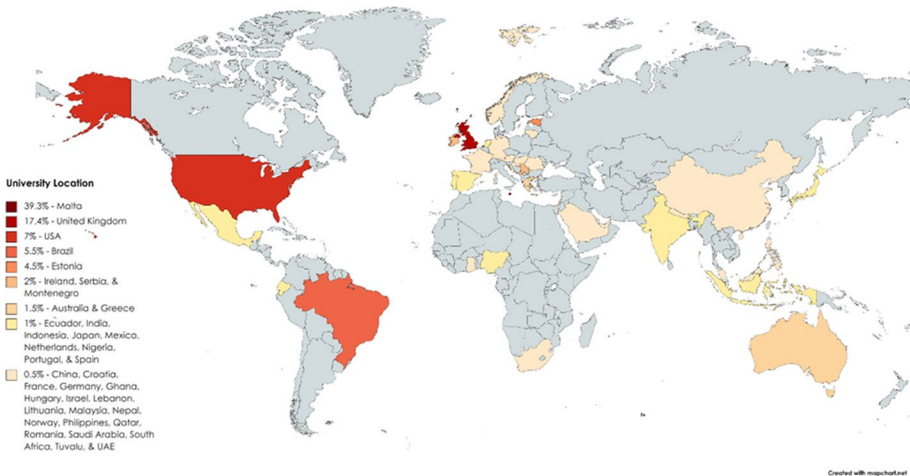
Fig. 2 Surveyed countries

$n=11$, China $n=1$, Croatia $n=1$, Ecuador $n=2$, Estonia $n=9$, France $n=1$, Germany $n=1$, Ghana $n=1$, Greece $n=3$, Hungary $n=1$, India $n=2$, Indonesia $n=2$, Ireland $n=4$, Israel $n=1$, Japan $n=2$, Lebanon $n=1$, Lithuania $n=1$, Malaysia $n=1$, Malta $n=79$, Mexico $n=2$, Nepal $n=1$, the Netherlands $n=2$, Nigeria $n=2$, Norway $n=1$, Philippines $n=1$, Portugal $n=2$, Qatar $n=1$, Romania $n=1$, Saudi Arabia $n=1$, Serbia/Montenegro $n=4$, South Africa $n=1$, Spain $n=2$, Tuvalu $n=1$, United Arab Emirates $n=1$, UK $n=35$ and USA $n=14$).

Over 60% of the participants were female and about 37% were male. Regarding age distribution, two categories represent more than half of the sample (30% in age group 51–60 years and 27% in age group 41–50 years). When it comes to the primary knowledge area of work, the sample is quite diverse, with one quarter of respondents being from social sciences and around half sample distributed among humanities/linguistics, health sciences, business, engineering and environmental and earth sciences. Around two-thirds of the sample were permanent members of staff mainly involved in undergraduate or postgraduate teaching and research. Complete sample characteristics are presented in Table 1.

This final part of Sect. 3 will provide details of the methodological procedures used in conducting the principal component analysis and the results of statistical tests assessing the model's goodness of fit and gender difference among sampled respondents.

The model's adequacy resulting from the PCA is assessed by means of two main statistical tests, KMO and Bartlett's test. The KMO value exceeding 0.6 and a significant Bartlett's test enables the rejection of the null hypothesis of lack of sufficient correlation between the variables (2014b; Field, 2018; Hair Jr. et al., 2014a; Meyers et al., 2016; Shanthi, 2019). If these two measures are within the specified criteria, PCA is recommended. Additionally, the internal consistency of the sub-scales (components) that comprise the proposed model was calculated using Cronbach's alpha, a measure of scale reliability that assesses how closely related a set of items is as a component (Field, 2018).

The PCA was performed on a set of 18 items measured through a five-point Likert agreement scale. The 3 following items "I expect that global cooperation on tackling COVID-19 will likely divert attention and resources away from global action on climate

Table 1 Sample characteristics: gender, age group, knowledge area of work and role

Gender	Percentage	Age group	Percentage
Female	62.0%	21–30	7.0%
Male	37.0%	31–40	22.0%
Prefer not to say	1.0%	41–50	27.0%
		51–60	30.0%
		60+	14.0%

Primary knowledge area of work	Percentage	Role at the university	Percentage
Social sciences	26.0%	Permanent member (undergraduate teaching and research)	35.0%
Humanities/linguistics	12.5%	Permanent member (postgraduate teaching and research)	31.0%
Health sciences	12.0%	Permanent member (teaching)	13.5%
Business studies	11.0%	Permanent member (research)	7.0%
Engineering	10.5%	Temporary member	13.5%
Environmental and earth sciences	9.5%		
Biological sciences	4.0%		
Agrarian sciences	1.5%		
Physical science	0.5%		
Mathematical science	0.5%		
Other areas (e.g. education, law, medicine, music, architecture)	12%		

change", "To me, COVID-19 presents a preview of how we will have to respond to global warming" and "I can see a frame of COVID-19 and responses through the lens of justice and ethics" were eliminated due to cross-loading among components. Thus, the final model resulted in 15 items clustered into 4 components with eigenvalues higher than one. The resulting dimensions of the model cover 65.12% of the total variance explained and have met the main psychometric threshold values. The adequacy of the model was measured through the Kaiser–Meyer–Olkin (KMO) test Bartlett's test of sphericity. The KMO was 0.795, and all KMO values for individual items were greater than 0.707, which is well above the acceptable limit of 0.5 (Field, 2018). Bartlett's test of sphericity was also significant ($X2$ (105)=1112.641, $p \approx 0.000$). The reliability of the model was measured through Cronbach's alpha, which is a value of internal consistency. The analysis resulted in values higher than the acceptable level of 0.6 for all components (Field, 2018) as it is shown in the last line of Table 2. All analyses were carried out using IBM SPSS Statistics software.

4 Results

The survey explored various aspects of the coping strategies employed by respondents and the circumstances under which they operated during the lockdowns. The findings offer a comprehensive context for understanding the challenges that academic staff faced while responding to the pandemic and its varying levels of stress.

This section has been divided into two parts, with the first part dedicated to presenting data from the survey through graphical representation and descriptive statistics. The second part focuses on developing a model to explain the impact of lockdowns on academic staff.

The first part, grounded in descriptive statistics, analysed the primary challenges experienced by teachers during the pandemic. This analysis includes discussions on the working conditions reported during the lockdowns, difficulties in peer and student interactions, the need to adapt to remote teaching, and the key strategies employed to cope with stress, maintain motivation and enhance productivity. Additionally, this part addresses the positive and negative aspects of working from home.

The second part described the effect of COVID-19 lockdowns on the work of academic staff using principal component modelling. This model comprises 15 variables grouped into the following four components: (1) "Enhancing the Teaching Experience for Sustainable Development", (2) "The Impact of Gender on Workload During the Pandemic", (3) "Opportunities for Redesigning the Future for Sustainable Development" and (4) "Curricular Changes".

4.1 Primary challenges faced during the pandemic period

Regarding the working situation during the lockdowns, two-thirds of the sample reported having worked solely from home, while 28.5% shuttled regularly between home and university offices. Around 3.5% indicated that they kept working normally at their offices. Different from several other sectors where employability became a serious challenge, the situation reported by teaching staff on how the pandemic impacted their employment seems different. Approximately 42% of the sample reported no changes at all, while very light or partial changes were indicated by 32% and 13% of the respondents, respectively.

Table 2 Principal component analysis and main factors that explain the effect of the COVID-19 lockdowns on the work of academic staff

	Component				Mean	SD
	1	2	3	4		
COMPONENT 1–BOOSTING TEACHING EXPERIENCE TOWARDS SD						
I used COVID-19 as an opportunity to better teach sustainability competencies to my students	**0.901**	0.006	0.208	0.058	**2.53**	**1.18**
I used COVID-19 as an entryway into teaching the UN Sustainable Development Goals	**0.838**	− 0.015	0.088	0.153	**2.31**	**1.20**
I used COVID-19 as an opportunity to help my students learn about how linear, industrial systems are brittle and unsustainable	**0.799**	0.096	0.091	0.192	**2.40**	**1.29**
I have revised the content of my classes connected to sustainability during and post-crisis	**0.716**	0.064	0.126	0.432	**3.00**	**1.12**
COMPONENT 2–EFFECT OF GENDER ON WORKLOAD DURING PANDEMIC						
Male members of staff have received more support from the administration than their female colleagues	− 0.109	**0.822**	− 0.035	0.091	**1.86**	**1.08**
Female members of staff have received more support from the administration than their male colleagues	− 0.055	**0.789**	0.001	0.128	**1.68**	**0.96**
Since the beginning of the outbreak male members of staff have faced more challenges than their female colleagues	− 0.023	**0.687**	0.075	0.125	**1.98**	**1.00**
Female members of staff coped with the crisis better than their male colleagues	0.249	**0.686**	0.150	− 0.155	**2.35**	**1.13**
Male members of staff cope with the crisis better than their female colleagues	0.146	**0.686**	− 0.076	0.042	**2.24**	**1.11**
COMPONENT 3–OPPORTUNITY TO REDESIGN THE FUTURE TOWARDS SD						
The incidence of COVID-19 has offered new opportunities to reimagine the future world, and this may benefit the global sustainability agenda	0.189	0.000	**0.788**	− 0.047	**3.85**	**1.02**
Despite all challenges, COVID-19 provided some positive impacts (reducing carbon emissions, saving time, etc.)	0.089	0.004	**0.766**	0.047	**3.87**	**1.00**
COVID-19 may change the way universities teach (by adding more online classes instead of fully in-class curricula)	− 0.078	0.004	**0.729**	0.290	**4.02**	**0.88**
The impact of the COVID-19 crisis allowed us to see a higher level of collaboration between universities to help each other in solving distance learning–teaching	0.228	0.063	**0.618**	0.116	**3.08**	**1.18**
COMPONENT 4–CURRICULA CHANGES						
The impact of the COVID-19 crisis on life as we knew it made me change the way I prepare students for change	0.273	0.111	0.155	**0.815**	**3.18**	**1.02**

Table 2 (continued)

	Component				Mean	SD
	1	2	3	4		
I have revised my teaching methods to highlight the impact of the COVID-19 crisis on life as we knew it	0.309	0.135	0.161	0.779	3.10	1.11
Component mean	2.57	2.02	3.71	3.14		
Component std. deviation	1.04	0.78	0.76	0.95		
Rotation sums of squared loadings (eigenvalues)	3.036	2.760	2.282	1.690		
Percentage of explained variance	20.238	18.398	15.211	11.269		
Reliability (Cronbach's alpha)	0.878	0.789	0.723	0.677		

Extraction method: principal component analysis. Rotation method: varimax with Kaiser normalization

Among a series of consequences of the pandemic, a significant reduction in the number of working hours (10%) or becoming unemployed due to losses of revenues/lower number of students (4%) were indicated to a lesser extent.

Several questions probed how the lockdown affected teaching activities, assessment activities and laboratory practice or internships. It is evident that all these activities were greatly affected by the pandemic, with laboratory practice and internships being the most impacted (49% of the sample indicating impact "to a great extent" in these aspects) possibly due to the face-to-face nature and required presence of such activities. Teaching and assessment activities had lower percentages of the sample in the worst category of impact, with 26% and 25% respectively.

According to the respondents, the main challenges of COVID-19 to their teaching were lack of personal interactions/dialogues with students (82%), lack of interest/motivation from students (58%) and lack of a pedagogical model for distance learning (58%). It is interesting to point out that challenges that were mainly centred on resources or technologies (for example, lack of materials/resources, 19%) scored much lower and were, therefore, considered to be less crucial than the social aspects and personal interactions. Nonetheless, the forced logistical changes at universities led to an increase in different teaching pedagogies and it appears that academics have generally embraced the change. In fact, 65% stated that the lockdown led to an increase in their creativity or new teaching ideas.

Almost all surveyed teaching staff (94.92%) have perceived some type of distress in their students, associated with the pandemic. Most of them indicated the distress to be noticeable or very noticeable (59%). Regarding their own situation, respondents indicated to have felt stressed due to the lockdown and the impact on their work and personal routine to a moderate extent (41%) and a great extent (25%). Thus, developing effective coping mechanisms to deal with the distress is worthwhile as it may help prevent the occurrence of mental illnesses in academic community' members. As shown in Fig. 3, the three most adopted strategies to face the distress arising from the pandemic, referred by the individuals sampled in this study, were: watching movies or series, practising sports and keeping learning and maintaining the work. Other mentioned strategies include walks, yoga and meditation, listening to music, handmade work (such as crochet, knitting and painting) and talking to family and friends.

When it comes to managing job and home activities, the situation of teaching staff is worrying. Just a few respondents reported balancing quite well (8%) or at most times (7%) their job duties and other responsibilities at home. Most of them reported that job activities take more time than others (35%) or almost all the time (30%) when working from home, which certainly can lead to negative consequences in both work and personal lives. One
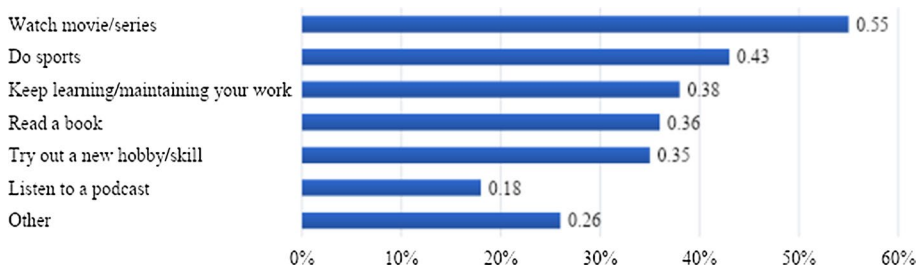

Fig. 3 Strategies used by teaching staff to cope with stress caused by the pandemic lockdowns

in five respondents are in a more intermediate situation, reporting being generally able to balance their tasks (21%).

The COVID-19 disease has been changing the dynamics of work in higher education, consequently altering productivity to some degree. Many studies have looked at the effect of the pandemic on productivity. When asked to rate overall productivity in relation to the lockdown, 44% of the respondents reported a considerable (14.57%) or moderate (29.65%) decrease in productivity.

In addition to changes in productivity, our investigation was also interested in assessing positive and negative aspects of the home office experience during the lockdowns, as presented in Fig. 4. Two related negative outcomes of the experience were the most indicated by the sample: "inability to disconnect" and "difficulties in work–life balance", indicating important challenges in dealing with the different work scenarios and keeping a healthy work routine. To a lesser extent—but still indicated by almost half of the sample—is the pressure felt by teaching staff to keep productive. Anxiety about job stability was the least indicated negative aspect, aligned with the results presented above on the impact of the pandemic on employment.

The most selected positive aspect was "less time spent in traffic", followed by the "possibility to attend several meetings", "reduced costs related to commuting" and "freedom to do house chores between work tasks". More family time was the least indicated advantage, probably because of the perception of work–life balance as suggested by the negative aspects. Just around 1 in 10 respondents do not see positive aspects in the home office experience.
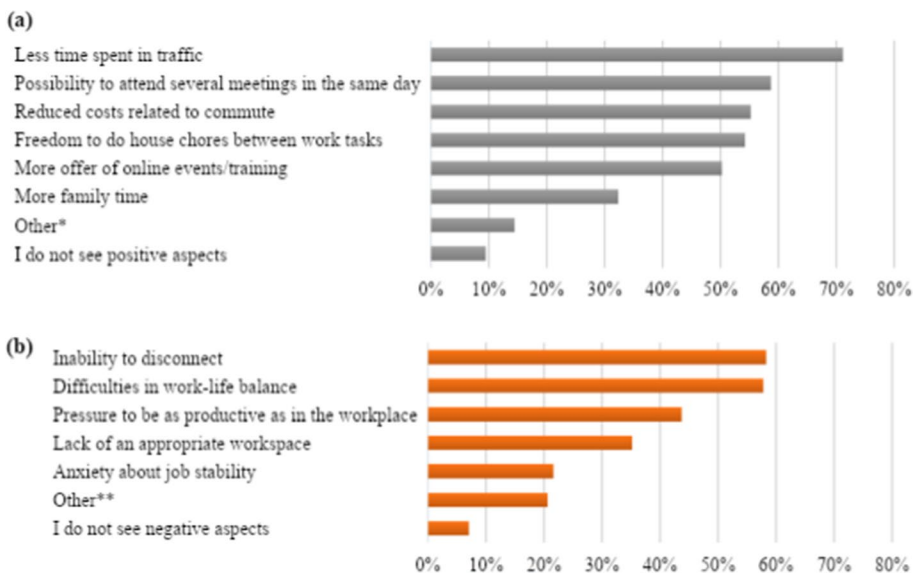
Fig. 4 Positive (**a**) and negative (**b**) aspects of the home office experience during the lockdowns. *Other positive aspects include: the possibility to participate in international events, more time to concentrate/focus on tasks, the opportunity to develop technical skills/new teaching strategies, among others. **Other negative aspects include reduction of income, challenges of homeschooling, increase in workload, lack of informal/social interaction with students/colleagues and zoom fatigue, among others

4.2 Modelling the effect of lockdowns on academic staff

As shown in Table 2, an exploratory modelling approach by principal component analysis was used to identify and order the main factors that explain the effect of the COVID-19 lockdowns on academic staff work.

The PCA revealed a model composed of four components that synthesize the information contained in the 15 variables of the survey. In this sense, the model resulting from the PCA fulfils its purpose, as it facilitates understanding about the effect of COVID-19 lockdown on academic staff work.

In the first column of Table 2, the components are highlighted in uppercase and bold, followed by their respective variables. Columns 2, 3, 4 and 5 present the factor loading matrix, indicating the extent to which each variable contributes to each component. Factorial loadings represent the correlations between the original variables and the components, playing a crucial role in understanding the nature of a particular component (Hair et al., 2014a, 2014b). In these columns, the higher loadings, ranging from 0.901 to 0.618 and shown in bold, justify the association of the variables with a specific factor. In the remaining columns, the lower loadings, equal to or less than 0.309, indicate a weak association of the variables with other factors.

The last two columns of Table 2 display the means and standard deviations of the model's variables. In the bottom part of the table, the last five rows present (1) the mean of each component, (2) its respective standard deviation and (3) eigenvalues, which represent the proportion of variance accounted for by each component, often referred to as the latent root. The fourth row provides the (4) percentage of explained variance, corresponding to the cumulative percentage of the total variance explained by successive factors. The fifth and final row in Table 2 displays the reliability results, assessed through Cronbach's alpha test.

The first component is made up of four items that aim to analyse the effect of the lockdown arising from the COVID-19 pandemic in driving teaching experiences towards sustainability. The average result ($M = 2.57$, $SD = 1.04$) indicates that the pandemic circumstance has a moderate power in boosting the academic staff members towards sustainable development. However, the best-rated item in this component deals with the prospect of revising the contents to include issues related to sustainability during and post-crisis ($M = 3.00$, $SD = 1.12$). Thus, respondents likely intend to add sustainability-related content in future courses.

It is observed that the second component, which analyses the effect of gender on the workload arising from lockdown, obtained the lowest mean ($M = 2.03$, $SD = 0.78$). It indicates that, at an average level, respondents showed disagreement with the statements of the scale added to the survey to assess the relation between gender and workload during the lockdown. There was no significant effect for gender regarding the average value assigned to component 2, $t(133.921) = -0.667$, $p = 0.5$, despite female ($M = 2.06$, $SD = 0.731$) attaining slightly higher scores than male respondents ($M = 1.98$, $SD = 0.853$).

The third component, concerning the opportunity to redesign the future towards sustainability and teaching, obtained the highest average score ($M = 3.71$, $SD = 0.76$), evidencing the expectation that the COVID-19 pandemic would bring long-lasting effects in the sense of improving the teaching–learning relationships, based on the experiences acquired during the pandemic period. Most respondents agree that the pandemic would change the way universities teach ($M = 4.02$, $SD = 0.88$).

The fourth component refers to curricula changes and covers aspects of revising teaching methods and the way teaching staff prepare for the academic experience. This component had the second-highest average score ($M = 3.14$, SD $= 0.95$) and reinforces the expected changes in the teaching process in the following years as an essential outcome of the pandemic. This assessment matches other results collected in the survey: 87% of the respondents confirmed the COVID-19 crisis would influence their teaching in the long term, and of these, the vast majority (82%) pointed out the use of a mixed approach to teaching/learning (e.g. blended learning) as a result. Other outcomes of the influence of the pandemic might be associated with using more technological resources for the "home office" approach (58%) and considering the possibility of extreme events when planning a discipline (33%). The option of less reliance on IT-based communication technologies was only selected by 7% of the respondents.

5 Discussion

During the study period (2021), academic staff of HEIs were required—and to some extent are still being required today—to adapt to the non-conducive working environment and often unfamiliar digital platforms. Remote e-working during lockdown has triggered challenges to teaching arrangements, communications, homework conditions and well-being. The lack of direct interactions between teaching staff and students during the peak of the pandemic was known to have undermined some teaching strategies, project works, discussions and tasks distribution, and maintenance and fostering of social relationships among peers and students, as explored by Mishra et al. (2020). These impacts were corroborated by our investigation, as the lack of interaction with students was the most indicated challenge in the teaching experience during the pandemic, and the impact in practical activities seemed to be larger than those in the teaching and assessment processes.

The impact of the sudden merger of working and living spaces without adequate preparation time has forced many to seek, often through trial and error, new ways of teaching and learning, and to adopt coping behaviours within the new working environment (Waizenegger et al., 2020). On the other hand, the academic staff in this study pointed out two negative aspects of this merge: the lack of a pedagogical model for distance learning and the difficulties in balancing work and personal life.

The disruptions to living and working conditions due to the COVID-19 pandemic have also affected academic staff mentally and emotionally. A survey of the academic staff of universities and colleges in the USA found that 69% of them were extremely or very stressed due to the impact of the lockdown (Mitchell, 2020). Also, over two-thirds reported struggling with increased workloads and deteriorating work–life balance, with blacks, women, disabled and non-binary academic staff members suffering the most. Similarly, at least half of the faculty consider retiring or leaving higher education, especially the tenured academic staff. Over the period 2020–2021, the pandemic compelled universities and colleges to fundamentally re-evaluate how they deliver value to students while ensuring that their staff has the support and resources needed to execute their jobs safely and efficiently. Therefore, administrators of HEIs should consider the pandemic's implications on various segments of academic staff, as indicated by our results as well—especially in terms of the need for a pedagogical model for distance learning.

The study provides additional evidence around the complex nature of changes as a result of the lockdowns. First, although there were shifts towards working from home, there is

also evidence that there were no noticeable changes in working arrangements for more than two-fifths of academics. This is in stark contrast to other studies which found much higher rates (Der Feltz-Cornelis et al, 2020; Kniffin et al, 2021). Our study, with a broader geographic distribution, brings a more nuanced picture of how the lockdowns impacted the work of academics during lockdowns. Here, bringing a more granular understanding of lockdown impacts suggests that although teaching, laboratory work and internships were all implicated, the main challenge appeared to be around the lack of personal dialogues with others and lack of interest/motivation from students. These were, according to the results, seemingly more important than the stressors induced by technological disruptions, unlike other studies indicated (Koff, 2021; Moralista & Oducado, 2020; Paliwal & Singh, 2021). Overall, and also in contrast to most of the extant literature, we did not find differential effects for genders, which might reflect a broader sample base than other studies (Pereira, 2021; Yildirim & Eslen-Ziya, 2021). Meehan et al. (2021), on the other hand, who investigated the effects of the lockdown in the Danish academia, have also reported that self-rated productive levels and the number of self-reported submitted grants and manuscripts had no gender difference. However, such studies do highlight strong inequalities of pressures and experiences of academics with different gender-structured duties such as childcare.

Second, and perhaps more significantly, despite such observably stressful situations and disruptive circumstances, most academics reported the pandemic as prompting a range of valued benefits. Whilst other studies have reported how the lockdowns prompted changes in teaching (Leal Filho et al., 2021c; Trevisan et al., 2020), our study highlights a more detailed picture of this area of change. In contrast to these other empirical works, our study indicates a significant proportion of academics reported how the lockdowns stimulated their creativity or prompted them to engage in new teaching ideas. Additionally, the lockdowns seemed to be most significantly associated with enhancing teaching and learning with respect to sustainability, creating the opportunity to redesign the future in this context and stimulating curricula change. This significant finding suggests that the character of the pandemic-induced lockdowns seemingly functioned to highlight the urgent need for sustainable thinking and behaving in the newly blurred boundaries between work and home life. However, it can also be explained by the rapid onset of new normative expectations around sustainability, where recent evidence highlights that norms provide one of the strongest motivators for climate-adaptive behaviours (van Valkengoed & Steg, 2019).

The rapid development of academic teaching work towards sustainable development does provide a significant re-characterization of educational development processes. The extant literature on how academics integrate sustainable development into educational activity is often described as a planned, strategic approach to maximize sustainability impacts (see Mburayi & Wall, 2018; Molthan-Hill et al, 2019; Chapple et al, 2020). In contrast to this contemporary literature and practice, this study highlights an approach to the integration of sustainability in academic teaching as prompted by crises, disaster management, rapid response, volatility, unpredictability and, for some, under highly stressful working conditions. This highlights a significantly different characterization of academic curricula development and enhancement work for academics globally.

This insight also places different requirements on the academic working infrastructures and patterns of work which can both induce and relieve stress levels. Providing academic staff with support services to cope with the psychological impacts of the lockdown and meeting the challenges of the new teaching environment, ensuring an equitable environment for teaching and research for male and female academics, those working in different disciplines and from diverse income and racial groups can reduce the negative impacts of

the lockdown. There is also the need to develop a new approach to work, that relies less on physical contact. This can be achieved by restructuring educational strategies to address inequalities and creating novel ways of democratizing work patterns and modes of learning to make up for the social disadvantages of isolation. Beech and Anseel (2020) highlight some long-term opportunities associated with the experiences gained by the education systems during the pandemic period. According to the authors, the digitalization of learning might provide more accessible forms of education to support lifelong learning, and the learning–teaching styles could have had a lasting effect to be used in the post-pandemic period.

Overall, this study was motivated by the need to assess the impact of the crisis caused by the pandemic so that lessons can be learnt, and recommendations can be provided, and focused on a group of the educational sector—academic staff of higher education institutions. The contribution of this investigation relies on the international analysis of the impacts perceived by academic staff that is added to the literature, along with national and institutional cases. Another distinctive contribution is the relation between those impacts and the revision of teaching practices to support the global sustainability agenda.

6 Conclusions

This study reported on how the lockdowns influenced the work and lives of academic staff at universities, and by means of an online survey, collected 201 responses from 39 countries.

The first research question of this investigation referred to the perception of academic staff on the impacts of the pandemic on their work. According to the sample, classes involving practical activities were more severely impacted. The primary obstacles in the teaching practice revolved around social aspects and personal interactions, such as the lack of direct engagement with students, their lack of interest or motivation and the lack of a pedagogical model for distance learning. In contrast, challenges related to resources or technologies were comparatively less significant. Compared to the effects on teaching and research practices, academic staff experienced more substantial impacts on their personal lives, particularly in terms of increased stress levels and the challenge of balancing job and home demands. The respondents indicated the inability to disconnect and difficulties in balancing work and personal life as the most negative aspects of the lockdowns. On the positive side, spending less time in traffic was identified as the most positive outcome.

The second research question focused on the potential opportunity the COVID-19 pandemic might represent for revising teaching and research approaches to cover sustainability aspects. The principal component analysis indicated that the pandemic could bring long-lasting effects to the global sustainability agenda due to improved teaching–learning relationships and experience acquired during the lockdowns. Not only does the studied sample indicate the potential change in the way universities teach, but they also indicated having already revised their teaching approach to connect the pandemic with sustainability challenges.

6.1 Limitations

This paper has some limitations. The first one refers to the fact that the study was undertaken in 2021 and some of the trends (e.g. familiarity with online teaching) have changed. A further limitation is related to the fact that the sample was not large enough to allow definitive conclusions to be drawn. The study provides nonetheless a welcome contribution

to the literature since it has analysed and documented trends related to the pandemic from a set of 39 countries, hence helping to foster a broader understanding of the international implications of the pandemic.

6.2 Suggestions for further action in future pandemics

As several countries have advanced in controlling the pandemic and in the share of the population vaccinated, universities have been reopening and have largely returned to physical teaching. This trend, however, may change, should new mutations of the virus lead to new waves of infections.

The outcomes of this study may provide a series of lessons for this re-adaptation period—and in case of future challenges:

- First, as the pandemic is seen as an opportunity to bring long-lasting effects to improve teaching–learning relationships and redesign the future towards sustainable development, HEIs can consider using more digital resources and new teaching styles. This is expected to not only improve learning but also support the preparedness for similar situations that could arise in the future. This can be recommended as challenges associated with resources or technologies have not seemed to impact to a great extent the studied sample, and although this might be the case in different contexts, it is important that risks of similar situations in the future help decision-makers and the educational sector to better prepare for it.
- Second, as the pandemic seems to have encouraged educators to include issues related to sustainable development in their teaching, universities should make sure the momentum is not lost and save energy to invest in that by revising curricula and sharing good practices to inspire more teaching staff.
- Lastly, given the stressful conditions and changes in productivity among some staff and students, academic institutions should offer greater support to teaching staff to better balance their professional and personal lives and students with an opportunity to also adapt to a changing situation. By doing so, they may certainly increase efficiency in teaching–learning processes and deploy techniques such as regular breaks and flexible deadlines to address health concerns.

Appendix 1: Questionnaire

1. University location
   (add country).
   2. Gender
   Male.
   Female.
   Prefer not to say.
   3. Age
   21 to 30 years old.
   31 to 40 years old.
   41 to 50 years old.
   51 to 60 years old.
   More than 60 years old.

4. My role at University

Permanent member of staff mainly involved in undergraduate teaching and research.

Permanent member of staff mainly involved in postgraduate teaching and research.

Permanent member of staff mainly involved in teaching.

Permanent member of staff mainly involved in research.

Temporary member of staff.

5. In which primary knowledge area do you work?

Environmental and earth sciences.

Biological sciences.

Chemical sciences.

Physical sciences.

Mathematical sciences.

Engineering.

Health sciences.

Agrarian sciences.

Social sciences.

Humanities/Linguistics.

Business studies.

Other (please specify).

6. How long have you been affected by the lockdown and unable to perform on campus teaching at the university?

Between 1 to 2 weeks.

Between 2 weeks and 1 month.

Between 1 and 3 months.

Between 3 and 6 months.

More than 6 months.

7. To which extent do you agree with the actions taken by your university to lockdown the operations during this period?

Totally disagree.

Disagree.

Neither agree nor disagree.

Agree.

Totally agree.

8. During the crisis, you

Work(ed) normally from your office/laboratory.

Work(ed) at "home office" only.

Shuttled regularly between home and your office/laboratory.

Have not worked (no activities/university full shutdown).

9. To which extent has the lockdown influenced your teaching?

Not at all.

A little bit.

To some extent.

To a moderate extent.

To a great extent.

10. To which extent has the lockdown influenced your assessment activities?

Not at all.

A little bit.

To some extent.

To a moderate extent.

To a great extent.

11. To which extent has the COVID-19 impacted disciplines with practices in laboratories, curricular internships and final course reports?

Not at all.

A little bit.

To some extent.

To a moderate extent.

To a great extent.

12. How do you rate the impacts of the COVID-19 crisis on your teaching workload?

It substantially decreased.

It decreased.

No impact.

It moderately increased.

It greatly increased.

13. Which are/were the main challenges of COVID-19 to your teaching?

Lack of materials/resources.

Lack of interest/motivation from students.

Lack of support from the administration.

Lack of expertise regarding new technologies.

Lack of personal interactions/dialogues with students.

Lack of a pedagogical model for distance learning.

Lack of personal interactions/dialogues with colleagues (meaning others lectures).

Lack of personal interactions/dialogues with staff (meaning academic, IT staff among other).

Need for rapid response.

Other (please specify).

14. Has the lockdown led to an increase on your creativity or to new ideas for your teaching?

Yes.

No.

Other.

15. How do you manage your job and home activities?

My job activities take almost all time when working from home.

My job activities take more time than others when working from home.

I am generally able to balance between job and other activities at home.

Most of the times I manage to keep my job hours under control.

I am doing quite well in balancing job duties and other responsibilities when working from home.

16. How would you describe your ability to work under the COVID-19 threat?

COVID 19 information and development often distracts my ability to work.

COVID 19 information and development sometimes distracts my ability to work.

I am usually able to work despite the news and developments of COVID 19 crisis.

Most of the times I am able to work despite the news and developments of COVID 19 crisis.

I do not feel any distraction of my ability to work caused by the COVID 19 crisis 1.

17. Have you felt stressed due to lockdown and its impact on your work and personal routine? If so, to what level?

Not at all.

A little bit.

To some extent.

To a moderate extent.

To a great extent.

18. How has the pandemic affected your employment?

It led to unemployment due to losses of revenues/lower students numbers.

It led to a significant change, e.g. A significant reduction in the number working hours.

It led to a partial change, e.g. Slight reduction in the number of working hours.

I only had a very light change in my schedule.

I experienced no changes at all.

19. Do you think there are/were positive aspects of the home-office experience during the lockdown? If so, which of the following apply to you?

I do not see positive aspects.

Reduced costs related to commute.

Less time spent in traffic.

Freedom to do house chores between work tasks.

More family time.

More offer of online events/trainings.

Possibility to attend several meetings in the same day.

Other (please specify).

20. Do you think there are/were negative aspects of the home-office experience during the lockdown? If so, which of the following apply to you?

I do not see negative aspects.

Inability to disconnect.

Lack of an appropriate workspace.

Difficulties in work-life balance.

Pressure to be as productive as in the workplace.

Anxiety about job stability.

Other (please specify).

21. What stress coping strategies do you use in case of necessity? Multiple answers possible

Keep learning and maintaining your work.

Read a book.

Listen to a podcast.

Do sports.

Watch movie/series.

Try out a new hobby or skill (e.g., cook a new recipe, play an instrument, learn a language, learn how to sew, gardening).

Other (please specify).

22. How could you rate your overall productivity in relation to the lockdown?

It has decreased considerably.

It has decreased a little.

It has not changed.

It has improved considerably.

It has improved a lot.

23. Please indicate your level of agreement with each statement below: (1–totally disagree; 5–totally agree)

	1	2	3	4	5
Female members of staff have received more support from the administration than their male colleagues					
Male members of staff have received more support from the administration than their female colleagues					
Since the beginning of the outbreak female members of staff have faced more challenges than their male colleagues					
Since the beginning of the outbreak male members of staff have faced more challenges than their female colleagues					
Female members of staff coped with the crisis better than their male colleagues					
Male members of staff cope with the crisis better than their female colleagues					

24. Have you noticed the sign of distress among your students?
Yes, it very noticeable.
Yes, it is noticeable.
Yes, it is sometimes noticeable.
Yes, it is occasionally noticeable.
Yes, but rarely noticeable.
No, i have not noticed.
25. Will the COVID-19 crisis influence your teaching in the long-term?
Yes.
No.
26. If so, in which ways?
Consider the possibility of "extreme events" when planning a discipline.
Less reliance on it-based communication technologies.
Use more technological resources for "home office" approach.
Using a mixed approach of teaching/learning (blended learning/b-learning).
Other (please specify).
27. Please indicate your level of agreement with each statement below: (1–totally disagree; 5–totally agree)

	1	2	3	4	5
The incidence of COVID-19 has offered new opportunities to reimagine the future world and this may benefit the global sustainability agenda					
I expect that global cooperation on tackling COVID-19 will likely divert attention and resources away from global action on climate change					
The impact of the COVID-19 crisis on life as we knew it made me change the way I prepare students for change					
I have revised my teaching methods to highlight the impact of the COVID-19 crisis on life as we knew it					
I have revised the content of my classes to add more issues connected to sustainability during and post-crisis					
Despite all challenges, COVID-19 provided some positive impacts (reducing carbon emissions, saving time, etc.)					
COVID-19 may change the way universities teach (for adding more online classes instead of fully in-class curricula)					
The impact of the COVID-19 crisis allowed to see a higher level of collaboration between universities to help each other in solving distance learning teaching					

	1	2	3	4	5
I used COVID-19 as an entryway into teaching the UN Sustainable Development Goals					
I used COVID-19 as an opportunity to better teach sustainability competencies to my students					
I used COVID-19 as an opportunity to help my students learn about how linear, industrial systems are brittle and unsustainable					
To me, COVID-19 presents a preview of how we will have to respond to global warming					
I can see a frame of COVID-19 and responses through the lens of justice and ethics					

Data availability The datasets generated during and/or analysed during the current study are available from the corresponding author upon reasonable request.

Declarations

Conflict of interest The authors declare no competing interests.

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Authors and Affiliations

Walter Leal Filho[1,2] · Tony Wall[3] · Amanda Lange Salvia[2] ⓘ **·**
Claudio Ruy Vasconcelos[5,6] · Ismaila Rimi Abubakar[7] · Aprajita Minhas[2] ·
Mark Mifsud[8] · Valerija Kozlova[9] · Violeta Orlovic Lovren[10] ·
Hossein Azadi[11] · Ayyoob Sharifi[12,24] · Marina Kovaleva[2] · Todd LeVasseur[13] ·
Johannes Luetz[14,15,16] · Luis Velazquez[17] · Priyatma Singh[18] · Rudi Pretorius[19] ·
Noor Adelyna Mohammed Akib[20] · Tamara Savelyeva[21] · Luciana Brandli[4] ·
Nandhivarman Muthu[22] · Patrizia Lombardi[23]

✉ Amanda Lange Salvia
amanda.lange-salvia@haw-hamburg.de

Walter Leal Filho
W.Leal@mmu.ac.uk

Tony Wall
t.wall@ljmu.ac.uk

Claudio Ruy Vasconcelos
claudioruy@yahoo.com

Ismaila Rimi Abubakar
irabubakar@iau.edu.sa

Aprajita Minhas
aprajita.Minhas@haw-hamburg.de

Mark Mifsud
mark.c.mifsud@um.edu.mt

Valerija Kozlova
valerija.kozlova@riseba.lv

Violeta Orlovic Lovren
violeta.orlovic@f.bg.ac.rs

Hossein Azadi
hossein.azadi@uliege.be

Ayyoob Sharifi
Sharifi@hiroshima-u.ac.jp

Marina Kovaleva
Marina.Kovaleva@haw-hamburg.de

Todd LeVasseur
levasseurtj@cofc.edu

Johannes Luetz
j.luetz@unsw.edu.au

Luis Velazquez
luis.velazquez@unison.mx

Priyatma Singh
priyatmas@unifiji.ac.fj

Rudi Pretorius
pretorw@unisa.ac.za

Noor Adelyna Mohammed Akib
adelyna@usm.my

Tamara Savelyeva
tvs3@cornell.edu

Luciana Brandli
brandli@upf.br

Nandhivarman Muthu
m.nandhivarman@gmail.com

Patrizia Lombardi
patrizia.lombardi@polito.it

1   Department of Natural Sciences, UK Consortium on Sustainability Research, Manchester Metropolitan University, Chester Street, Manchester M1 5GD, UK

2   European School of Sustainability Science and Research, Hamburg University of Applied Sciences, Ulmenliet 20, 21033 Hamburg, Germany

3   Liverpool Business School, Liverpool John Moores University, Liverpool L3 5UG, UK

4   Graduate Program in Civil and Environment Engineering, University of Passo Fundo, Campus I - BR 285, São José, Passo Fundo, RS 99052-900, Brazil

5   Department of Production Engineering, Federal University of Paraíba, João Pessoa, Brazil

6   Algoritmi Research Centre, School of Engineering, University of Minho, 4800-058 Guimarães, Portugal

7   College of Architecture and Planning, Imam Abdulrahman Bin Faisal University (Formerly, University of Dammam), P.O. Box 1982, 31441 Dammam, Saudi Arabia

8   Centre for Environmental Education & Research, University of Malta, Msida MSD 2080, Malta

9   Faculty of Business and Economics, RISEBA University of Applied Sciences, 3 Meža Street, Riga 1048, Latvia

10 Faculty of Philosophy, University of Belgrade, Belgrade, Serbia

11 Department of Economics and Rural Development, Gembloux Agro-Bio Tech, University of Liège, Gembloux, Belgium

12 Graduate School of Humanities and Social Sciences, and Network for Education and Research on Peace and Sustainability, Hiroshima University, Higashi-Hiroshima 739-8530, Japan

13 School of Humanities and Social Sciences, College of Charleston, Sustainability Literacy Institute, Charleston, USA

[14] Graduate Research School, Alphacrucis University College (AC), Brisbane, QLD, Australia

[15] School of Law and Society, The University of the Sunshine Coast (USC), Maroochydore, QLD, Australia

[16] School of Social Sciences, University of New South Wales (UNSW), Sydney, NSW, Australia

[17] Industrial Engineering Department, University of Sonora, Hermosillo, Mexico

[18] Department of Science, School of Science and Technology, The University of Fiji, Lautoka, Fiji

[19] Department of Geography, University of South Africa, Pretoria, South Africa

[20] Centre for Global Sustainability Studies (CGSS) and School of Biological Sciences, University Sains Malaysia, Penang, Malaysia

[21] The Hong Kong Institute of Education for Sustainable Development, Hong Kong, China

[22] Department of Ecology and Environmental Sciences, Pondicherry University, Puducherry, India

[23] Interuniversity Department of Regional and Urban Studies and Planning, Politecnico di Torino, Turin, Italy

[24] School of Architecture and Design, Lebanese American University, Beirut, Lebanon