

A characterisation of the academic profile of a community of professors involved in Sustainable Human Development: the case of the Global Dimension in Engineering Education

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Abstract

In the last decade, a number of technical universities and engineering faculties have been engaged in different initiatives aimed at integrating sustainable development in their functions. Academic staff engagement in sustainable development issues has been recognised to be a catalyst in curriculum change processes. This contribution presents and discusses key findings from a research conducted on academics involved in training activities related to Sustainable Human Development in the framework of the European initiative “Global Dimension in Engineering Education – GDEE”. This initiative aims at promoting the integration of Sustainable Human Development as cross-cutting issue in teaching activities of technical universities, mainly by improving the competencies of academic staff, and through staff engagement in a wide range of initiatives related to Sustainable Human Development. A number of academics, mostly engineers and lecturers from European technical universities, have been involved in different activities of the project: elaboration of training materials, delivery, coordination and evaluation of on-line courses, development of case studies and attendance of courses. The present study analyses and characterises the academic profile of two groups of academics, with different grade of expertise and involvement in Sustainable Human Development, with the aim to enhance the understanding of the academic profile of faculty engaged these topics, and fostering the replicability of similar initiatives in different contexts. From one side, a group of experts that have contributed in developing training materials and on-line courses. From the other side, a group of participants to training activities, namely academics of engineering or science-based universities that completed one or more courses offered through the Spanish virtual platform. The methodology includes i) a bibliometric analysis of the scientific publications of the two groups, and ii) an analysis of a semi-structured questionnaire focused on academic activities and social outreach of this collective. The results provide an in-deep characterization of this community, highlighting trends and similarities of the academic activities and the scientific production of this collective. The analysis also highlighted that academics involved in this project present research and teaching activities strongly integrated and with positive mutual feedback, as well as relevant linkages with civil society and non-governmental organisations. Based on these findings, the paper concludes suggesting a specific profile of trainers to successfully promote initiatives similar to GDEE in other contexts and proposing the implementation of more appropriate policies and mechanisms, at university level, to recognize the efforts of academics engaged in issues related to Sustainable Human Development.

Keywords: Global Dimension, Engineering, Sustainable Human Development, Sustainable Development Goals, Higher Education Policy.

1. Introduction

The last decades have witnessed an increased political will in relation to global Sustainable Development (SD), which has been identified as one of the greatest challenges that our

societies are facing. This process of growing social recognition has guided the Post-2015 Development Agenda leading to the final adoption of the Sustainable Development Goals (SDG) (United Nations, 2015). In response to this growing call, an increasing number of higher education institutions (HEI) have been engaged incorporating SD into their systems (Lozano et al., 2014), reconsidering the content of their curricula. Nonetheless, many challenges remain. Scientific literature identifies multiple barriers preventing a proper integration of SD into higher education (Velazquez et al. 2006; Lozano 2006). These barriers have been related to: i) lack of awareness or interest in SD issues of academics, students and staff; ii) the structure of higher education, characterised to be conservative and disciplinary with strong resistance to change of the functions of education and research; and iii) lack of resources and adequate institutional support (Verhulst and Lambrechts, 2014).

These issues are particularly sensitive in technical universities where education is primarily focused on the technical and, traditionally, there have not been many opportunity to develop broader knowledge and skills to respond to the complexity of global problems related to SD (Crofton, 2000). Currently, engineering methods and tools are still characterised by a strong practical orientation and are mostly focused at finding and implementing solutions that work with certainty and predictability (Halbe et al., 2015).

In this environment, characterised by technical paradigms and a strong disciplinarity, it is not an easy task promoting a cultural shift to existing dominant structures and practices to integrate SD values into curricula. For these reasons, few engineering schools seems to have made major updates to their courses and curricula over the past few decades (Davidson et al., 2010). Responses to the calls of curricula reform in engineering are, in general, relatively limited (Fenner et al., 2005; Lozano and Lozano, 2014; von Blottnitz et al., 2015), and much of the efforts are mostly focused in developing individual courses on SD (von Blottnitz et al., 2015). Different approaches have been focused specifically on technical universities (Boni and Pérez-Foguet, 2008; Lozano et al., 2014; Pérez-Foguet et al., 2005; Segalàs et al., 2010). Furthermore, other efforts have aimed at reinforcing the alignment between engineering and development studies (Boni and Pérez-Foguet, 2008; Pérez-Foguet et al., 2005), in line with Sustainable Human Development (SHD) theoretical framework (Absell, 2015) .

It is worth highlighting that in HEI often there is no adequate institutional support and incentives for those academics willing to integrate SD in their teaching and research activities (Hoover and Harder, 2014), and most of the efforts lie primarily in personal satisfaction of overcommitted academics and remain mostly unrewarded (Krizek et al. 2012). In the case of engineering, activities not falling within the disciplinary context of the core technical content are often not fully recognised during the evaluation of teaching and research merits. Mulder et al. (2012) analysing the education of engineers for SD and its relevant challenges, emphasize the need for complementary approaches to foster changes in engineering curricula. Specifically, they point out that top-down institutional support has to be complemented with bottom up initiatives, aimed at further engaging motivated faculty. It is vital, thus, to effectively tackle this shortcoming, identifying the drivers to foster the empowerment and the active engagement of academics in sustainability education and research.

Having this context in mind, this contribution presents and discusses key findings from a research conducted on professors and researchers involved in academic activities related with SHD in the framework of the European initiative “Global Dimension in Engineering Education” (GDÉE). The GDÉE initiative is a European network whose aim is to increase the awareness, critical understanding and attitudinal values of undergraduates and postgraduates students in technical universities across Europe related to SHD and its relationship with technology. This has been dealt with by integrating SHD as cross-cutting issue in teaching activities by improving the competences of academics and through engaging both staff and students in initiatives related to SHD. It started in 2012 as a collaborative project between a consortium of European Universities and Non-Government Organisations of Spain, Italy and United Kingdom funded by EuropeAid.

The pedagogical approach, based on previous works of project partners (Boni Aristizábal and Pérez-Foguet, 2006; Oliete-Josa and Pérez-Foguet, 2008), has been described extensively

elsewhere (Trimingham et al., n.d.). For the purpose of this research, it is worth mentioning that the project strategy has been based on a continuous professional development approach addressed to academics focused on three main areas: competences, connectivity and collaboration.

1. Competences: enhancing the competences of academics and students with regards to their understanding of SHD issues and their capability to mainstream them in the academic curricula;
2. Connectivity: enhancing the capability of academic institutions to connect and share efforts within and across EU Member States as well as share and disseminate results and best practices regarding the integration of MDGs/SDGs into technology studies;
3. Collaboration: enhancing the ability to work with other stakeholders, notably Non-Governmental Organizations (NGOs) in order to advance a more practical dimension to the work carried out at academic levels.

Through activities related to each one of these three areas the project aimed at fostering a Global Dimension (GD) as an integral part of engineering education. A GD is one that encourages students to think of themselves as global citizens and thus promote a sense of global social responsibility (Bourn & Neal 2008). The focus is on the incorporation of SHD in academic activities, specifically promoting the understanding of issues related to global development: extreme poverty, human rights, globalisation, equality issues and environmental challenges. This approach has already relationships with other agendas, such as: sustainability science, humanitarian engineering and ethics. However, the benefits of including a GD is that it can help students make links to the real world, and enable engineers to play a role in poverty reduction, human rights issues, and conflict resolution. The composition of the consortium, comprising universities and NGOs, reflects the approach promoted with this initiative: fostering the cooperation between NGOs and academia as key factor in reinforcing the presence of SHD in formal teaching programs at all levels of engineering education.

According to this strategy, the project included different complementary activities aimed at up-skilling, motivating and engaging academics with development issues, as well as promoting SHD issues in engineering education. Among main project outcomes, nine on-line courses were developed in order to increase the competences and abilities of academic staff of technical or science-based universities to integrate development-related issues in their teaching and research activities. For the implementation of each course, a set of training materials has been developed by selected European experts in this field. Besides, a set of teaching resources aimed at supporting lecturers at integrating SHD issues in teaching activities were developed. All these resources are available online at the project website (GDEE, 2015) distributed as Open Educational Resources (OER).

At the project completion, in April 2015, the GDEE community comprised more of four hundred members from a total of eighty-four different universities. The network includes different profiles, mostly academics but also non-academics experts in the field of development (from NGOs, development training centres, and engineering organizations). Some of them were directly involved in project's activities; others are participants who attended GDEE on-line courses offered in the three partners' countries; and others are academics or professionals interested in joining the activities of the network. With respect to this research, it is worth mentioning that almost hundred professionals, mostly academics, have closely collaborated in developing training and teaching materials as well as in the delivery, coordination and evaluation of on-line courses. On the other hand, almost three-hundred people, mostly academics, enrolled in one or more for a total of 885 enrolments.

2. Methods

Starting from the context described earlier, this research aims at analysing comparatively and characterising two groups of the GDEE community, in order to enhance the understanding of the academic profile of faculty engaged in SHD issues and, consequently, foster the replicability of the initiative in different contexts.

The two groups analysed have different grades of expertise and involvement in SHD. From one side, 43 contributors, experts in SHD that have closely collaborated in developing training materials as well as in the delivery of on-line courses. From the other side, 47 participants, academics of engineering or science-based Spanish universities that completed one or more courses offered through the Spanish virtual platform.

Methods include: i) a bibliometric analysis of the scientific publications of contributors and participants in order to analyse the scientific profile of the two groups and ii) an analysis of a semi-structured questionnaire aimed at deepening the understanding of the academic profile of faculty involved in activities related with SD.

2.1 Bibliometric analysis

The bibliometric analysis of the two groups of GDEE community includes the following steps:

- Selection and analysis of the research publications registered in Scopus database of the GDEE community.
- Generation of an overlaid journal map based on data download from Scopus
- Operationalization of a disciplinary diversity index.

After comparing the two main scientific databases Web of Science (WoS) and Scopus, following Aghaei Chadegani et al. (2013) we opted to use the latter as our principal data resource mainly because Scopus adapts better to the characteristics of GDEE community. In fact, among GDEE courses participants there are a number of young; professors and PhD students, and Scopus covers a superior number has a broader coverage of journals even if with lower impact. Thus, essential research quality indicators (such as volume, impact, h-index) have been analysed using Scopus database.

After performing author search in Scopus database for each member of the groups of contributors and participants, for a total of 90 entries. We found out that, roughly, only 60% of the members of GDEE community have a Scopus ID, for different reasons. Among contributors, mainly due to a number of NGO practitioners and other experts that do not have research publications. Instead, among courses participants, we found, surprisingly, a significant number of professors without Scopus ID as well as few practitioners and PhD students. Subsequently, we examined the scientific literature of all the members of the GDEE community with Scopus ID (respectively 31 contributors and 22 participants).

Bibliometric analysis can be greatly enriched with the help of appropriate visualisations. Science maps, for example, are suitable tools for this purpose. They are visual representations built on the overall science interrelationship based on journal articles (Leydesdorff et al., 2014; Porter and Rafols, 2009), and help to visually identify major areas of science, their size, similarity and interconnectedness. Specifically, the use of science maps is particularly helpful since allows to analyse different aspects of disciplinarity such as: i) the variety of “disciplines”; ii) the balance, or distribution, of disciplines (expressed by the relative size of nodes in the map); and iii) the disparity, or degree of difference, between the disciplines (expressed by the distance between the nodes of the map) (Porter and Rafols, 2009).

Given the purposes of this study, we opted for a base map tool called Overlay.exe²¹, a global map of science that can be interactively overlaid with journal distributions in sets downloaded from Scopus. Base maps can be used as a basic framework on which the journal distribution of a set of documents downloaded from Scopus can be projected. Subsequently, it is possible assessing the portfolio of documents in terms of the spread across journal and journal categories.

²¹ Overlay.exe is available online at: http://www.leydesdorff.net/scopus_ovl/index.htm . For a complete description of the tool please consult (Leydesdorff et al., 2014)

Furthermore, base maps can be used as a distance maps for measuring interdisciplinarity in term of journal composition (Leydesdorff et al., 2014). Simple to more complex indicators have been developed for the purpose of assessing interdisciplinarity of researchers (Porter et al., 2007). For the purpose of this research we opted for the use of Rao-Stirling index. Unlike other indexes commonly used to assess interdisciplinarity, such as Shannon or Herfindahl, Rao-Stirling accounts not only for the variety but also for the disparity, namely the ecological distance among different subsets of journals (Leydesdorff and Rafols, 2011; Porter and Rafols, 2009).

2.2 Semi-structured questionnaire

Contextually to the bibliometric analysis, a survey aimed at deepening the understanding of the academic profile of faculty involved in GDEE activities has been developed. The survey was divided into six categories:

1. Academic profile of the respondents (affiliation, accredited years of teaching and research)
2. Teaching activities: including specific information on subjects imparted by respondents (such as student evaluation and grading criteria) and engagement of respondents in teaching innovation activities.
3. Research activities: including main research fields of respondents, especially focusing on the relation between research and teaching activities.
4. Degree of integration of SDGs in respondents' teaching and research activities, as well as the perceived relation between crosscutting competences adopted by HEI and SDGs.
5. Social outreach and collaboration: entities with which respondents regularly cooperate and the type of collaboration.
6. Perception of the recognition/evaluation of academics merits including university evaluation and regional/national accreditation agencies.

The survey comprised 23 close-ended questions, mostly employing a 5 point Likert scale from 'totally disagree' to 'totally agree', as well as ranking and multiple select questions, which were complemented with 13 open-ended questions to ask respondents a deepening based on their experience on different academic issues. Table 1 shows the survey structure in detail.

Table 1. Survey structure

Academic profile of the respondents	
Professional data	Open-ended questions
Teaching activities	
Subjects imparted	Open-ended questions
Evaluation and grading criteria	Open-ended questions
Engagement in teaching innovation activities	Likert scale; Open-ended questions
Research activities	
UNESCO nomenclature for fields of science and technology	Open-ended questions
Relation between research and teaching	Likert scale; Open-ended questions
Sustainable Development Goals	
Degree of integration of SDGs in teaching and research	Likert scale

Relation between SDGs and university transversal competences	Likert scale
Social outreach and collaboration	
Collaboration with social entities	Likert scale; Multiple-select
Research dissemination channels	Ranking
Perception of the recognition/evaluation of academics merits	
University monitoring of academics activities	Multiple-select
Recognition of academic merits and promotion procedures	Likert scale; Open-ended questions

The aim of the survey was not assessing the engagement of faculty in each specific SDGs but, rather, identify the degree of integration of SDGs concept in respondents' teaching and research activities, specifically those related to engineering. For this reason, SDGs have been grouped in twelve items described in Table 2.

Table 2. Sustainable Development Goals grouping.

Description	SDG
End of poverty and hunger	(SDGs 1, 2)
Ensure healthy lives and well-being	(SDG 3)
Inclusive, equitable and quality education	(SDG 4)
Reduce inequalities and achieve gender equality	(SDGs 5, 10)
Clean water and sanitation	(ODS 6)
Affordable and clean energy	(SDG 7)
Promotion of a decent work and sustainable industrialization	(SDGs 8, 9)
Sustainable cities/communities and sustainable production and consumption patterns	(SDGs 11, 12)
Climate change adaptation	(SDGs 13)
Conservation and sustainable use of ecosystems	(SDGs 14, 15)
Promotion of peace, justice and strong institutions	(SDG 16)
Promotion of global partnership for SD	(SDG 17)

The survey has been sent to all the academics of the groups of contributors and participants analyzed with the bibliometric analysis using survey tool SoGoSurvey, and made available for a period of three months.

3. Results

3.1 Analysis of scientific production

Table 3 summarizes overall results of the bibliometric analysis of the two groups. It includes, from left to right, the number of people with or without Scopus ID, the number of papers (Np), the

number of total contributions (Nt) and the percentages of them classified in Scopus Engineering subject; and in the second line, the total number of hits in different categories (Ncat), the ratio of Ncat over number of papers, the percentage of hits in Engineering, the number of hits of total contributions (Ntca), ratio of Ntca over total number of contributions, and ratio of them in Engineering subject.

It is interesting to highlight some differences between GDEE contributors and participants. First of all, contributors have a higher number of Scopus ID than participants. However, participants with Scopus ID are scientifically more productive, almost 21% more papers/person. Secondly, contributors' research publications (including both articles and total contributions), are more focused in the category of Engineering, than those of participants, more than 20% in both. Finally, contributor's articles are more interdisciplinary in nature, counting in average in 2,63 categories, versus 1,98 of participants and, equivalently, when considering total contributions.

Table 3. Summary of main characteristics of both groups analysed.

	Scopus ID	No Sc. ID	Num papers	Num total	Eng/Np	Eng/Nt
Contributors	31	12	220	352	60%	64%
Participants	22	25	362	536	36%	42%
Total	53	37	582	888	45%	51%
	Num categ.	Ncat/Np	Eng/Ncat	Num t. cat.	Ntca/Nt	Eng/Ntca
Contributors	578	2,63	23%	891	2,53	25%
Participants	715	1,98	18%	1003	1,87	22%
Total	1293	2,22	20%	1894	2,13	24%

Figure 1 presents the total number of scientific contributions of the two groups, respectively articles and all contributions, using Scopus classification (only categories with more than 10 contributions are displayed). Coherently with the target of the project, the average profile of GDEE academic has the most relevant activity in the field of engineering, followed by Environmental Science and Chemical Engineering.

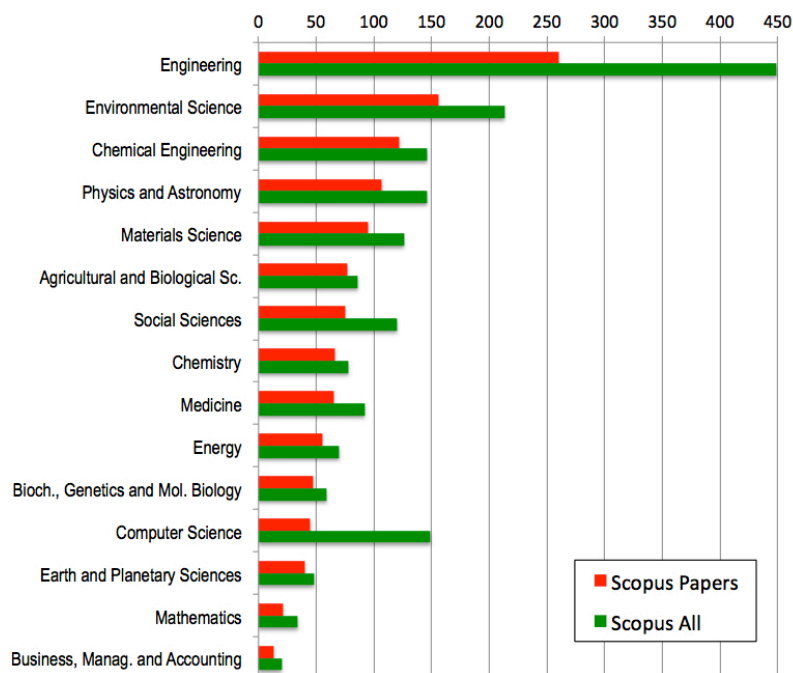


Figure 1. Number of papers and all contributions of GDEE community using Scopus classification.

Figure 2 presents the relative distribution of scientific publications using Scopus Subject Classification. Respectively, scientific articles and all contributions (comprising articles, book chapters, conference papers) of the two groups are displayed. Being engineering the predominant subject in both cases, it fixes the reference value for 100%. Then the order of subjects is fixed by decreasing the relative value of articles of contributors. It can be appreciated that the highest relevance of contributors is in Environmental Science and Social Sciences. Instead, the group of participants shows higher relevance in more categories (Physics and Astronomy, Materials Science, Agricultural and Biological Sciences, Medicine, etc.). Remarkably, the key areas that differentiate the two groups are Social Science and Medicine. In both categories, a particularly relevant research activity of one group is opposed to a significantly low activity of the other.

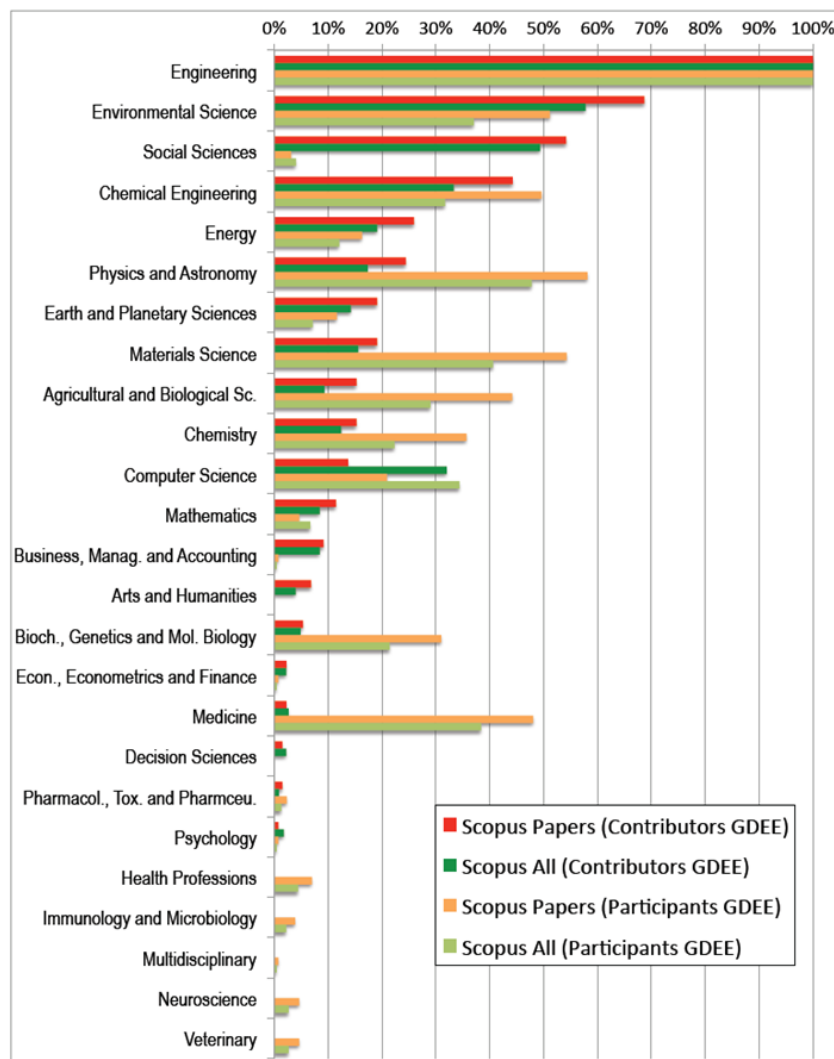


Figure 2. Relative distribution of articles and all contributions of GDEE community using Scopus classification.

These findings can be easily visualised in Figure 3 with the help of overlaid Science Maps. The figure shows the journals distribution of the scientific production of the two groups, highlighted onto a base map of global science (in light green), according to Scopus classification. At the top of the two maps are well visible the journals of Engineering fields (blue and yellow), predominant subject of research for both groups. Then, contributors and participants show journal distribution focused in opposed research areas, respectively left for journal categories related to social sciences journals and right for categories related to medicine, such as biotechnology, medical physics, radiology etc.

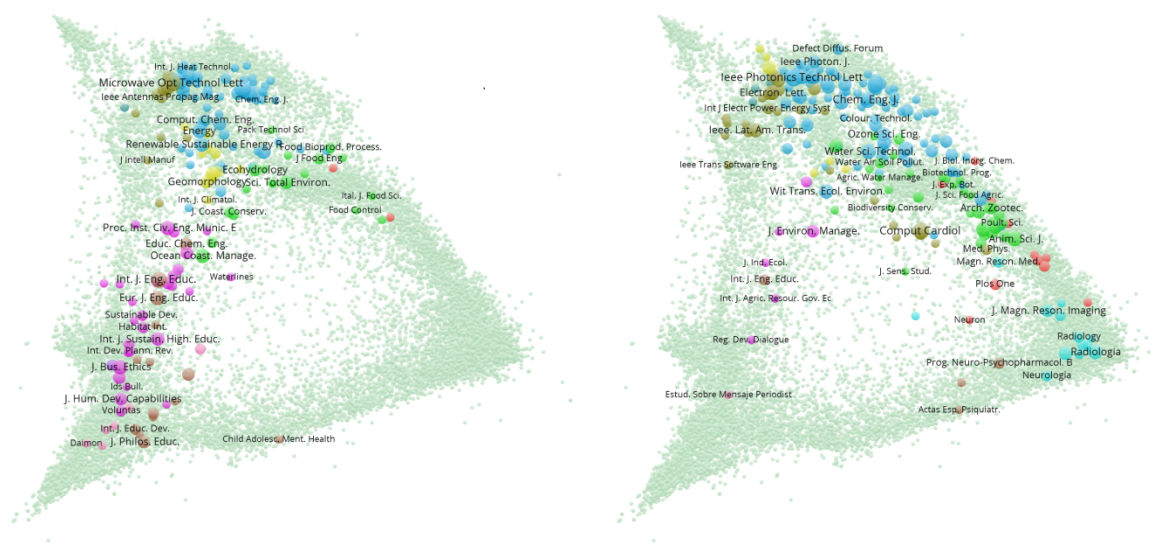


Figure 3. Journals distribution of the scientific output of 'contributors' (right) and 'participants' (left).

As outlined earlier, the information provided by science maps is particularly useful to assess interdisciplinarity of different portfolios of publications. Specifically, in the case of the two groups analysed, Rao-Sterling interdisciplinary index can be operationalized using the values of the distance among the respective subsets of journals provided by the map. The calculation of Rao-Sterling index shows that the degree of interdisciplinarity of the two groups is similar. In fact, the index is almost identical for the two groups, respectively 0,1848 for contributors and 0,1892 for participants. It can be visually appreciated that, although the spread across the map of the two groups is opposite, the relative distances between core engineering publications and other publications classified in different disciplines is similar.

3.2 Analysis of the survey

The survey was answered by 18 respondents from 7 HEI, representing the 33% response rate of all academics contacted. The responses were analyzed via statistical and descriptive analysis.

3.2.1 Profile of the survey respondents

Respondents' affiliation is mainly concentrated in Spanish polytechnic universities, respectively with 7 respondents from Polytechnic University of Catalunya, 4 from Technical University of Madrid and 3 from Technical University of Valencia. Other 3 respondents are from Engineering faculties of different Spanish universities: Castilla-La Mancha, Rovira i Virgili and Alcalà. Besides, an academic of the faculty of Architecture of the Universidade do Porto (Portugal), that completed GDEE courses through Spanish learning platform, has also answered the survey.

The majority of the respondents are doctors (83%), and females appear to be more motivated in answering the survey (56%). 56% of the respondents have age comprised between 40 and 49 years. The group of the respondents comprises juniors and senior researchers. Figure 4 shows the distribution of the years of professional teaching and research accredited by quality agencies.

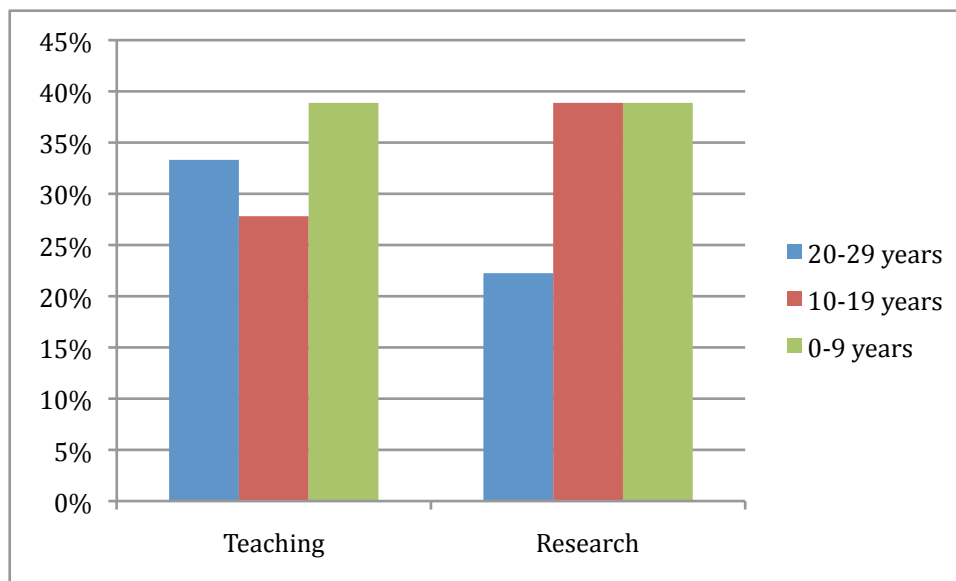


Figure 4. Distribution of accredited years of teaching and research

3.2.2 Teaching activities

The respondents were asked to indicate 1 to 3 subjects they imparted teaching, with reference to the last 5 years of their academic activity. Subsequently, they have been asked to deepen specific issues, specifically: i) the integration of mechanism of active participation of students; ii) the evaluation and grading criteria employed to evaluate students. In total 28 subjects were indicated by respondents, respectively 16 subjects of bachelor degree and 12 of master degree. Additionally, respondents were asked information on their engagement in activities of teaching innovation.

For the great majority (85%), the subjects indicated by respondents have mechanisms for the active participation of students. Among examples provided, shown in Figure 5, teamwork activities are, by far, the most important mechanism indicated, followed by online forum (offered via virtual platforms or social networks), then case study preparation and debates. It is worth mentioning a specific case highlighting teamwork activities in field work, in the framework of a subject partially developed on-field, in Morocco.

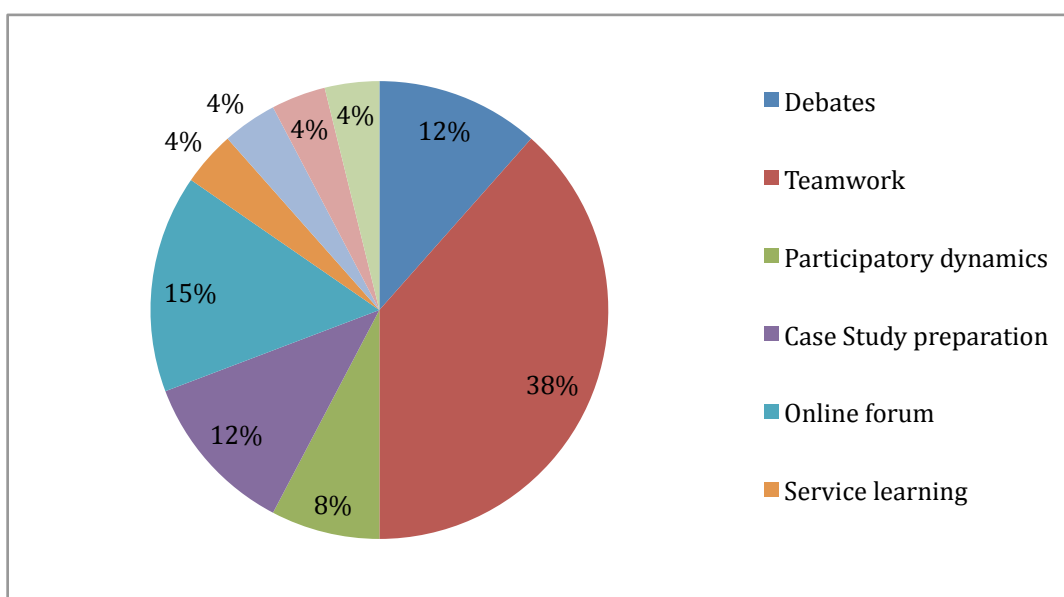


Figure 5. Active participation mechanisms

Figure 6 presents evaluation and grading mechanisms selected by respondents. It can be noted that, 'final exam' is the factor to which respondents give major importance, followed by 'teamwork' with a significant weight, and by 'independent work'. Peer evaluation is indicated as the less important factor considered in grading students.

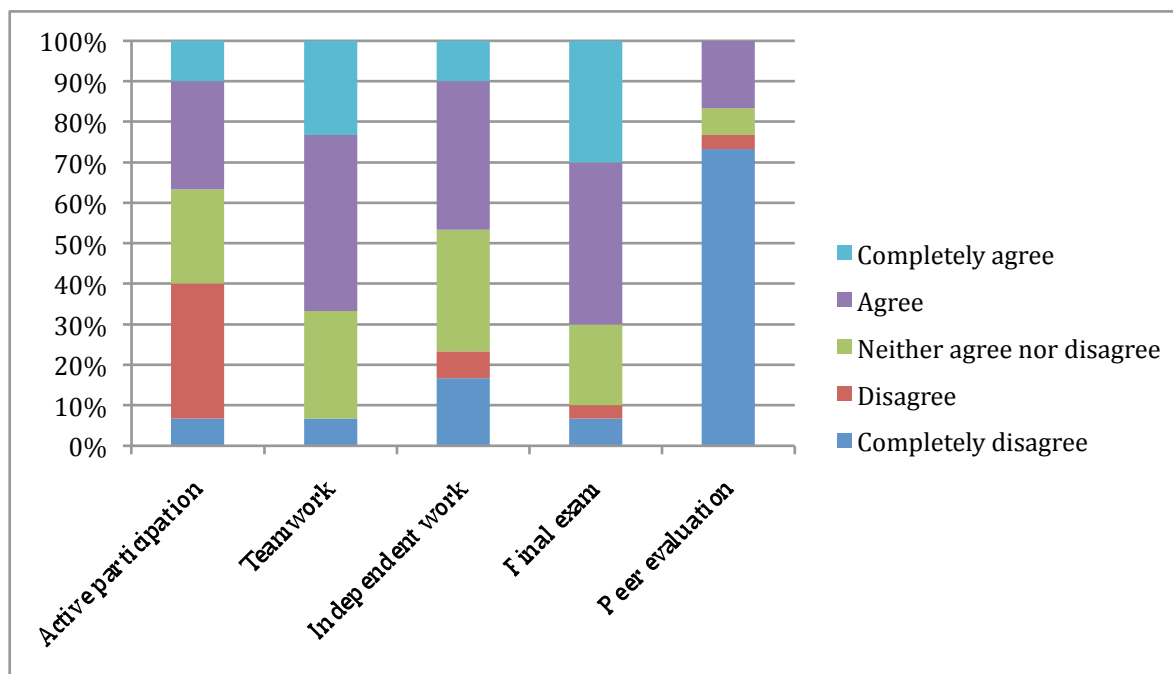


Figure 6. Evaluation and grading mechanisms

The great majority of the respondents (94%) indicates that respective universities have integrated transversal competences in their curricula. 83% of these academics considers that these competences are related to GD. 83% asserts that personally integrates GD in teaching activities through transversal competences and, respectively, the 67% and 61% considers that GD are also integrated in Bachelor/Master thesis and in other subjects of the courses of study.

Overall, the respondents are active in activities related to teaching innovation (Figure 7). It is noteworthy a significant activity as promoters of courses of teaching innovation (50%). 39% indicates that is author of publications or articles on this subject and only 22% participates in courses on teaching innovation. Among the most relevant issues specified as promoters, are noteworthy training activities relating SD (in its different variants as GD, SHD, Education for Development, Education for Sustainable Development) and engineering. Other issues indicated are: learning and service, urbanism, renewable energy and geographical information system (GIS).

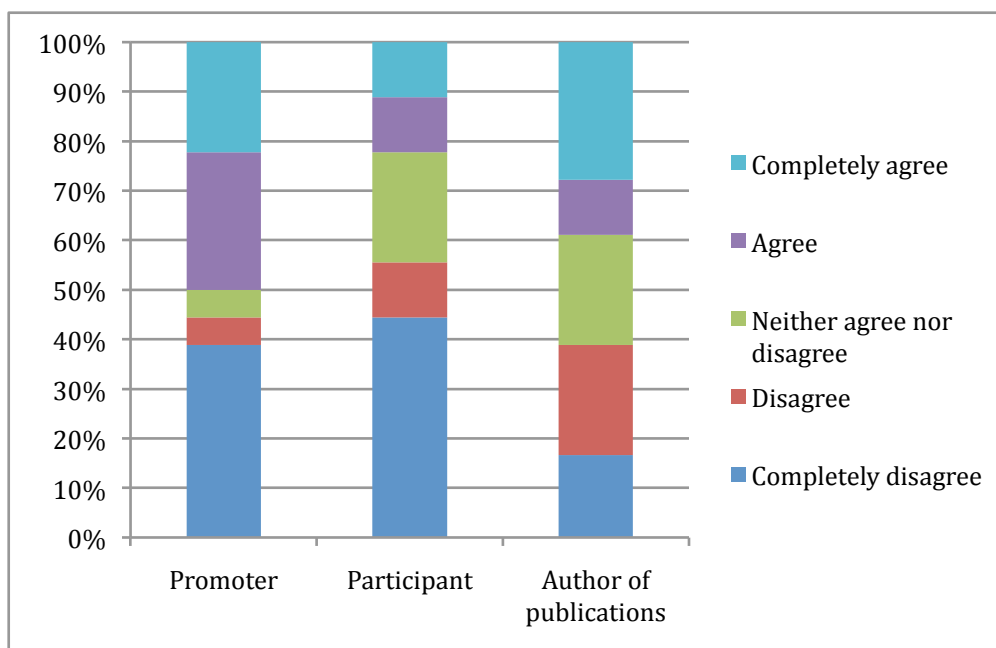


Figure 7. Engagement in teaching innovation activities

3.2.3 Research activities

The relation between teaching and research activities can be described, overall, as positive. Referring to the subjects indicated in the survey, 68% of the respondents points that the subject imparted are strongly correlated with their research activities. Besides, 94% considers that teaching and research activities reciprocally feed one another. This is confirmed in the related open-ended questions, where many academics describe that research driven in the area of SD provides the basis on which grounds most of their teaching activity. Specifically, case studies based on research outcomes are successfully used in class complementing theoretical issues. In fact, respondents highlighted that sharing with students the results of research initiatives brings credibility to the subjects imparted and is very well appreciated by students. It is also noted that teaching Master subjects adds personal flexibility of professors in prioritizing research topics that can easily be integrated into teaching practice.

3.2.4 Sustainable Development Goals

Figure 8 shows the degree of integration of SDGs in the teaching activities. The SDGs most integrated in teaching by the respondents were 'Climate change adaptation' (SDG 13), followed by 'Conservation and sustainable use of ecosystems' (SDGs 14, 15) and, in third place with the same value, 'Clean water and sanitation' (SDG 6) and 'Sustainable cities/communities and sustainable production and consumption patterns' (SDGs 11, 12). The SDGs with the lowest recognition were: 'Promotion of a decent work and sustainable industrialization' (SDGs 8 y 9), 'Promotion of peace, justice and strong institutions' (SDG 16) and, in the last position, 'Promotion of global partnership for SD' (SDG 17).

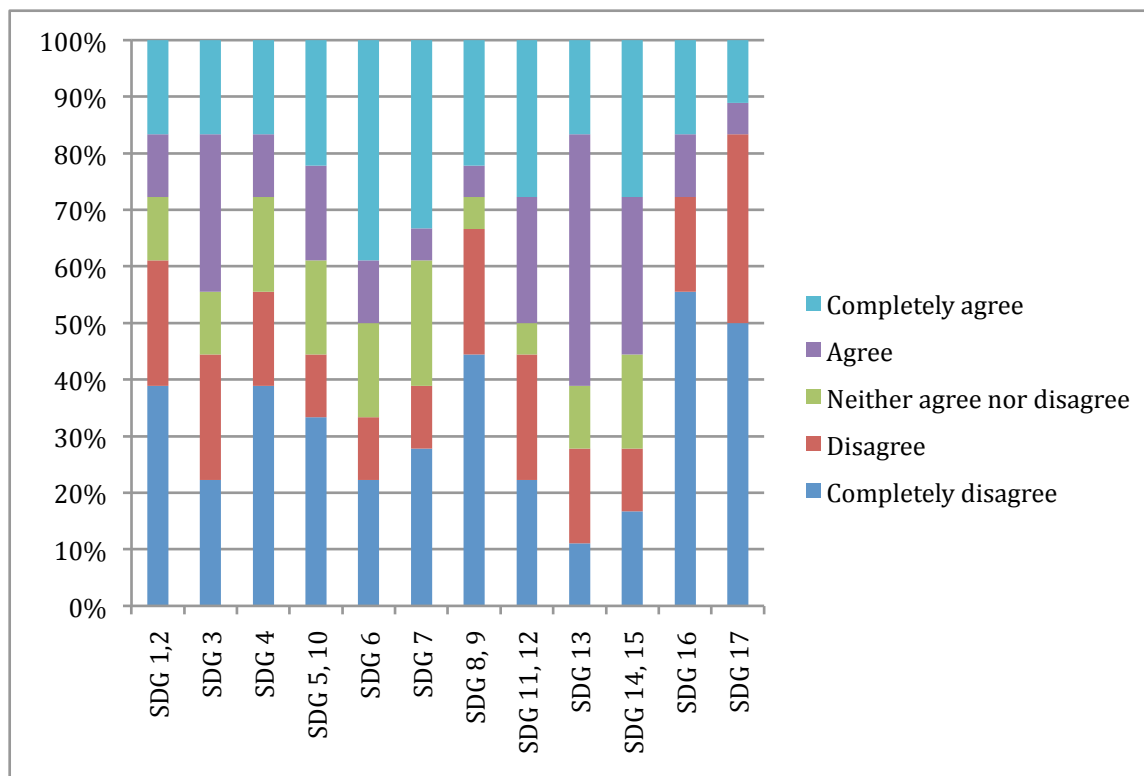


Figure 8. Integration of SDGs in teaching activities

Figure 9 shows the degree of integration of SDGs in the research activities. The SDGs most acknowledged were 'Conservation and sustainable use of ecosystems' (SDGs 14, 15), followed by 'Clean water and sanitation' (ODS 6) and 'Sustainable cities/communities and sustainable production and consumption patterns' (SDGs 11, 12). SDGs less integrated in research resulted: 'Promotion of global partnership for SD' (SDG 17), 'Affordable and clean energy' (SDG 7) and 'Promotion of peace, justice and strong institutions' (SDG 16), in the last position.

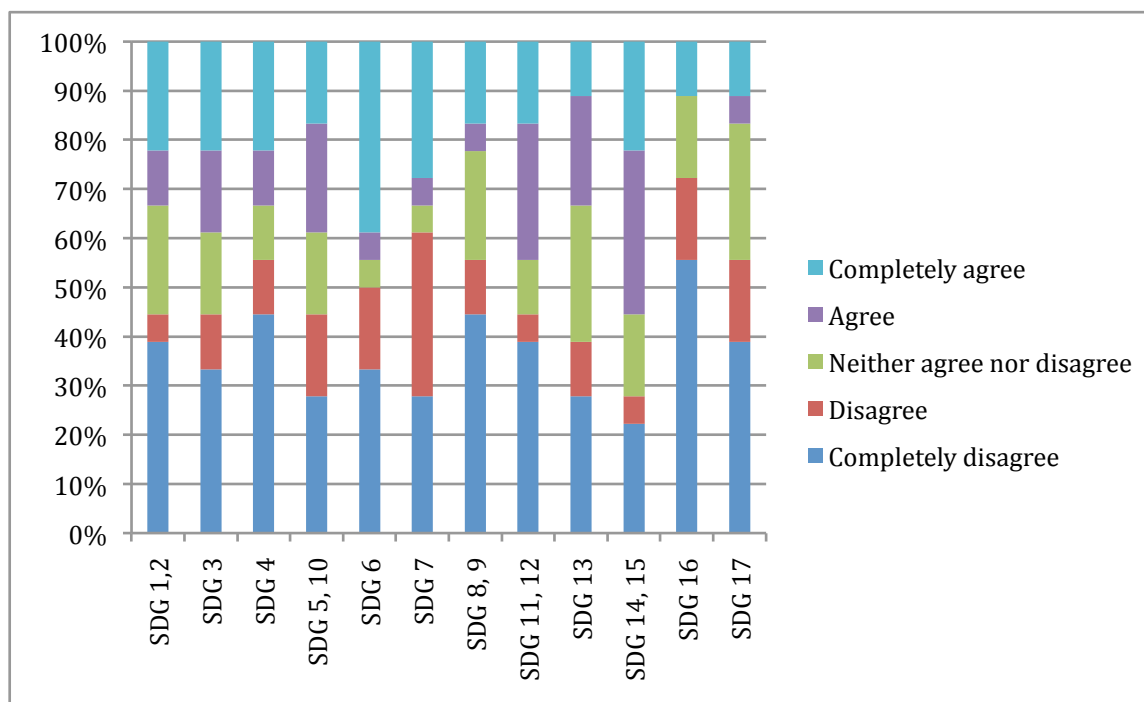


Figure 9. Integration of SDGs in research activities

A further question in this section was the perceived relation between SDGs and transversal competences implemented in respective universities. In this case, a percentage between 28 and 39% of the respondents opted to not answer to different items correspondent to SDGs. Supposedly, a lack of significant knowledge on the different transversal competences has conditioned the answers of this specific question. Those academic that chose to respond indicate 'Sustainable cities/communities and sustainable production and consumption patterns' (SDGS 11, 12) as the item that express the highest relation between transversal competences and SDGs, followed by 'Affordable and clean Energy' (SDG 7) and 'Conservation and sustainable use of ecosystems' (SGDs 14, 15). The lowest relation have been indicated respectively for 'Promotion of peace, justice and strong institutions' (SDG 16) and 'Promotion of global partnership for SD' (SDG 17).

3.2.5 Social Outreach

Respondents were asked to indicate with which type of entities they usually engage outside the university with the aim of disseminating their academic activities and the kind of relationship they have with such entities. Figure 10 presents respondents' engagement with different societal entities. Entities with the highest frequency are respectively: public entities, Civil society organisations (CSOs) and NGOs and International Development NGOs. Social and Environmental third sector are the entities with the lowest frequency. Figure 11 shows the specific relationship that participants have with each one of the entities specified. It is interesting noting that respondents engage with public entities because of the existence of project with financial allocation or due to institutional relationship. Instead, their engagement with CSOs/NGOs and International Development NGOs is mostly on own behalf. Student practice activities are mostly concentrated in domestic firms and SMEs.

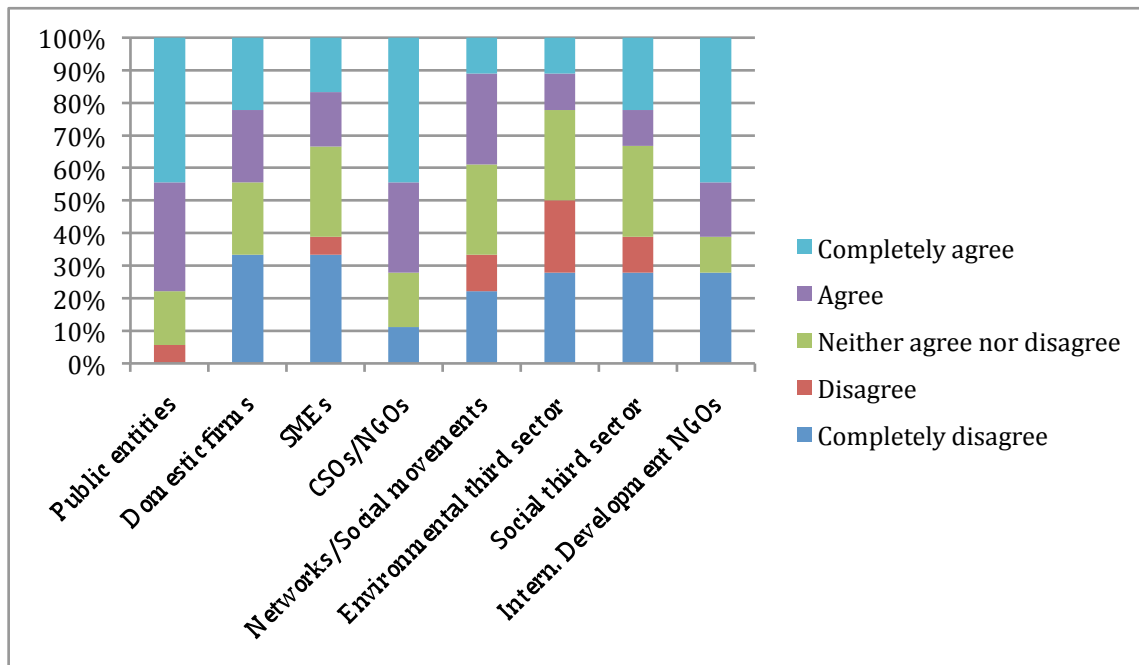


Figure 10. Respondents' engagement with societal entities.

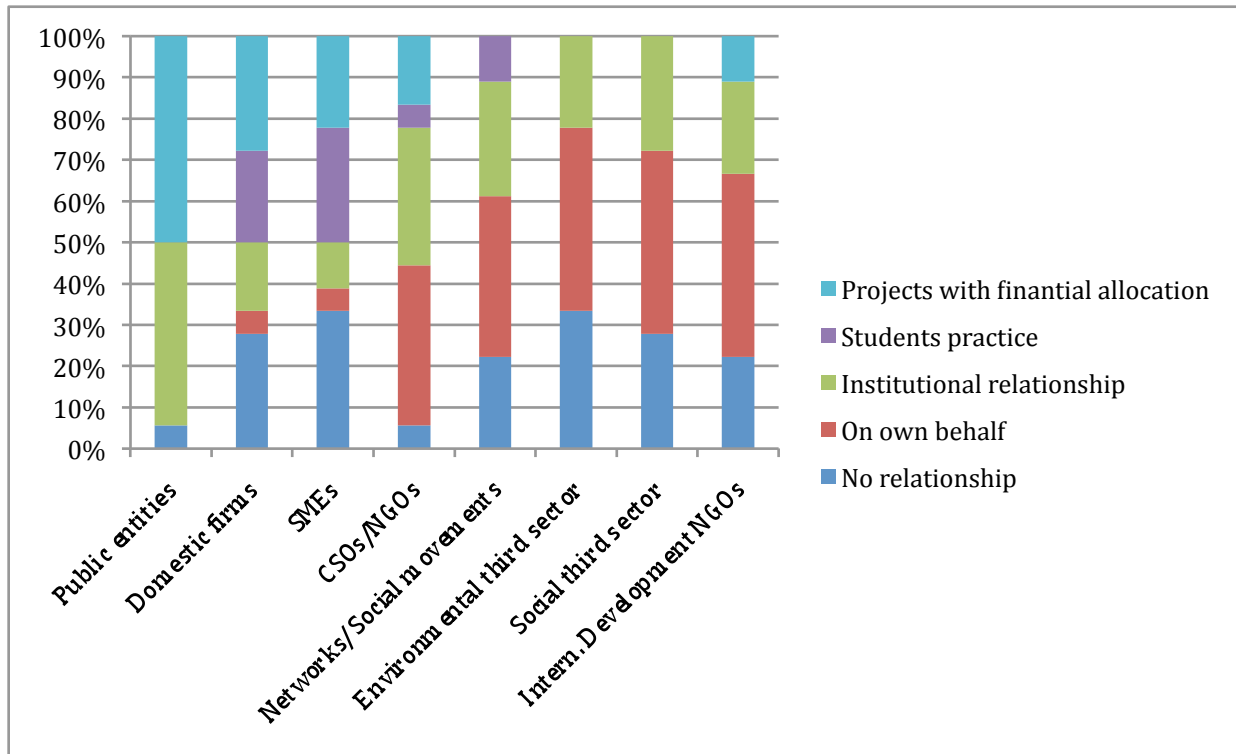


Figure 11. Respondents' relationship with social entities

Regarding the dissemination of research outcomes, respondents prioritize first quartile scientific journal, followed by international conferences and journals of all databases, as shown in figure 12. Dissemination addressed to a non-scientific audience, such as popular articles, blogs or press are the items with less relevance.

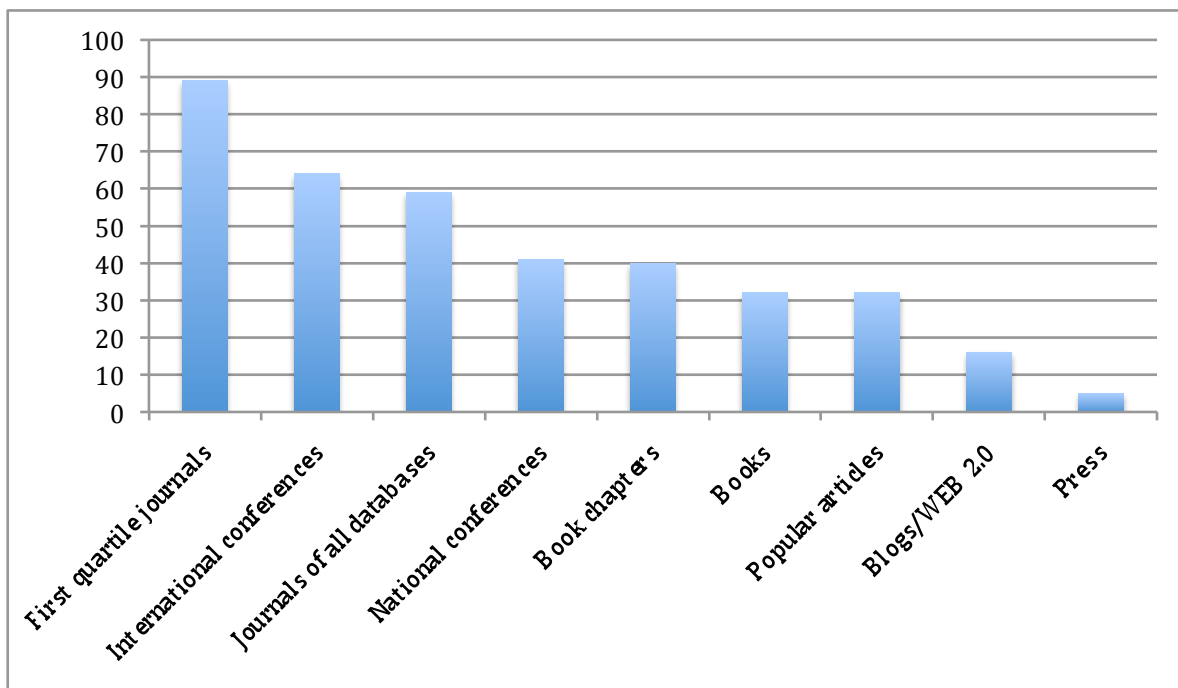


Figure 12. Dissemination of research outcomes prioritized by respondents.

3.2.6 Perception of the recognition/evaluation of academics merits

Respondents were asked to select, in a multiple-select question, all relevant items of the university monitoring of academic activity of professors. Research, with 90%, is the most relevant issue of the monitoring function that universities perform on academic activities, followed by teaching (83%) and knowledge transfer activities (78%). Social Outreach, unsurprisingly, has not been indicated as an aspect monitored by universities.

Universities evaluation mechanisms are not particularly well appraised by respondents. Despite the fact that the mode of Likert scale corresponds to the central value (neither agree nor disagree), a high percentage of the respondents (33%) of respondents emphasize a negative evaluation of the evaluation system.

Open-ended questions highlight both positive and negative factors related to the academic evaluation system. Among the formers, respondents pointed out resources allocation managed by universities, for example resources that the university dedicates to finance specific projects of research or doctoral scholarships. Another important issue highlighted is the reduction of the teaching load of faculty involved in successful research initiatives. The most critical views pointed out that the majority of activities carried out by faculty are not taken into account in the recognition of academic merits, and that research merits often are not considered for the reallocation of the teaching load among other colleagues.

According to the answers, almost 80% of the respondents has been evaluated by quality accreditation agencies. The majority values negatively the process of accreditation of academics pointing out different reasons. Firstly, they emphasize that the procedures for accreditation have burdensome bureaucratic requirements, often not entirely transparent. Secondly, some of them criticise the concept of academic quality accepted and applied in accreditation processes, especially stressing the ambiguity of criteria and scales that may lead to considerable disparities among colleagues. Finally, younger faculty stand out different accreditation requirements between seniors and younger academics. In the last decades, accreditation requirement have been tightened and more demanding requirements, such as leading a European project as Principal Investigator, now concern younger academics.

4. Discussion

The bibliometric analysis of the scientific publications of a reduced community of professors involved in GDEE training activities points out relevant issues. The two groups present interesting similarities. Both have their principal research production specifically focused in engineering-related disciplines and show a similar degree of interdisciplinarity research. The main difference between the two groups is that, whereas contributors have particularly relevant research activity in Social Science, participants are particularly actives in Medicine-related disciplines (biotechnology, medical physics, radiology etc.). It can be argued that faculty, including those with consolidated research trajectory and high degree of interdisciplinary research, are looking for a wider perspective and understanding of global challenges relevant to SHD, and their relations with the field of engineering.

This reflects wider societal debates that concern particularly higher education. Societal awareness on global challenges has tremendously increased in the last decade. A number of academics recognise critical challenges that need appropriate engineering solutions that current engineering formal training could hardly provide. On the other side, student themselves are demanding a re-thinking of the content and the form of engineering curricula.

The survey, even with the limitations related to the reduced number of respondents, highlights important issues related to academic activity that complements the information provided by the bibliometric analysis. Focusing on teaching activity it is worth emphasising that results indicates that transversal competences adopted by universities are, for the great majority, related to the GD. Besides, respondents state that global dimensions are integrated, through transversal competences, in different subjects of the courses of study, as well as through Bachelor/Master thesis. From one side, this shows that there has been considerable integration of SD issues throughout Spanish university system, specifically regarding engineering faculties. From the

other side, this contrasts with scientific literature (Davidson et al., 2010; Lozano and Lozano, 2014) that substantially indicates that incremental improvements, basically focused on individual courses on SD, are more common in engineering faculties (von Blottnitz et al., 2015). For this reason, it is important further exploring the effective integration of SD in engineering courses.

Also research activity is indicated, by the large majority of the respondents, as strongly integrated with teaching and with positive mutual feedback. Again, this favourable condition is not consistent with the literature that highlights, conversely, the lack of integration of these university functions as a barrier to further engage in efforts towards SD (Verhulst and Lambrechts, 2014).

The degree of integration of SDGs in teaching and research endeavours is mostly related to topics traditionally closer to scientific and engineering competences while, unsurprisingly, other relevant topics more related to Social Science and Humanities such as gender equality, poverty reduction and inclusive/equitable education show lower levels of integration. The mechanistic separation of disciplines and the lack of the ability to work across different fields is recognised as one of the major challenges of engineering curricula reform.

The analysis of social outreach describes academics engaged primarily with public entities due to funded projects and institutional relationship. Conversely, their engagement with social entities such as CSOs/NGOs is mostly at a personal level. Furthermore, the efforts aimed at disseminating scientific outcomes are mostly concentrated to scientific contexts while popular dissemination is quite insignificant. This description is consistent with other analysis on the role of academics in the contemporary university that describe an increasing “corporate approach” of HEI where managing is emphasised over thinking and academics spend an increasing amount of time on managing activities and administrative requirements and less time is dedicated to public service (White, 2015). Furthermore, these results underpin the critics of different agents of the social sector, such as CSOs/NGOs, stating that university has been unable to enhance collaboration channels with social entities.

Finally, it is worth emphasizing the critical view that most of the academics expressed on the evaluation system, at both levels of universities and accreditation agencies.

5. Conclusions

During the last decades, a growing numbers of HEI have been engaged in refocusing their educational and research functions towards SHD principles. Engineering covers all aspects related to human development and it is essential that professional engineers be able to respond adequately and urgently to global challenges. Polytechnic universities and engineering faculties have made major progresses in this direction. Nevertheless, more efforts are needed in order to advance to in-deep curricula reforms. The practical and structured orientation of engineering education and methods, make particularly challenging the promotion of a cultural shift towards frameworks of knowledge defined by uncertainty, complexity and cultural sensitivity.

This work was specifically addressed at enhancing the understanding of the academic profile of faculty engaged in training activities related to SHD, with the aim of improving and fostering the replicability of similar initiative in different contexts. The results indicate that SHD experts involved in GDEE activities are academics whose research range from engineering to social science and are involved, for the great majority, in activities with social entities and movements. In other word, they may be described as promoters of those educational principles and values that can facilitate a cultural change in engineering education. To successfully promote initiatives similar to GDEE, trainers with academic profiles that conjugate expertise in engineering and social science can be beneficial not only for training participants but can also indirectly contribute to stimulate processes of cultural change in HEI.

A critical aspect emphasized by results is related to the role of academics as potential change agents for the society. This research confirms that academics are not sufficiently engaged, through their activities, at facilitating a transition of societal setting toward SD. Even if the research pointed out the linkages of academics with different social organisations and movements, it is worth noting, reversely, that the dissemination of their scientific activities is addressed almost exclusively to

academic audiences. This is consistent with the fact that social outreach has been indicated as an aspect not monitored by universities. Consequently, a challenge that remains is how to foster a more fruitful and intense collaboration between researchers and social entities, starting from a proper outreach.

Universities are expected to function as leaders of societal change towards sustainability. For this reason, they should support and recognise in their policies all those activities and initiatives aimed at promoting, in non-academic contexts, a deeper understanding of global challenges and social debates on possible policy solutions. Initiatives such the GDEE can contribute at enhancing liaisons outside academia through specifically skilled trainers and activities designed jointly by faculty and CSO/NGOs.

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