DOI: 10.3217/978-3-85125-842-4-06

121 An analysis of the Sustainability in the Engineering degree in Industrial Design and Product Development

Victor G. Galofré[1], Jordi Segalas[2]

[1]Research Institute for Sustainability Science and Technology, UPC-Barcelona Tech Barcelona, Catalonia, victor.garcia.galofre@gmail.com

[2]Research Institute for Sustainability Science and Technology, UPC-Barcelona Tech Barcelona, Catalonia, jordi.segalas@upc.edu

Abstract

Education for the Sustainable Development Goals (ESDG) in universities calls teachers to become agents of change, capable of training graduates on the challenges that the Agenda 2030 arises and to qualify students with the needed SDG competencies. Being able to conduct an analysis that maps the current situation in a degree is the starting point to tackle such a challenge, by helping to become aware of which gaps and opportunities exist and might be addressed. The EDINSOST2-SDG project, involving 8 Spanish universities, sets the framework for this study. This paper shows the results of diagnosing the presence of the sustainability competencies and the SDG at the undergraduate engineering degree in Industrial Design and Product Development at the School of Engineering of Vilanova i la Geltrú of the Universitat Politècnica de Catalunya. The methodology developed and applied to measure the presence of sustainability and the SDG in the degree has been piloted in a previous phase of the case study. Results showed how using official documentation and study guides as information sources implied depending on the validity of these documents, which are not always updated. In this phase, data is obtained through the questionnaires for teachers designed at EDINSOST2-SDG and compared to previous results to validate and further develop the methodology. First step is detecting which subjects should be prioritized for conducting the analysis and developing a strategy to gather information. Second step is developing a Sustainability Presence Map, that shows the percentage of presence per degree, semester and subject, of the 4 sustainability competencies proposed by the Conference of the Presidents of the Spanish Universities (CRUE). Third step is to obtain an SDG Presence Map, which provides information about the presence of the SDG according to the UNESCO SDGs learning objectives. Step 4 is comparing the results of both phases of the case study and discussing which sources are more reliable and why this methodology can be useful for the higher education industry.

Keywords: Education for sustainable development, Sustainability in engineering degrees, Curriculum design, Sustainability competences.

Introduction

Political and social background

In 2015, the United Nations adopted the Agenda 2030 for Sustainable Development. To stimulate actions over the next few years, the resolution proposes 17 Sustainable Development Goals (SDG) and 169 associated targets to facilitate the balance between the three dimensions of sustainable development: the economic, the social and the environmental. SDG4, Quality Education, affirms that by obtaining a quality education one sets the foundation to improve people's lives and sustainable development. Universities are called to work towards this goal when considering its target 4.7; «By 2030, ensure that all learners acquire the knowledge and skills needed to promote sustainable development, including, among others, through education for sustainable development and sustainable lifestyles, human rights, gender equality, promotion of a culture of peace and non-violence, global citizenship and appreciation of cultural diversity and of culture's contribution to sustainable development» (United Nations, 2015).

In May 2021, the UNESCO World Conference on Education for Sustainable Development gathered participants form governments, international, intergovernmental and non-governmental organisations, civil society, youth, the academic community, the business sector and all spheres of teaching and learning. All of them adopted the Berlin declaration of Education for Sustainable Development asking for urgent action regarding the «dramatic and interrelated challenges that the world is facing, particularly, the climate crisis, mass loss of biodiversity, pollution, pandemic diseases, extreme poverty and inequalities, violent conflicts and other environmental, social and economic crisis that endanger life on our planet» (UNESCO, 2021).

The 20th may, the Spanish government published the law on climate change and energy transition, specifying that «The Government shall encourage universities to review the treatment of climate change in the curricula leading to the award of official university degrees where it is coherent with the competencies inherent to them, as well as training of university teaching staff in this field» (Ley 7/2021, de 20 de Mayo, de Cambio Climático y Transición Energética., 2020). In addition, at a local level, the 14th of May of 2019, the Catalan Government declared the Climate Emergency. Climate movements criticized its process and content, denouncing a lack of participation and clear goals. As a response, the movements redacted a document gathering 11 urgent policies to face the climate emergency. In relation to education and training, the article number 10 of the document urged to «revise the current curriculum so that within a

maximum of 3 years, the education system addresses the state of climate and ecological emergency in both regulated education and social education programmes, incorporating rigorous knowledge about the seriousness of the problem, the causes, the false solutions and the urgent policies that need to be undertaken to address the drastic reduction of greenhouse gas emissions». The urgent policy also demands continuous training programmes for primary, secondary, high school and university teachers and, for the coming academic year and as a first step, including the subject of climate emergency in secondary schools and teacher training in universities (Xarxa climàtica, 2020).

Considering this background, a new scenario is open to promote changes in the Spanish education system. To accelerate Education for the SDGs in Universities 5 main steps should be followed. Step 1, Mapping what a university is already doing; step 2, building capacity and ownership for ESDGs; step 3, identifying priorities, opportunities and gaps; step 4, integrating, implementing and embedding SDGs and step 5, monitoring, evaluating and communicating (Australia/Pacific SDSN, 2017).

The EDINSOST2-SDG framework

EDINSOST2-SDG is a project aimed at integrating SDGs into sustainability training in Spanish university degrees and continues with the achievements of the project EDINSOST. It is financed by the Spanish Ministry of Science, Innovation and Universities (MCIU), the State Research Agency (AEI) and the European Regional Development Fund (Sánchez-Carracedo et al., 2020; Segalàs Coral & Sánchez Carracedo, 2019). The project provides a set of tools that allow to map the learning of sustainability and the SDGs in a degree, which contributes to accomplish step 1 of the 5 steps recommended by the SDSN. Even so, a methodology has not yet been developed to exploit these tools for obtaining tangible results, a fact that sets the objective of this paper. The tools applied in this case study are the following:

- Engineering Sustainability Map (ESM)

The ESM is a matrix containing a common Sustainability Map for all engineering degrees which summarizes 53 learning outcomes related to the 4 transversal sustainability competences proposed by CRUE (CRUE, 2012) and the SDGs' learning objectives proposed by UNESCO (UNESCO, 2017). The 4 CRUE competencies are operationalized in 4 possible dimensions (social, economic, environmental and holistic), 7 competency units, 3 domain levels (according to the Miller's pyramid) and end up in 53 learning outcomes.

- Sustainability Presence Map (SPM)

The SPM is a matrix that shows how a subject or group of subjects fulfils the learning outcomes of the ESM. Each cell relates each learning outcome proposed by the ESM to each subject that is being taught in the degree.

- Questionnaire for professors

The questionnaire for professors was designed to complete the Sustainability Presence map. Previous research pointed out that using official documentation and teaching guides as information sources did not offer truthful results, as those sources are not always up to date. The survey, consisting of 22 questions and 53 sub-questions, was designed to obtain information about the accomplishment of the 53 learning outcomes of the ESM, according to the teacher's perspective.

- SDG Presence Map (SDGPM)

The SDGPM is a matrix that shows how a subject or group of subjects fulfils the SDG based on the learning objectives of UNESCO.

Context of the case study

This case study is piloted in the bachelor's degree in Industrial Design and Product Development Engineering that is being taught at the UPC Engineering School of Vilanova i la Geltrú (EPSEVG). The degree provides the student with the skills to become an industrial engineer and a product developer. The school management team has shown interest in improving the presence of sustainability and the SDGs in their degrees and has encouraged teachers to participate in this study.

To organise the acquisition of skills among the student body, the UPC defines four types of competences in their educational system:

- Transversal competences: competences that are common to all students at the UPC, regardless of the degree they are pursuing (ANECA, 2012).
- Basic competences: competences that are common to most degrees but are adapted to the specific context of each degree. (ANECA, 2012).
- General competences: competencies that are intended to provide students with useful knowledge, skills and attitudes to function in their professional field. (ANECA, 2012).
- Specific competences: competences specific to a degree that are oriented to the achievement of a specific graduate profile (ANECA, 2012).

Competencies are distributed throughout the subjects of the degree by curriculum designers and end up configuring the degree structure. Figure 1 Shows the curriculum containing the common framework of the degree in Industrial Design and Product Development Engineering, the specific optional subjects related to itineraries and the cross curricular electives. The degree has a study load of 240 ECTS [7]. These are distributed in 60 basic education credits (10 subjects), 126 compulsory credits (21 subjects), 30 optional credits (5 subjects) and a final degree project worth 24 credits. A total of 51 subjects configures the degree.

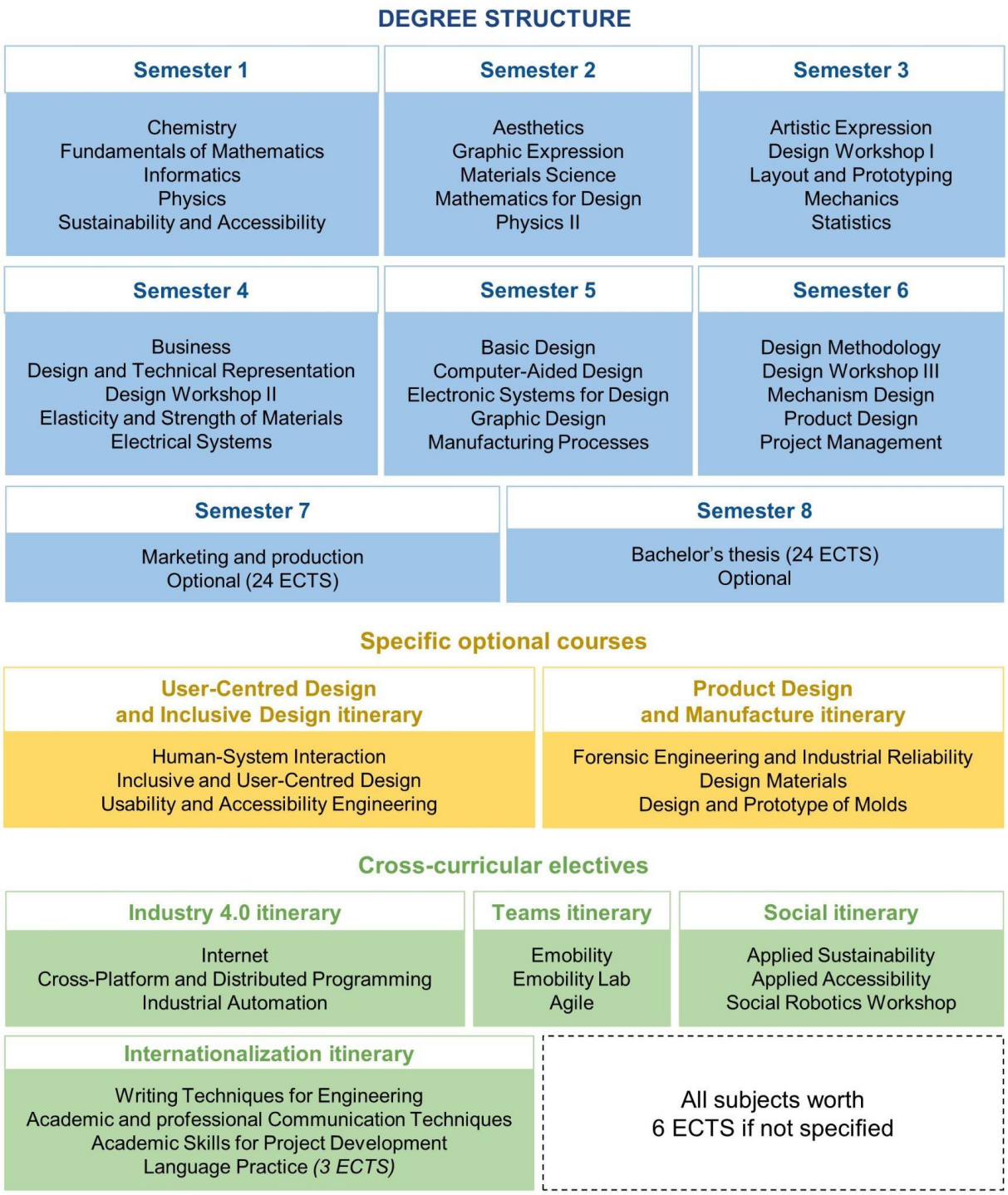

Figure 1. Structure of the undergraduate degree in Industrial Design and Product Development Engineering at EPSEVG.

Methods

This paper presents the piloting of a methodology to evaluate the presence of sustainability and the SDGs in Engineering Degrees, using tools provided by EDINSOST2-SDG. The methodology is piloted as a case study to the Engineering Design degree taught at EPSEVG of the Universitat Politècnica de Catalunya.

First step is to provide the questionnaire to the teaching staff. The questionnaire has to be answered by the professor who is responsible for the subject and each subject requires a minimum of one answer to be evaluated. Convincing teachers to participate in the process is crucial. Identifying which subjects are more likely to address sustainability issues is helpful to be aware of which teachers should be prioritised in case of need. This study also counted with the school management support, a fact that encouraged teachers to contribute to the research.

Second step is to apply the answers of the questionnaire to the Sustainability presence map (SPM). The questions of the survey are directly related to the presence of the 53 learning outcomes of the Engineering Sustainability Map (ESM) in a subject. Subsequently, to convert the answers of the questionnaire into a numerical score in the SPM, it is necessary to pay attention on which questions are related to each learning outcome of the ESM. The criteria to score the corresponding learning outcomes implies that those answers marked with “Nothing” equal “0”; “Little” equal “1”; “Quite a bit” equal “2” and “A lot” equal “3”. Table 1 shows the layout of the SPM. In case that a subject has more than one coordinator, the scores of the answers of the questionnaire have been averaged and the final score for each learning outcome has been rounded up to fit the scoring criteria.

Table 1. SPM layout when applying the answers of the questionnaire.

Applying the answers of the questionnaire to the SPM		Competences of the degree		
		Subject 1	Subject …	Subject n
ESM learning outcomes	Learning outcome 1	*3, 2, 1 or 0*	*3, 2, 1 or 0*	*3, 2, 1 or 0*
	Learning outcome …	*3, 2, 1 or 0*	*3, 2, 1 or 0*	*3, 2, 1 or 0*
	Learning outcome n	*3, 2, 1 or 0*	*3, 2, 1 or 0*	*3, 2, 1 or 0*

Third step is to convert the score of the SPM into percentage. Eq. (1) must be applied in each cell of the SPM to obtain a percentage that considers the operationalisation of the ESM. The results that can be obtained through this formula will show information about the presence of the 4 sustainability competences. To obtain information about the competency units, the final results of competence 2 need to be multiplied by the number of competency units that are related to the competence, which are 4 (CU2, CU3, CU4 and CU5).

$$SPM[\%] = \frac{100 * SPMscore}{nDIM * nCU * nL * nPr} \quad (1).$$

SPMscore: cell score in the SPM; ***nDIM:*** number of possible dimensions of a competence; ***nCU:*** number of competency units related to the dimension; ***nL***: number of learning levels related to the competency unit; ***nLO:*** number of learning outcomes related to the level; **n*Pr:*** number of possible results according to the SPM scoring criteria. Scoring 0 will always mean a 0% of presence. Therefore, it is not considered as a possible result that distributes weight of the percentage.

Once the SPM [%] is completed, adding up the results of each subject according to the operationalisation of the Engineering Sustainability Map, allows to gather information at different levels, i.e., the percentage of presence according to each Competency Unit or to each of the 4 CRUE competencies. To analyse the presence of Sustainability in a set of subjects, for instance, to obtain information related to a specific itinerary, a semester or a degree, the scoring of each learning outcome of the subjects will be averaged. This process will generate a new column which can provide results with the same format as the analysis of a subject.

Fourth step is completing the SDG Presence Map (SDGPM), which allows to obtain the presence of SDGs in a degree. As table 2 illustrates, it is a matrix set for each subject of the degree showing the presence [%] of each SDG (columns) in relation to each learning outcome (rows). To calculate the presence of each SDG in a subject, the percentage of presence of each SDG related to a learning outcome has to be multiplied by the percentage of the SPM[%] of the corresponding learning outcome. Multiplying the two results allows to calculate to what extent the percentage of SDGs are being covered through the scoring of a learning outcome.

Table 2. SDGPM layout.

SDGPM of a subject		Competences of the degree		
		SDG1	SDG …	SDG17
ESM learning outcomes	Learning outcome 1	*SPM[%] * SDG[%]*	*SPM[%] * SDG[%]*	*SPM[%] * SDG[%]*
	Learning outcome …	*SPM[%] * SDG[%]*	*SPM[%] * SDG[%]*	*SPM[%] * SDG[%]*
	Learning outcome n	*SPM[%] * SDG[%]*	*SPM[%] * SDG[%]*	*SPM[%] * SDG[%]*

The sum of each column containing the score of each learning outcome synthesizes the results of the presence of each SDG in a subject. To combine a set of subjects, the scoring of each learning outcome of the different subjects will be averaged. This operation will allow us to obtain 17 new columns gathering an average score for each learning outcome in relation to each SDG. As a final step, the percentage of each column will be summed, obtaining an average score of the presence of each SDG in the set of subjects to be calculated.

Results and Discussion

Results of the diagnosis

First aspect to discuss is the scope of the analysis. Data has been obtained from 20 subjects which did not allow an analysis of the entire degree yet. Even so, the methodology applied in this case study has shown interesting results that will be completed as more teachers are convinced to participate in the analysis. The information that has been collected involved the following subjects: *Physics, Sustainability and Accessibility*, *Materials Science, Layout and prototyping, Business, Basic design, Manufacturing processes, Electronic systems for design, Mechanism design, Design methodology, Inclusive and User-Centred design, Design and prototype of moulds, Marketing and production, Human-System interaction, Multiplatform and distributed programming, Mechanics, Mathematics for design, Electrical Systems, Applied Sustainability* and *Usability and Accessibility Engineering*.

The methodology presented in this article provides two types of results. It is possible to obtain data about the presence of the 4 competences in sustainability defined by CRUE and results according to the Competency Units featured on the Engineering Sustainability Map. Results can be presented either by grouping subjects together or by analysing each subject individually. The diagnosis also provides information about the presence of the SDGs, considering the UNESCO learning objectives and their relation to the 53 learning outcomes of the Engineering Sustainability Map.

Results are synthesized in a graphical format to ease the communication of the diagnosis outcomes. Spider charts show how competences or SDGs are covered. Visualizing the presence of sustainability and SDGs in a degree raise awareness of which aspects could be improved in a curriculum. A diagnosis of a cluster of subjects, which could be an analysis including an itinerary, semester or degree, shows an average presence, which helps to highlight which are the less (or most) sustainability-aspects being addressed. Considering the results of a specific subject provides hints on which competencies could be further developed and therefore enhancing the whole itinerary, semester or degree results.

The next figures are examples of the information that can be obtained. Figures 2 and 3 represent the average percentage of presence obtained when clustering the results of the 20 surveys that were answered. Figure 2 shows the results according to the 4 CRUE competencies, related to sustainability. Results show a balanced percentage in competences 1, 2 and 4 (C1, C2, C4) while competence 3 (C3) has a lower presence. By observing figure 3, which shows the results according to competency units (CU), CU2, CU3 and CU6 appear as the ones that are being less addressed. Consulting which learning outcomes of the Engineering Sustainability Map are related to these competencies may help to develop a strategy to add new content in this set of subjects to improve the presence of the 4 sustainability competences. To understand the

results, it is important to bear in mind that the concept “presence” used when considering the presence of the sustainability competencies, refers to the percentage of accomplishment of the learning outcomes of the ESM proposed by EDINSOST2-SDG. A group of subjects would very rarely score a 100% of presence but the methodology offers results that expose which competencies are being prioritized and which none.

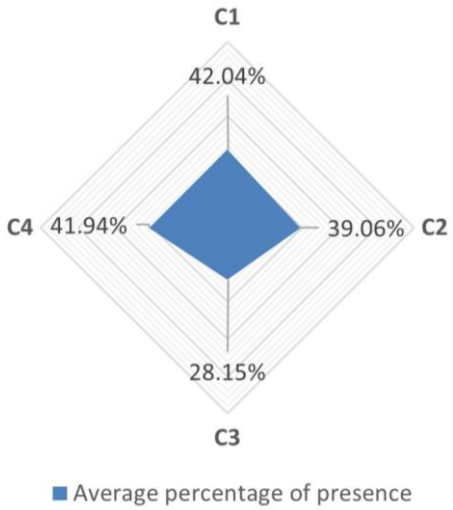

Figure 2. Average percentage of presence of the 4 CRUE competencies of the whole range of subjects.

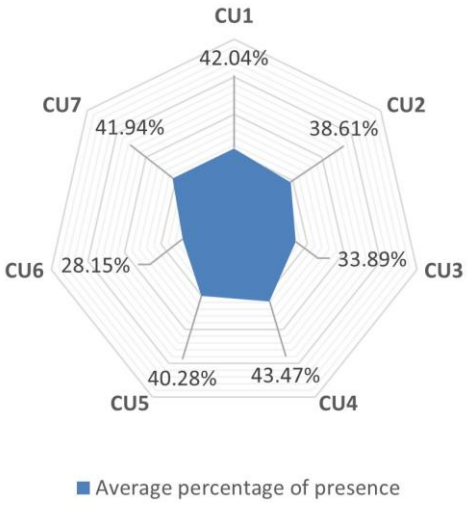

Figure 3. Average percentage of presence of the Competency Units of the whole range of subjects.

Figure 4 and 5 show results of the analysis at a more specific level. Figure 4 shows the spider diagram related to the percentage of presence of the 4 sustainability competencies in the subject Materials Science. Results clearly indicate how C1 and C4 are being prioritized. Figure 5 shows the results of the same subject related to the competency units. CU1 and CU7 show the highest percentage of presence. In this case, as an example to understand the potential of the analysis, it could be useful to discuss how to improve the presence of C2 which is related to the sustainable use of resources and prevention of negative impacts on the natural and social environment. C2 is disaggregated in CU2, CU3, CU4 and CU5 which include concepts such as circular economy or environmental impact that can be related to the subject. On the other hand, C3 and CU6 might be less likely to be associated with the subject materials science, since these are related to participation in community processes that promote sustainability.

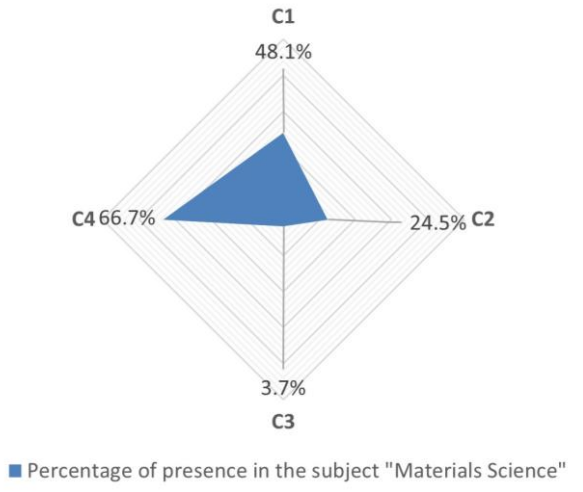

Figure 4. Percentage of presence of the 4 CRUE competencies in the subject Materials Science.

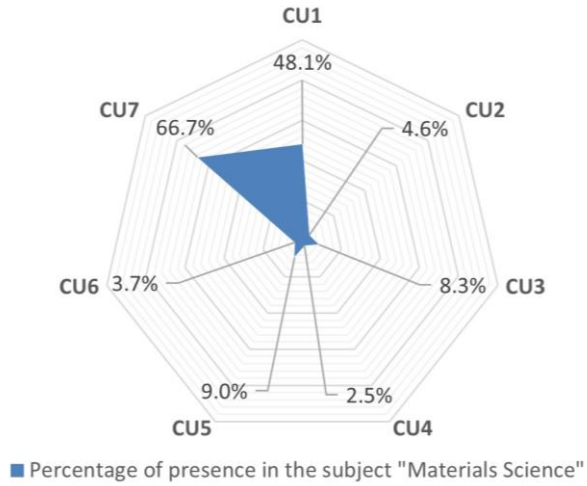

Figure 5. Percentage of presence of the Competency Units in the subject Materials Science.

Figures 6 and 7 show the results of the analysis in relation to SDGs. To interpret the charts, it is needed to notice that the concept “presence” used when analysing the presence of the SDGs, is related to which SDG learning objectives are related to the Engineering Sustainability Map. Some of the SDGs learning objectives are not related to any of the 53 learning outcomes and therefore, SDG2 (No hunger), SDG14 (Life below water) and SDG15 (Life on land) will always score 0. The EDINSOST2-SDG project is currently working on finding further relations between the learning outcomes and the SDGs. Due to this fact and considering that SDGs are indivisible and interrelated, it has been decided to include all SDGs in the results of the analysis anyways.

Figure 6 shows the average percentage of presence of the SDGs in the group of subjects analysed in this study case. Results show a certain homogeneity, but a desired scenario should show how SDGs related to product engineering stand out from the rest. Results show, in example, how SDG7 (affordable and clean energy), SDG9 (Industry, innovation and infrastructure) and SDG12 (Responsible consumption and production) may have room for improvement, considering their close relation to the topic.

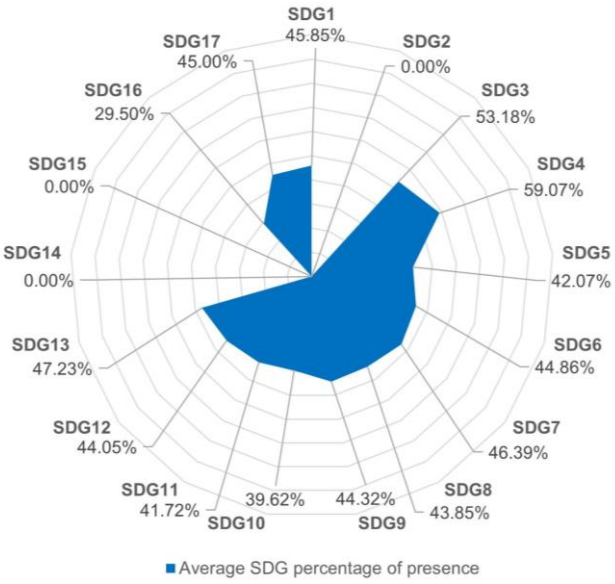

Figure 6. Average SDG percentage of presence of the whole range of subjects.

Figure 7 shows the SDG percentage of presence in the subject Materials Science. In the same way as the analysis of the 4 Sustainability competences in a subject, deepening into a more specific level of presence shows more accurate results. In this case, SDG3 (Good health and well-being) and SDG4 (Quality Education) stand out, letting us know that the subject is oriented to aspects related to health and includes an important amount of learning outcomes related to education. As an example to consider SDGs aspects to include in the subject, SDG6 (Clean water and Sanitation) is a SDG interesting to discuss with the teacher by relating it to water pollution caused by the production and disposal of specific materials. On the other hand, SDG9 (Industry, innovation and infrastructure) and SDG12 (Responsible consumption and production) are also likely to be discussed as long as they should be very present in the degree.

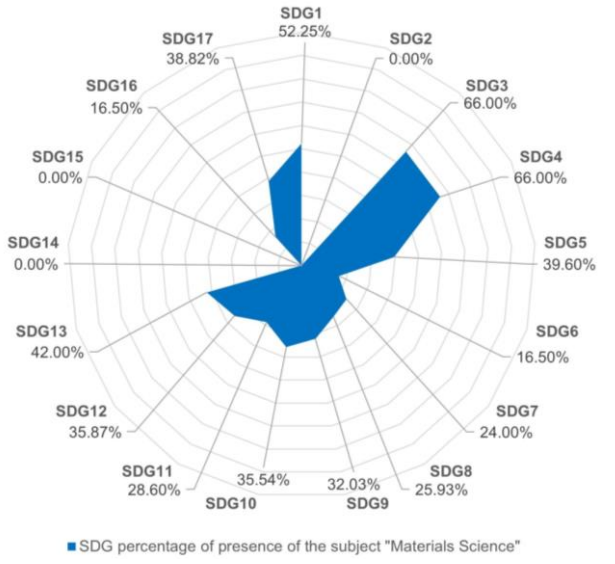

Figure 7. SDG percentage of presence of the subject Materials Science.

Comparison of the data sources

A comparative analysis has been carried out to demonstrate how the results may vary depending on the sources of information, which can be the official documentation of the degree, the study plans or the questionnaires.

The first aspect to discuss is the scope of the analysis. In this comparative study, only those subjects with available data from the three data sources were taken into consideration. The information has been limited by the number of questionnaires answered by the teachers. Thus, the comparative analysis considers the same subjects as the previous diagnose. These 20 subjects are *Physics, Sustainability and Accessibility, Materials Science, Layout and prototyping, Business, Basic design, Manufacturing processes, Electronic systems for design, Mechanism design, Design methodology, Inclusive and User-Centred design, Design and prototype of moulds, Marketing and production, Human-System interaction, Multiplatform and distributed programming, Mechanics, Mathematics for design, Electrical Systems, Applied Sustainability* and *Usability and Accessibility Engineering*.

Second aspect to discuss is the capacity of gathering information through each source and their validity. Official documentation and study guides provide information about a higher number of subjects (62 and 72 subjects, respectively) while questionnaires gather less data by far (20 subjects).

The official documentation distributes competencies in a non-truthful manner, i.e., by distributing the same competencies for all the elective subjects or including subjects which do not exist in the current degree structure, questioning whether the documentation is up to date.

Study guides provide information about a slightly higher number of subjects in comparison to official documentation and those subjects are up to date. Regarding the validity of the source, competencies in study guides are not distributed exhaustively i.e., by skipping types of competencies or adding competencies that do not match with the official documentation. This lack of coherence is critical since the methodology to analyse the presence of CRUE competences and SDGs through official documentation and study guides depends on the competencies related to each subject.

Obtaining information through questionnaires has proven to be challenging as it depends on the predisposition of each teacher to participate in the study or not. Obtaining information about each subject of the degree would allow a precise analysis of the presence of CRUE competencies and SDGs at an itinerary, semester or degree level. The validity of the information does fit the content of the subject, but data contains a bias, as the answers are based on the teacher's opinion, their knowledge in relation to sustainability, their attitude when completing the questionnaire, etc. To overcome this bias, critical thinking related to sustainability should be included in further steps to introduce sustainability in a degree, specifically when developing teacher training

courses. This will contribute to flattening the learning curve of the teaching staff when using the questionnaire as a tool to conduct future diagnoses.

In relation to the results that can be obtained from the 3 data sources, Figures 8 and 9 exemplify some of the differences. Figure 8 shows the results of the diagnosis when clustering the whole set of subjects. The average percentage of presence of the 4 CRUE competencies are represented in blue, red and yellow to distinguish the source from where the results are coming. As expected, the results vary considerably directly affecting the interpretation of the analysis and the further discussion of which actions should be taken.

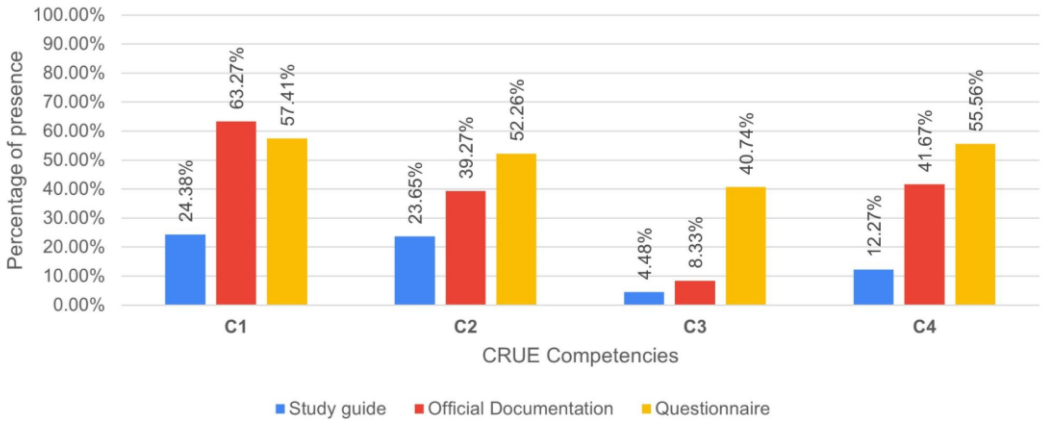

Figure 8. Average percentage of presence of the Competency Units of the whole range of subjects. Comparison of the results obtained using study guides, official documentation and questionnaires as sources of information.

Figure 9 shows these differences in a more precise way, as it shows the presence of the 4 CRUE competencies in a specific subject, Manufacturing processes. The results vary drastically depending on the source. This pattern is repeated when analysing the results of the other subjects of the study.

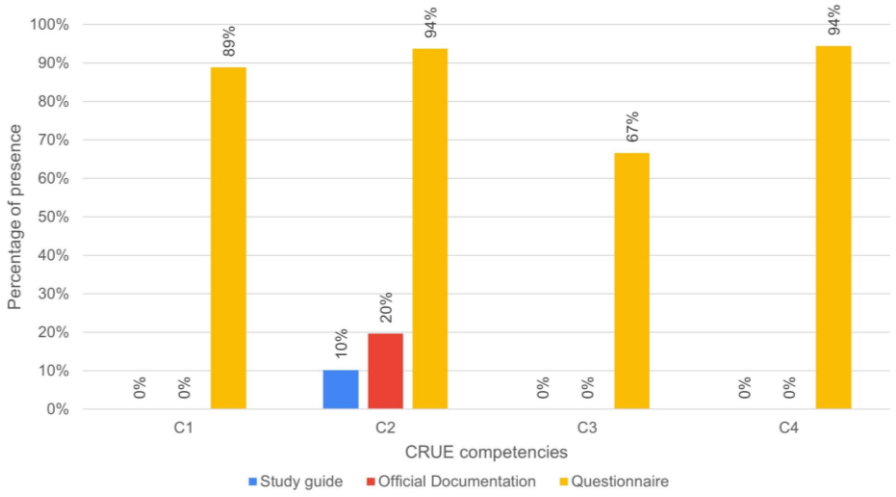

Figure 9. Percentage of presence of the 4 CRUE competencies in the subject Manufacturing Processes. Comparison of the results obtained using Study guides, Official documentation and Questionnaires as sources of information.

Conclusions

In this article, we have introduced a methodology allowing to map the current situation of a degree regarding the presence of the 4 Sustainability competences proposed by CRUE and the presence of the SDGs based on the SDGs learning objectives and the learning outcomes proposed in the project EDINSOST2-SDG. The methodology has been applied to the Engineering Degree of Design at the EPSEVG of the UPC. Performing such an analysis in a degree contributes in clearing the path to building capacity among the teachers, identifying opportunities and gaps to integrate sustainability and SDGs in a subject or cluster of subjects (itinerary, semester, degree…) and it also directly contributes to evaluating and communicating how sustainability is being addressed in a degree.

A comparative analysis has been conducted to explore which data sources are more reliable to analyse the presence of the 4 sustainability competences and the SDGs in a subject or degree. Results have shown how official documentation and study guides are not to be trusted when applying this methodology but conducting an analysis through these sources is useful to become aware of the coherence of these documents and could help university staff to generate future versions of these documents. Using questionnaires as a data source has turned out to be an optimal method to provide results that are more in line with the classroom's reality. As this is a new type of analysis thought to be implemented in universities, it should be noted that it involves a learning curve, not only for those who are conducting it, but also for teachers who answer the questionnaire and are eager to introduce sustainability in their subjects. It is expected that as more analyses are carried out, the results will be more accurately adapted to reality. A step further to confirm the validity of the results could involve gathering teachers' opinions through in-depth interviews and the students' learning progress related to sustainability and the SDGs.

Available results show how sustainability is being embedded in 20 subjects of the degree. Engaging teachers to participate in the study is a key aspect to analyse the whole degree since results can show how sustainability is being addressed in a subject, itinerary, semester, degree or any other possible cluster of subjects, but the data availability depends on the teacher's willingness to participate in the study.

Further steps to complete the scope of the analysis should include more connections between the 53 learning outcomes of EDINSOST2-SDG and the SDGs. Another interesting aspect to explore is the possibility of providing an easy and intuitive way to perform the analysis. Refining the way results are communicated is also an opportunity for improvement, i.e., by showing the results while providing recommendations on which learning outcomes could help to achieve desired scenarios.

To conclude, the authors would like to thank the Spanish Ministry of Science, Innovation and Universities for funding the project.

References

ANECA. (2012). *Guía de apoyo para la elaboración de la memoria de verificación de títulos oficiales universitarios (Grado y Máster)*. https://www.uchceu.es/docs/calidad/tramite-titulaciones/guia-ANECA.pdf (accessed 02.04.2021).

Australia/Pacific SDSN. (2017). Getting started with the SDGS in Universities: A guide to for Universities, Higher Education Institutions andthe Academic Sector. Australia, New Zealand and Pacific Edition. In *Sustainable Development Solutions Network*. https://www.miteco.gob.es/es/ceneam/recursos/pag-web/empezar-ods-universidades.aspx

Ley 7/2021, de 20 de mayo, de cambio climático y transición energética., 62009 (2020). https://www.boe.es/eli/es/l/2021/05/20/7.

CRUE. (2012). *Directrices para la introducción de la Sostenibilidad en el Curriculum (Revisión 2005)*. CADEP Calidad ambiental, desarrollo sostenible y prevención de riesgos. https://redcampussustentable.cl/wp-content/uploads/2018/03/3-Directrices_Sosteniblidad_Crue2012.pdf (Accessed 05.02.2021).

Sánchez-Carracedo, F., Sureda Carbonell, B., & Moreno-Pino, F. M. (2020). Analysis of sustainability presence in Spanish higher education. *International Journal of Sustainability in Higher Education*, *21*(2), 393–412. https://doi.org/10.1108/IJSHE-10-2019-0321.

Segalàs Coral, J., & Sánchez Carracedo, F. (2019). El proyecto EDINSOST. Formación en las Universidades españolas de profesionales como agentes de cambio para afrontar los retos de la sociedad. *Revista De Educación Ambiental Y Sostenibilidad*, *1*(1), 1–16. https://doi.org/10.25267/rev_educ_ambient_sostenibilidad.2019.v1.i1.1204.

UNESCO. (2017). *Education for Sustainable Development Goals Learning Objectives*. UNESCO, France.

UNESCO. (2021). *Berlin Declaration on Education for Sustainable Development* (Issue May, p. 4). UNESCO and Federal Ministry of Education and Research. https://en.unesco.org/sites/default/files/esdfor2030-berlin-declaration-en.pdf (accessed 20.05.2021).

United Nations. (2015). *Resolution adopted by the General Assembly*. United Nations Seventieth Session. Agenda Items 15 and 116.; United Nations General Assembly. https://doi.org/10.1163/157180910X12665776638740.

Xarxa climàtica. (2020). *11 Polítiques Urgents Per Fer Front a L'Emergència Climàtica a Catalunya*. https://www.ecologistasenaccion.org/wp-content/uploads/2020/01/demandes-xarxa-clima.pdf (accessed 10.02.2021).