Sustainable development goals in the subject sustainability and environmental technology in the degree of engineering in industrial design and product development at ULPGC

Objetivos de desenvolvimento sustentável no assunto sustentabilidade e tecnologia ambiental no grau de engenharia em desenho industrial e desenvolvimento de produto na ULPGC

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ABSTRACT
This paper shows the change in the perception of the Sustainability and Environmental Technology subject in the students of the degree in Engineering in Industrial Design and Product Development at ULPGC in the last years. The changes made to the teaching project have led to a higher interest of students in the subject as well as an increased importance of this subject in their studies plan. Among the modifications, the use of social networks (mainly Instagram) was implemented as a way to motivate students and to engage them through the learning and dissemination of the main concepts related to Sustainable Development Goals (SDG), although also covering other aspects such as life cycle assessment, eco-design or recycling, among others. The curriculum was realigned to include new topics, so that the subject is well contextualized in the degree; initially the subject just dealt with topics related to control and treatment of pollution, while the new outline includes recycling, life cycle assessment and eco-design, among others. The questionnaires performed to students at the beginning and end of the term show a high degree of satisfaction and the courses developed with a high degree of implication and motivation from the students' side.

RESUMO

Este artigo mostra a mudança na percepção da disciplina de Sustentabilidade e Tecnologia Ambiental nos alunos do curso de Engenharia em Design Industrial e Desenvolvimento de Produtos da ULPGC nos últimos anos. As mudanças feitas no projeto de ensino levaram a um maior interesse dos alunos no assunto, bem como uma maior importância deste assunto em seu plano de estudos. Entre as modificações, o uso de redes sociais (principalmente Instagram) foi implementado como forma de motivar os alunos e envolvê-los através da aprendizagem e divulgação dos principais conceitos relacionados aos Objetivos de Desenvolvimento Sustentável (ODS), embora também abranja outros aspectos, como a avaliação do ciclo de vida, eco-design ou reciclagem, entre outros. O currículo foi realinhado para incluir novos temas, de modo que o assunto seja bem contextualizado no grau; inicialmente o assunto apenas tratou de temas relacionados ao controle e tratamento da poluição, enquanto o novo esboço inclui reciclagem, avaliação do ciclo de vida e eco-design, entre outros. Os questionários realizados aos alunos no início e no final do termo mostram um alto grau de satisfação e os cursos desenvolvidos com um alto grau de implicação e motivação do lado dos alunos.

1 INTRODUCTION

The degree in Engineering in Industrial Design and Product Development is found in a good part of Spanish universities, generally integrated into Engineering schools. However, the characteristics of this degree imply that there are significant differences with the more traditional engineering degrees (as, for instance, mechanical, chemical, or electrical). For example, the contents of the subject of Environmental Technologies and Sustainability, with this or other similar names, is usually common to all degrees in engineering, except in industrial design engineering. A search performed on the curriculum for the same degree carried out online in different Spanish universities shows that very few universities include this subject as compulsory in the study plans of Engineering in Industrial Design and Product Development (*Grado En Ingeniería de Diseño*

Industrial y Desarrollo Del Producto · Terrassa · ESEIAAT – Universitat Politècnica de Catalunya. BarcelonaTech. UPC., n.d.; Ortega & Angulo, 2015). It is noteworthy that, in both universities, students receive basic subjects of a more engineering nature, such as physics, mathematics or chemistry, although at ULPGC they do not receive chemistry training.

On the other hand, there are more references about it as part of the degree's teaching plan, as an elective subject, and in many cases the teaching guides are not available.

Finally, it should be highlighted that Sustainable Development Goals is currently not a part of the curriculum in most engineering degree programs. These are a set of 17 objectives, settled by United Nations and adopted by over 178 countries in the world, with the objective of advancing through a more prosperous, sustainable and fair society (*THE 17 GOALS | Sustainable Development*, n.d.). It is interesting to note that the 17 objectives can be related to engineering area, and not only those more focused on technical aspects (such as objective 7, affordable and clean energy). In this subject, we have incorporated specific activities to study the SDG and to propose specific measures that students could undertake in their daily lives to contribute to their achievement. It has been observed that the students from the first years (2014-2016) did not have previous ideas on SDG, while the last ones at least have heard about them and are able to recognize their identifiers. This also shows the need to introduce them in university curriculum while aligning them with technical contents, while emphasizing the need of applying them in daily lives and in their professional performance.

On the other hand, it is undeniable that the changes in the use of technology and the massive use of Internet in our daily lives have affected even our communication mode. Social networks have gained increased popularity and have become an essential element in communication nowadays, serving as communication, connection and information source (Wiederhold, 2020). Its use is growing significantly more than ever and is marking a great revolution in educational systems (Chen & Xiao, 2022).

This differentiating profile of this degree and the enrolled students show the need to adapt this subject to this specific degree, giving higher weight to the contents related to sustainable development rather than to control and treatment of pollution, which are the main focus of this subject in those other aforementioned degrees. This subject was completely modified in 2014 to incorporate such contents and adapt them to the profile of both the degree and the students who, on the other hand, do not have some of the basic knowledge necessary in order to understand it, such as fundamentals of chemistry or fluid mechanics. Before such adaptation, the level of implication of students in the subject was quite low and a significant proportion of them expressed that the subject was not interesting for their training and did not provide any remarkable skills or knowledge for their professional development.

The change in the contents of the subject in 2014/2015 achieved a shift in the students' perception of the subject, getting a more positive attitude about its importance and closeness to the industrial design field and resulted in high levels of implication and participation (Ortega & Angulo, 2015). These changes were mainly related to the incorporation of SDG within the curriculum, together with the settlement of some basic ideas on eco-design, lifecycle assessment and reuse/recycling/upcycling concepts, together with a reduction of the hours dedicated to wastewater or atmospheric pollution treatment. It is important to highlight at this point that these students have not previous training in Chemistry, and so these topics are particularly complex to them; besides, this area (environmental pollution) it is not within the primary focus of engineers in industrial design.

After some years allowing to consolidate the proposed program, some more changes were implemented. Some contents about Sustainable Development Goals (SDG) and how these could be tackled from the perspective of Industrial Design engineers were included in the course. To undertake this task, the class was divided in groups of 4-5 students, and 3 different SDG were assigned to them; some groups were repeating some of the SDG. Within the different weeks, they had to study the specific SDG, and understand the objective

of the goal, the starting level and the final objective, and propose some measures that they could undertake at an individual daily level. Then, the different groups presented their work to the entire class, and a debate about the different SDG and how they are all linked together, even if it is not always obvious, arouse. As a result, and as a class, the students had to agree in a set of actions to be implemented within their daily lives and commit to undertake them. Some of these actions were related to the reduction of discarded food (excessive buying of fresh food, usually), increasing local products consumption and paying more attention to disposal of products and separation of residues, among others, which also included trying to involve other people in these issues (family or friends). Finally, as these generations of students are strongly linked to social networks, it was proposed, as a voluntary task, that the tasks produced along the course were adapted to a more visual format, and published in an Instagram account, created, and managed by them. Regardless this was an optional activity, it was surprising that all students participated in this activity.

This work shows the results of two different quests, filled in an anonymous way by students. The first one was answered the first day of class, before the presentation of the subject and its contents, and the other one was made available throughout the course on the virtual campus platform. From results obtained, it is clear that students have changed their perception and consider this subject as very important for their training, and with a vital role in their professional future. It pretends to show that the efforts made in adapting a subject and the methodology employed to the specific characteristics of a degree and students result in a higher interest, motivation and implication of students. The experience has also demonstrated that SDG have been successfully implemented in the selected subject, benefiting of the synergies between the social and environmental needs with the learning of technical concepts. On the other hand, an increase of environmental and social concerns topics was covered by these students in their final degree projects, which have been related to their awareness about SDG achieved during this subject.

2 METHODOLOGY

The same questions were posed to the students in 6 different courses, starting in 2014/2015. The answers of the two first questions were marked in 1 to 5, being 1 considered as I don't agree, and 5 as I fully agree. The other questions were answered just with yes or no, or as free text. The first quest consisted in the following questions:

1. Are you interested in this subject?

2. Do you think this subject is important for your training?

3. Have you read the curriculum?

4. Have you asked for information about the subject to other students?

5. Is there any topic that you would like to address in the subject?

The second quest, opened after one month of course and closed two weeks after publishing the final qualifications, consisted in 6 questions, listed below. The first two questions were marked in 1 to 5, while the remaining ones were given as free answers:

1. Are you interested in this subject?

2. Do you think this subject is important for your training?

3. Is there any topic you would like to tackle that is not included? If so, which one?

4. Is there any topic you think is not interesting and should be removed or reduced? If so, which one?

5. Write the aspects you consider as more positive, or you like most, from the course.

6. Write the aspects you consider as more negative, or you don't like, from the course.

3 RESULTS

The results obtained after the analysis of the answers given to the initial questionnaire are found in table 1, while those for the second quest are summarized in table 2. In order to show the results in numerical form, values from 0 to 4 were given to the different answers in questions 1 and 2: 0 was given to

the lower answer (I absolutely don't agree) and 4, to the higher one (I fully agree). The results shown in both tables are obtained as the percentage of answers in each of the 5 categories multiplied by the value of the answer, from 0 to 4. So, for example, the first question (are you interested in this subject?) in the first year obtained 0 answers on the two highest scales (I fully agree and I agree), 7.1 % in the third level (I somewhat agree), 21.4 % in the fourth level (I don't agree) and 71.4 % in the last one (I absolutely don't agree), and thus the points obtained are: $0.071x2+0.214x1+0.714x0=0.356$. Similarly, for the second year, the values were (respectively, from high to low): 18.2, 54.5, 18.2, 9.1, 0.0 %, and so, the punctuation obtained raised up to 2.82. For remaining questions answered with yes or no, results are expressed as ratio of students answering yes (in percentage).

Table 1 – Answers to the initial questionnaire.

Question	14/15	15/16	16/17	17/18	18/19	19/20
1	0.36	2.82	2.86	2.92	3.29	2.62
2	0.50	2.68	2.86	3.21	3.42	2.74
3	9.3 %	17.5 %	17.1 %	20.8 %	37.8 %	23.1 %
4	26.7 %	49.2 %	47.1 %	58.5 %	48.9 %	41.0 %
5	0.0 %	3.2 %	7.1 %	5.7 %	0.0 %	2.6 %

Source: authors.

If the results obtained in the initial questionnaire for the different courses are compared, it can be seen that after the first year there was a drastic shift in the perception of the students at the beginning of the course, which was maintained for the rest of the courses. This was also related apparently to a higher ratio of students reading the curriculum or asking for information to other students before the first day of class. It appears also that students prefer to get the information from other students than from the curriculum, which is published and accessible via campus virtual and the official website of the university. On the other hand, the information received from other students have a positive effect in the interest in the subject.

It is also interesting to note that, in general terms, students don't have, at this point, any idea of potential topics to include in the curriculum to make it more appealing, which correlated with the relatively low percentage of students that

have read it before the first class. From the answers got, renewable energies, eco-design and urban wastes treatment are the only topics mentioned by students. Interestingly, two of them (eco-design and urban wastes) are included within the curriculum, which shows, again, that most of them have not really read the entire document, although claiming that have done it.

From table 1, it can be seen that there is a very significant increase in the perception of students (questions 1 and 2), especially in the first year after the change in the curriculum. This might mean that they have positively considered the changes introduced in the subject. All analyzed courses show a positive trend when comparing the questions 1 and 2 before and after the course, and so their expectations about the subject have been met. The creation of the Instagram accounts was proposed in the course 17/18, where the highest increase in the perception of the importance of the subject is observed. Especially interesting are the results from the last two courses, where the interest for their future working skills is found to be over 3.5. In these two years, the 55.6 % and 53.8 %, and the 64.4 % and 64.1 % of students have answered with the maximum scale to these two questions, and only one of them has answered as "I don't agree" in question 1 (year 19/20).

Table 2 – Answers to the second questionnaire.

Question	14/15	15/16	16/17	17/18	18/19	19/20
1	3.00	2.98	2.89	3.08	3.53	3.44
2	2.86	3.05	2.86	3.34	3.64	3.59
3	0.0 %	3.2 %	1.4 %	1.9 %	2.2 %	0.0 %
4	0.0 %	0.0 %	4.2 %	1.9 %	6.6 %	2.6 %

Source: authors.

It is remarkable that all students were engaged in the creation and publication of some of their works on their Instagram accounts, especially in those tasks related to SDG, even although this was an optional activity, not considered within the evaluation. It should be highlighted that each group run their own account, and the activities were monitored through that, and not students personal accounts. Lab activities were also posted by some of the groups in the subject. Some of the students even published as "stories" situations on their daily

lives, such as the excessive packaging when going to the supermarket, the separation of residues after a party (glass, plastics, cardboard and rests of food). Next figure shows some of the publications they have prepared.

Figure 1 – Some of the publications prepared by students for their Instagram accounts.

Source: authors.

Regarding the remaining questions, below is a list of most repeated answers for each of them:

Question 3:

o   Increase the time dedicated to eco-design

o   Not as a new topic, but it would be interesting to visit companies or organizations related to industrial design and environment

o   Application of legislation and standards to the design of a product

o   Renewable energies applied to a course project, as for example the development of a solar furnace

o   Not as new topic, but it would be interesting to have more cohesion with other subjects of the degree

Question 4:

o   Legislation and standards

o   Wastewater treatment and atmospheric pollution

Question 5:

o   Practical and dynamic classes

o   Incentivation of the participation and increase in our motivation

o   Discussion and debates performed in class

o   For the last two years: creation of the Instagram group

o   SDG: analyzing and dealing with societal and environmental problems and how we can answer them from industrial design engineering Question 6:

o   Language (the subject has 75 % of credits in English)

o   Not deepening in the life cycle assessment calculations

o   For the last two years: excessive time dedicated to the preparation of Instagram posts

From these answers, the most significant is the positive feedback from the creation of social networks profile, although part of students consider they need excessive time to prepare and publish the posts. This could be solved in next courses by the coordination of this subject with others that deal with graphic design, and by choosing only one or two publications per course and group.

The experience was not continued in time due to a change in the structure of the degree, which has been recently approved. The proposal for course 2023/2024 will include the use of social networks, in a more integrated way. Part of the limitations, as the use of language, should be solved, as they subject has been moved from the second to the third course, and students would have already passed the technical English course. Besides, some other aspects usually appearing, as the lack of deepening in some aspects might be also tackled, although one of the most claimed ones (performing LCA calculations) is probably not been implemented, due to the level of difficulty of such studies.

4 CONCLUSIONS

-        Considerable increase in interest in the subject, with higher participation in class activities, reaching 100 % of students involved in optional activities.

-        The new curriculum for the subject has led to an improvement in the conception of the importance of the subject in the curriculum in more than five times.

-       The students do not take into account the teaching project at the beginning of the course, and usually prefer to have feedback from older students.

-       Next planification would need to include a proper horizontal coordination with other subjects. The new curriculum has moved this subject to third course, and so some further assessments to enhance complementarities need to be performed.

-       Part of the improvement obtained in terms of student interest in the subject may be due not only to the change in the syllabus, but also to the introduction of coursework related to the subject (life cycle) and ecodesign.

-       The use of social networks is generally well accepted by students, although this need to be assessed more in detail to avoid an excessive loading.

-       There is an opportunity in getting an actual integration of several subjects now found in the third course of the degree, and a challenge that need to be enfaced.

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