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COMPARISON BETWEEN THE IMPORTANCE THAT STUDENTS GIVE TO ENVIRONMENTAL AWARENESS FOR THEIR PROFESSIONAL DEVELOPMENT AND THE WORK CARRIED OUT BY THE BILBAO SCHOOL OF ENGINEERING IN THIS FIELD

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Abstract

We have made an analysis of the degree of environmental awareness of the students in the degrees of Mechanical Engineering, Electrical Engineering and Electronic and Automatic Engineering of the School of Engineering of Bilbao. To do this, we have analyzed the importance they believe the environment has in the development of their future job performance in the field of engineering. Given this aspect, we have tried to compare such importance with the work that is currently being carried out with these students in this field. To this end, two aspects have been studied that we consider fundamental in the training of students for the development of this competence in sensitivity to the environment: on the one hand, the work carried out by the Bilbao School of Engineering as an institution and the degree of perception that this has the student body. On the other hand, we have studied the information offered by the programming of several subjects on environmental competence and the degree of perception that students have of the inculcation that they are receiving during their learning process in said subjects and throughout the grade, taking into account the different forms of learning: master classes, laboratories, projects... The result leads us to think of an imbalance, which will have to be revealed so that corrective measures are put in place as soon as possible so that these future engineers have more arguments and awareness to combat climate change from our beloved profession, what is coming right now.

Keywords: environmental awareness, engineering students, university.

1 INTRODUCTION

In September 2015, the General Assembly of the United Nations adopted the 2030 Agenda for Sustainable Development. This agenda is a very ambitious plan in favor of people, the planet, prosperity, peace, access to justice... It is specified in 17 objectives and 169 goals that cover a large number of aspects for the year 2030. In the resolution of September 25, 2015, the Member States committed themselves "... to guarantee lasting protection of the planet and its natural resources". The Agenda implies a common commitment, but each country sets its own national goals based on the Sustainable Development Goals. Several of these objectives are directly related to the preservation of the environment. Specifically, objective 15 called "life of terrestrial ecosystems" calls for sustainably managing forests, combating desertification, stopping and reversing land degradation and halting the loss of biodiversity, while objective 13 entitled "climate action" calls for urgent action to combat climate change and its effects. Specifically, one of the goals of this objective deals with "improving education, awareness and human and institutional capacity regarding climate change mitigation, adaptation to it, reduction of its effects and early warning". The concept of expanding the range of technological measures repeatedly appears in these objectives, a concept that appeals to the engineering profession, since it will be our profession that has a great responsibility in this area.

The University of the Basque Country (UPV/EHU) believes that Higher Education plays a fundamental role in advancing towards the development model insofar as it equips students, future professionals, with the knowledge, skills and attitudes to reorient social structures and systems. The UPV/EHU is aware of its responsibility and therefore intends to contribute through its teaching practice to the training of people and professionals committed to the Sustainable Development Goals of the 2030 Agenda to integrate sustainability into the planning and design of subjects that they impart. To this end, in 2019 it took a step in this direction with the publication of the Catalog of Transversal Competencies of the UPV/EHU, which establishes a set of eight competencies common to all UPV/EHU degrees. In said catalog we find the EE13 sub-competence which literally says "analyze the social and/or environmental impact of the proposed scientific-technical solutions, assessing their functionality and relevance according to criteria of sustainability and social justice" [1].

2 METHODOLOGY

Since sustainable development involves a large number of aspects (poverty, health, well-being, universal education, gender equality, clean water and sanitation, decent work...), we have decided to focus on the environmental aspect in order to carry out a relevant study [2, 3, 4]. Given the importance that the UPV/EHU seems to give to environmental awareness, we have carried out a study with 188 people who study at the Bilbao School of Engineering (BIE/EIB) [5, 6, 7]. In the first place we have analyzed the degree of environmental awareness of the students [8, 9]. Given this aspect, we have tried to compare the importance that students give to the environment with the work that is currently being carried out with these students in this field. For this we have studied the perception that students have of the degree of environmental awareness of the BIE/EIB, and subsequently we have asked said students about their perception of the degree of environmental inculcation received in their studies. We have compared these last two aspects with: on the one hand, the work carried out by the BIE/EIB as an institution in the environmental field. On the other hand, we have analyzed the information offered by the programming of various subjects on environmental competence.

The 188 people who have been chosen for this study are students of the subjects of Fluid Mechanics, Installations and Hydraulic Machines; and Computational Fluid Mechanics. The subject of fluid mechanics is taught in the second year in the Degrees of Mechanical Engineering, Industrial Electronic and Automation Engineering; and Electrical Engineering, while the other two subjects are taken only in the Degree of Mechanical Engineering. Installations and Hydraulic Machines are studied in the third year, while the student body studies Computational Fluid Mechanics in the fourth year. This has been done to observe if as they advance in their undergraduate studies, the perspective regarding the environment changes. The study also intended to see if gender influences the environmental aspect, but unfortunately the percentage of women studying these degrees is still small [10]. Specifically, the percentage of women participating in the study (according to existing enrollment) is 13%, which is why we consider the information obtained in this regard to be of little relevance. Most of the participating students (around 64%) state that their initial interest in engineering was high or very high and this percentage is maintained after completing part of their studies, which gives us a good starting point: they are people who feel the engineering profession.

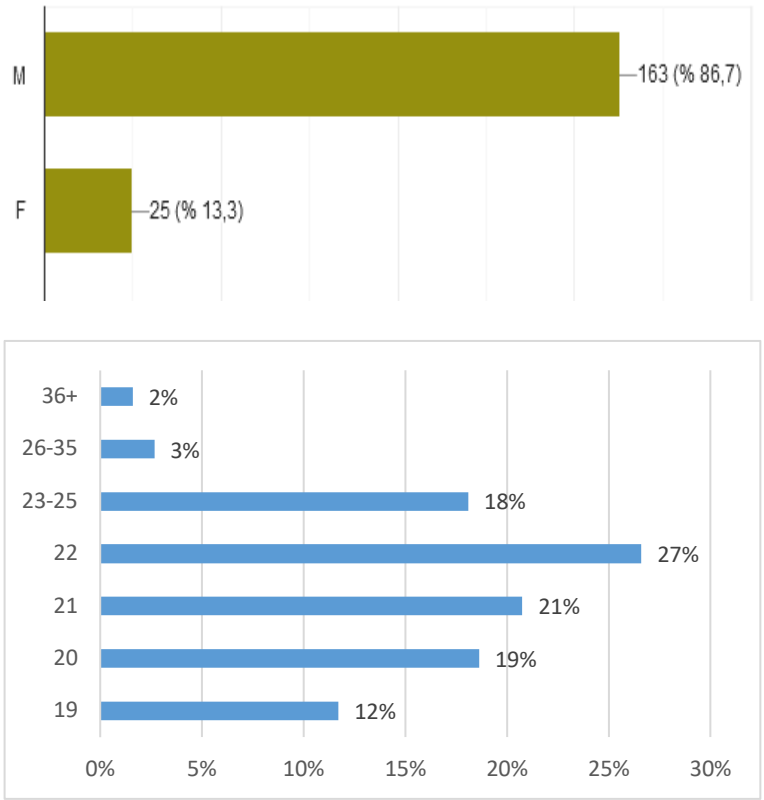

Figure 1. Distribution by gender and age of the respondents.

3 RESULTS

3.1 Degree of environmental awareness of students

To analyze the degree of awareness of the students, apart from asking directly about it, we have asked them about specific facts, that is, about whether they have participated in actions to protect the environment [11]. We have done this because it is usual in these issues for us to answer about what we would like to think (or what is politically correct) and there is usually a significant deviation between our actions and what we say we think (no one or very few people declares openly racist although later his behavior indicates the opposite). From what we have detected, we can affirm that around 59% of the students have a high or very high degree of environmental awareness, since they affirm this and it is corroborated since practically 100% of the people who respond in this way have participated in different active actions in favor of the environment. A large percentage (73%) of the people participating in the study think that taking care of the environment is an individual responsibility, but an even higher percentage think that taking care of the environment is the responsibility of institutions. Regarding the engineering profession, slightly less than half of those surveyed believe that our profession bears a large part of the responsibility for current pollution levels, and if they are asked whether the solutions proposed by engineers should be respectful of the environment, there the percentage is clearly majority (88%). If we introduce the variable of economic cost versus environment, the percentage of support for the environment drops a little, but it is still the majority. It is noteworthy that many students (80%) consider it important that their future work performance be respectful of the environment, but few students (23%) consider that studying the degree is beneficial to develop their environmental awareness, that is, they have little confidence in the work carried out by the UPV/EHU in this field.

Table 1. Opinion on engineering and environment.

Question	*1 nothing agree*	*2 little agree*	*3 moderately agree*	*4 quite agree*	*5 totally agree*
Engineers in the exercise of their task must propose solutions that harm the environment as little as possible.	0%	1%	11%	41%	47%
The engineers in the exercise of their task must propose a compromise solution (balance) between the economic cost and the most favorable environmental solution.Two	0%	2%	18%	44%	36%
I consider it important that my future job performance be respectful of the environment.	2%	5%	14%	48%	31%
I consider that studying the degree is beneficial to develop my environmental awareness.	10%	31%	35%	17%	6%

3.2 The environmental awareness of the school

3.2.1 The students´ perception

Subsequently, we have analyzed the students' perception of the degree of environmental awareness of the BIE/EIB. Only 23% of the students consider that the school has a high degree of environmental awareness and a similar percentage considers that the school seeks to make its students sensitive to the environment. This percentage is consistent with the little confidence they have in the work that the UPV/EHU does, seen above. Perhaps this low percentage is due to the little knowledge that students have of the work that the school does in this field, since only 28% know of any activity that the school does. Thus, the vast majority of people who are aware of the environmental practices of the school are the ones who have a better vision of the school.

3.2.2 The environmental activities

We have analyzed the environmental activities recently carried out by the school. In May 2021, the school has implemented an environmental improvement management system called Ekoskan in "teaching, management and research activities". With this system, it undertakes to identify and evaluate the main environmental aspects and to incorporate measures that promote energy efficiency, responsible water consumption, waste water discharges, materials, waste and the biodiversity component, as well as to

provide training to the personnel involved on the aspects linked to their activity and their functions, raising awareness so that their behaviour in the workplace reflects their commitment to the environment. It has already carried out several activities, but it is understandable that since it has been running for a short time, its dissemination is limited. It is not that nothing was done before that date, but that activity was much smaller (in addition, it was largely focused on waste collection).

3.3 Environmental training received by students

3.3.1 The students´ perception

Finally, we have studied the students' perception of the degree of environmental training received during their studies. The results are quite clear. Only 9% believe that the programming of the subjects carried out in the degree reflected through the corresponding teaching guide includes the development of environmental skills by students. Similar percentages, 13%, are observed when asking if the resources used by teachers help students in their environmental learning process. It is striking that large majorities think just the opposite, that is, that they make such learning difficult. Trying to analyze whether there are differences when it comes to inculcating environmental concepts between the different types of teaching, we realize that there is not, that practically all types of teaching contribute in a similar way to the development of environmental concepts and also contribute very little, or even make it difficult, according to a large number of students. In the theoretical classes, 12% think that the environmental variable is taken into account, while 62% think that it is not taken into account. In the practical activities proposed to the students, the percentages are even worse in relation to the environment. Only a scant 9% believe that this type of teaching facilitates the environmental learning process, while 66% believe that this type of teaching favors little or very little this learning. Similar percentages are obtained when asking about the projects that students must carry out, or about the workshop or laboratory sessions that they received to develop the theoretical concepts seen in the classroom. When inquiring about internships in companies that students can do, we find that the vast majority have not done internships in companies, so the number of responses is much lower: 49. In any case, the percentages are very similar.

Regarding the impression they have of the teachers, the percentages are a little more encouraging: 25% agree or strongly agree that the teachers are environmentally aware and a little less (20%) believe that the teachers have good training in said field. Focusing on the subjects, only 10% believe that the subjects studied in the degree develop environmental competence and 11% believe that they have contributed to increasing their environmental awareness. Taking advantage of this survey, we wanted to ask about the subjects that the authors of this article teach: Fluid Mechanics, Hydraulic Installations and Machines; and Computational Fluid Mechanics. In the three subjects, the percentages are higher than those obtained when asking generically about the subjects. These better percentages could also be due to the fact that we have been the ones who have asked the questions and that sympathy and closeness may have influenced the answers. In any case, the answers are consistent with each other, since better percentages are observed in the subject of Hydraulic Installations and Machines (24% and 25%) than in the other two, and there are better percentages in classical Fluid Mechanics (17% and 19%) than in the Computational (15% and 12%), which requires much more use of the computer. We say that they are coherent, since the program and the concepts taught in Hydraulic Installations and Machines are closer to real situations than the other two subjects, which are somewhat more theoretical or less practical. In general, few students, 19%, believe that their time at the University has increased their environmental awareness. We have also observed that as they advance in their undergraduate studies, the perspective regarding the environment does not change.

3.3.2 The environmental competence in the teaching guide

Finally, we have analyzed the information offered by the programming that appears in the teaching guide on environmental competence [12, 13]. In the first place, we have searched among the competences that students must acquire in the degree. In the three degrees in which we have carried out the study, Mechanical Engineering, Industrial Electronic and Automation Engineering; and Electrical Engineering, a competence appears (of fourteen) that says verbatim: "ability to analyze and assess the social and environmental impact of technical solutions". However, investigating between the subjects of the degrees, the results are disappointing. In Mechanical Engineering, 37 subjects are offered, 38 in Industrial Electronic and Automatic Engineering and 36 in Electrical Engineering. Some of these subjects are common to all three degrees. Among the common subjects, students must take two subjects in the fourth course of six credits each in which the program is related to some issue with the environment: Integrated Management Systems and Environmental Technologies. In the first subject of 6 topics, the environment appears in 2 of them: “the environment in business management” and “quality,

environment and safety management systems or models". Paradoxically, among the competences of this subject, nothing related to the environment appears. In the second subject, Environmental Technologies, the environment appears in many topics and also appears in the competences. Then there are two other subjects common to the three degrees among which something appears in the competences. In Fluid Mechanics, second course and six credits, a competence says the following: "plan and develop designs and processes... analyzing and assessing the social and environmental impact of applied technical solutions." In the subject of Thermal Engineering, second course and six credits too, there is a slight reference that we could classify as a reference to the environment that says the following: "... and interpret the results in terms of energy savings and efficiency".

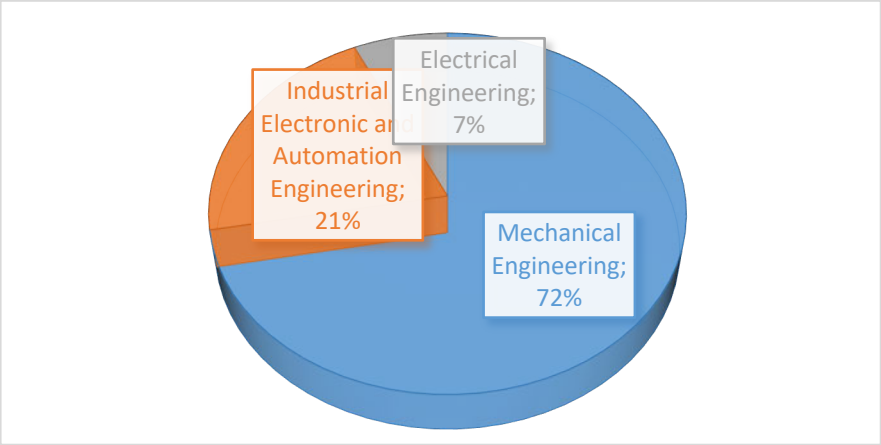

Figure 2. Distribution by studies of the respondents.

In the Mechanical Engineering Degree we find an elective subject in the fourth course of six credits entitled Industrial Architecture in which we find among its competences one that is very similar to the general one of the degree. At this degree, nothing more. In the Degree of Industrial Electronic and Automatic Engineering in the subject of third course and six credits Industrial Computer, the following competencies appear: "identify in the processes: points of energy improvement, if they have some type of environmental impact and possible social impact". In the subject Electronic Digital Systems, third course and six credits too, a laconic "those specified in the verified memory of the degree title" appears in the competencies, and nothing else in the rest of the degree subjects. Finally, in the degree of Electrical Engineering in the third course, in a subject called Power Plants and Renewable Energies of 9 credits there is a topic that appears in the program called "power plants in a special regime" in which is taught power generation in power plants based on renewable energies. Among the competences in this subject appears the same one that we have previously mentioned that appears in the undergraduate degree. Doing a review, of 63 different subjects, the environment is only mentioned among the competences in 7 of them, being quite generous in the count.

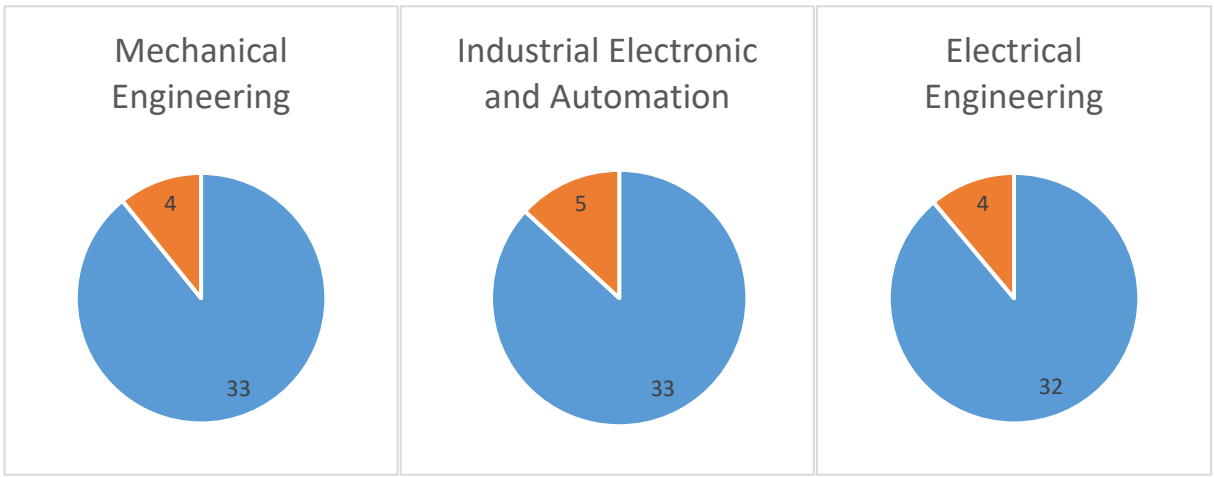

Figure 3. Number of subjects without environmental competence in the teaching guide and in how many that competence appears.

4 CONCLUSIONS

The students of the Degrees of Mechanical Engineering, Industrial Electronic and Automation Engineering; and Electrical Engineering feels mostly aware of the environment and thinks that it is a very important aspect in the development of their future job performance. However, the perception they have about the environmental training they are receiving in their learning stage is very low. The same thing happens with their perception of the work related to the environment that the Bilbao School of Engineering (BIE/EIB) does as an institution. This low perception coincides with the scarce reference to the environment that appears in the learning competencies that the students of the subjects must acquire during their training process. With this study, it is evident that the imbalance is great. Meanwhile, the University of the Basque Country (UPV/EHU) says that it is making great efforts to train people and professionals committed to the environment. Therefore, we believe that both the UPV/EHU university and the BIE/EIB school should review the measures they are implementing and implement corrective measures [14] as soon as possible so that these future engineers have more arguments, awareness and perhaps knowledge to combat climate change that is coming from our beloved profession.

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