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Towards the Achievement of the Sustainable Development Goals through Engineering Training for Labor Market Reintegration of Older Workers

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Abstract: The inclusion of training in the Sustainable Development Goals (SDGs) in higher education is essential to achieve them. In addition, labor market reintegration or improvement of older workers is a goal that an increasing number of people have set for themselves, especially in countries severely affected by crises. The union of these two premises has given rise to the application of a methodology in a master's degree in engineering. This manuscript makes a double contribution: on the one hand, it presents the methodology with its application through a practical case; on the other hand, it covers how students perceive the application of non-traditional training techniques. The methodology is based on student-centered learning, using case-based teaching and inquiry-based learning. The students' perception of this change in training was evaluated through a qualitative methodological approach for five consecutive years and through two types of surveys carried out each year, one of which involves comparison with traditional training methodologies. The results of the surveys show the favorable acceptance of this form of teaching, surpassing the results of traditional teaching methods by more than 25%. As a practical implication, this research identifies new ways of teaching complex subjects that facilitate training in SDGs and the subsequent labor market reintegration of older people.

Keywords: sustainable development goals; social responsibility; education; older workers; labor market reintegration; European higher education area; student-centered; inquiry-based learning; case study

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1. Introduction

1.1. Overview

Engineering, in all its branches, is essential to achieve the Sustainable Development Goals (SDGs) by 2030 [1]. To achieve these goals, it is necessary to start from training in higher education [2] so that future technicians will have internalized the need to achieve an environmentally sustainable environment, being aware of the importance of their work with respect to achieving sustainable development [3].

Of the 17 SDGs, 14 are related to engineering to varying degrees, starting with training and ending with execution. The various branches of engineering have something to contribute to each of the SDGs. Target 1.5 of Goal 1 (no poverty) refers to a reduction in vulnerability related to climate and environmental disasters. Target 2.A of Goal 2 (zero hunger) proposes an increase in investment in rural infrastructure. Target 4.7 of Goal 4 (quality education) promotes education for sustainable development. Target 5.B of Goal 5 (gender equality) favors the use of technology for the empowerment of women. Goal 6 (clean water and sanitation) is one that implies a considerable role for engineers with respect to all its targets to achieve affordable access to drinking water and adequate sanitation for all. The same is true of Goal 7 (affordable and clean energy), the targets of which are focused on ensuring universal access to energy services and increasing the share of renewable energy. Target 8.2 of Goal 8 (decent work and economic growth) promotes technological upgrading and innovation. Participation in Goal 9 (industry, innovation and infrastructure) is relevant to building infrastructure, promoting sustainable industrialization, and fostering innovation. The same is true of Goal 11 (sustainable cities and communities), with respect to ensuring access to safe and basic services and transport systems (targets 11.1 and 11.2). Goal 12 (responsible consumption and production) is related to ensuring sustainable production. Target 13.3 of Goal 13 (climate action) is focused on improving education and raising awareness of climate change mitigation. Target 14.1 of Goal 14 (life below water) is related to reducing marine pollution from land-based activities. Target 15.3 of Goal 15 (life on land) addresses desertification and restoration of degraded land. Finally, target 17.6 of Goal 17 (partnerships for the goals) encourages the improvement of cooperation on and access to science, technology, and innovation.

Periodically occurring economic crises mainly affect the most vulnerable elements of society: the elderly, women, young people, and migrants. Although crises have diverse origins, they share the common characteristic of affecting the whole world due to the globalization in which we are immersed. The most recent global crisis, which began in 2020 due to a pandemic, had not ended when another one began in 2022 due to the war in Ukraine. The previous global crisis originated in the real estate sector. Despite having started in 2008, there were still countries that had not reached the level they were at before the crisis when the next one started. The 2008 crisis affected employment in an important way. In the European Union, 6.2 million jobs were lost in the first 18 months [4]. This loss continued to increase until reaching its maximum value in 2013, with an 11.4% unemployment rate in the EU. However, countries such as Greece and Spain exceeded 20%, whereas others, such as Germany, Austria, and Luxembourg, did not reach 6% [5].

One of the tools commonly used for labor market reintegration or improvement, owing to its positive effect on the chances of finding a job, is training, both university [6] and specific training [7,8]. In particular, the EU has the European Social Fund (ESF) for this purpose. Among its purposes is the improvement of employment opportunities, lifelong learning, and the reinforcement of social inclusion [9], having served to finance training for older workers [10]. In Europe during the 2008 crisis, the proportion of master's degree students older than 29 years of age compared to minors increased, reaching more than 50% in some countries, such as Greece, and in others, such as Ireland, Cyprus and Finland, more than 40%; however, in other countries less affected by the crisis, such as Belgium, Germany, the Netherlands, and Poland, this proportion did not reach 20%. However, the same trend did not occur with respect to bachelor's degree students older than 29 years of age, with the rate not exceeding 15% in any European country. Taking Greece as an example, 10.5 per 1000 older students are pursuing a master's degree compared to 7.8 per 1000 younger students, whereas with respect to pursuit of a bachelor's degree, the proportions are 4.6 and 37.8, respectively. On the contrary, in Germany, the number of older students pursuing a master's degree is 4 of 1000, whereas 17.9 of 1000 younger students have the same pursuit; in terms of those pursuing a bachelor's degree, the proportions are 4.8 and 27.6 per 1000, respectively [5]. This high proportion has continued to hold since the 2008 crisis.

The responsibility of ensuring that these new students reach their goal of re-entering the world of work falls largely on the teachers. Teachers are also responsible for transmitting the need that society has to achieve the SDGs because these students will be the ones who, in the future, will shape the environment in which society moves.

The fact that many workers have chosen to improve their training to find a new job represents an opportunity to take advantage and build on their previous work experience. In this way, they can visualize possible improvements with respect to the jobs they had. In addition, students who have not had work experience being together in the same classes with others who have is an opportunity for the former to learn, in part, what they will find in their future working life. In addition, due to the relationship that is created between the students in class, they can learn, in a relaxed way, the reality of the world of work that they will soon find themselves in.

Therefore, many older workers have found, in higher education, a way to improve their skills [11] and facilitate their labor market reintegration and prosperity [12]. This is something to consider in higher studies, especially in the context of a master's degree: considering the students who attend the classes, their expectations [13], and not disappointing them [14], teachers must focus their teachings towards the achievement of the SDGs so that students internalize them, taking into account what the students are going to find in their jobs and the experience that they have accumulated due to their age and previous work experience [15]. This also favors students who have not yet had work experience. On the one hand, the teachings received will be clearly aimed at their future working life, and on the other hand, they will be able to benefit from the experience of those who have had that experience. All this can be favored by the new European education system.

1.2. Aim of the Research

The aim of this paper is twofold. On the one hand, we investigate the application of a student-centered learning methodology for labor market reintegration or improvement of older workers in the context of electrical engineering from the perspective of the SDGs. On the other hand, we explore the how students perceive this type of teaching by conducting two surveys. The method was implemented for five years, and the results correspond to the experience of students during the first five years of teaching electrical engineering according to the investigated methodology. The method was applied both in face-to-face and online teaching during the pandemic years, so the results obtained from the surveys can complement those of other studies, the likes of which are scarce in the literature related to science, technology, engineering, and mathematics (STEM) [16]. The remainder of this paper is organized as follows. First, we outline the theoretical background. Subsequently, we introduce the methodology and the context of its application. For a better understanding, a real example is presented. Next, the results obtained from the two annual surveys are analyzed. Finally, we present our conclusions obtained. To the best of our knowledge, this is the first implementation of such a teaching methodology in STEM subjects, including electrical engineering, and considering the perception of students.

2. Theoretical Background

A single market and currency and the possibility of movement and settlement of people were not enough to achieve the goal a united Europe [17]. It was also necessary to facilitate labor mobility and therefore to harmonize the university education system [18]. With respect to the latter, the goal was to standardize degrees from different countries so that they would be equivalent in terms of the competences that students acquire. The Bologna Declaration of 1999 laid out the foundations of the European Higher Education Area (EHEA) for the harmonization of education systems.

The education system that emanates from the Bologna Declaration establishes [19] a system of degrees based on two cycles, a bachelor's degree and a master's degree; a system for evaluating academic activity, the European Credit Transfer System (ECTS), a unit of which is equivalent to approximately 25 h of student work, including all the activities necessary to acquire the established skills and even the hours of study; a comparable level of quality with respect to the criteria and methodologies used; a European dimension in curriculum development; and promotion of student and teacher mobility. Through bachelor's studies, training is acquired with which it is possible to access the labor market or continue with master's studies. Through master's studies, specialized training is achieved at an academic or professional level, as well as an introduction to research, which allows access to doctoral studies.

These changes affect noy only the training cycles but also, and to a large extent, the way of teaching. The traditional teaching model is replaced by one with a more professional approach. Students acquire a relevant role and are encouraged to actively participate [20], promoting a shift in teaching methodologies towards student-centered learning according to the Leuven and Louvain-la-Neuve Ministerial Communiqué, the

Bucharest Ministerial Communiqué, and the European Commission's Communication on Rethinking Education [21] in a context that extends throughout life to achieve increased competitiveness [22]. This implies that students acquire skills and competencies based on real-world problems [23], which implies that the teacher must have a strong professional orientation in their way of teaching [24]. In particular, needs relevant to STEM studies must be reinforced due to the unsatisfied demand for graduates in these fields [25]. However, the opinion of students in these areas about this type of teaching has been scarcely investigated [26], although recently, some projects have been carried out [27].

Nowadays, STEM studies are considered of utmost importance to achieving progress that allows for the development of countries, and students must prepare for an increasingly scientific and technological world [28]. To train well-prepared students who can later develop in their professional lives and take care of the environment, various techniques have been developed that allow them to improve their abilities. In the case of engineering, practical application is more important than in the other sciences. This must be considered, and both teaching and learning must be oriented with this perspective in mind so that at the end of their studies, students achieve the competencies that they must later possess for the exercise of their professions [29]. These goals are even more important if the students are older workers who want to re-enter the labor market. We hypothesize that the most appropriate methodology for this way of teaching is one that forces student to investigate a problem, make deductions, and draw conclusions, making use of previously learned knowledge to solve it. Considering that teaching must also be adapted to the European Area, it must be applied in the context of student-centered learning.

The practical knowledge acquired by students must be implemented in the workplace where they will carry out their work [30] and in which they wish to reintegrate. For this reason, it is essential that the problems solved in the university are like those that students will face in their future jobs, with an important environmental focus [31]. To this end, the experience of years of using the proposed methodology in business schools [32] and in law and medicine [33] has shown satisfactory results in teaching. Thus, exposing a certain situation or posing a certain problem in a real case allows for the application of what has been learned. The proposed methodology has been applied in various branches of engineering studies: engineering mathematics [34], chemical engineering [35], mechanical engineering [36,37]; civil engineering [38], industrial engineering [39], and software engineering [40]. Thus, exposure to a certain situation or posing a problem in a real case allows for the application of what has been learned. However, to the best of our knowledge, the proposed methodology has not been implemented in electrical engineering. The application of the proposed methodology with respect to the way in which teaching and learning take place can be carried out in various ways [41], even with virtual reality [42,43].

The use of the Socratic method is essential to analyzing case studies [44]. It is a form of student-centered education with the aim of fostering in students the qualities that they should exhibit in their working life, transmitting the SDGs to them and identifying those relevant to the cases with which they are presented. The teacher must act as a moderator, facilitating and encouraging interventions of all students, guiding the class toward the end goal through enabling questions, first asking for answers and then opinions (both for and against) and helping students to reason through their relationship with prior knowledge. To achieve this, the teacher must carry out intense preparatory work for the class [45].

When a specific case is raised, a real situation is presented in which students must get involved and identify the problem and its causes, generate possible solutions by analyzing the pros and cons to choose the most appropriate response, and finally, develop an action plan to put that solution into practice [46]. Therefore, the teacher must, on the one hand, master the presented case and even, if possible, have personally experienced it, and on the other hand, have the ability to encourage the active participation of all students with respect to resolution of the problem, although when it comes to older workers, this is easier because they can introduce examples that have happened to them and that are related to the topic in question.

With respect to the use of real cases and inductive teaching and learning, various methods can be applied that depend on the expected result: inquiry-based learning, problem-based learning, project-based learning, case-based teaching, discovery learning, and just-in-time teaching [47]. Through inquiry-based learning, some specific questions are answered; problem-based learning has a wider scope, as it proposes the resolution of a complete problem. The objective of project-based learning is to obtain a final product, which can be a design of a real or computerized product. In case-based teaching, a series of case studies is introduced to students for analysis. In discovery learning, students must find the answer to a question or solve a problem with little help from the teacher. Finally, in just-in-time teaching, students have to complete Web-based exercises that they receive a few hours before the class; then, the teacher directs the class according to their answers to the exercises. The methodology used in inquiry-based learning is applied in other teaching methods; therefore, the border between such methods is not clearly delimited. It is precisely this methodology that is recommended for STEM subjects [48,49]. However, it is not yet being widely used, and when it has been used, it has been in more theoretical than practical subjects [50], although this methodology is beginning to be applied with a focus on the SDGs [51].

The inquiry-based learning methodology stimulates learning by posing questions or problems that help the student to build and acquire knowledge through discovery. In this case, the teacher is simply someone who helps to reach those goals [52], implying the importance of the active participation of students [53]. Although these are their common features, there are variations when it comes to the practical application of these methodologies. The modes of inquiry vary from structured inquiry (once the issue or problem has been raised, the teacher provides a guide to find the solution) to open inquiry (students are totally autonomous in posing the questions that will help them find the solution) and guided inquiry (the teacher gradually asks the questions) [54].

The proposed methodology makes use of two of the established methods: case-based teaching and inquiry-based learning. Through the use of case studies, real situations of interest are presented to the students in order to bring them closer to facts that they will have to face in their working lives. Once presented and understood, through inquiry-based learning, it is possible, on the one hand, to reach the desired result and, on the other hand, to acquire the knowledge corresponding to presented curriculum.

3. Materials and Methods

3.1. Context

The study was developed in the context of a STEM subject, specifically, an electricity subject of the master's in engineering, which corresponds to the second cycle of the system established in the EHEA. It is one of the mandatory subjects that students must take.

The first time the subject was taught with the proposed methodology was in the 2016/17 academic year. With this subject, it is intended that the student achieves a series of competences that allow him to: integrate the scientific and technological knowledge that he already possesses to apply it in new environments and with incomplete information; work both individually and as a team; clearly communicate the conclusions of his studies to both specialized and non-specialized audiences; and analyze and design electrical energy systems.

As a subject taught in a master's degree with a considerable number of students who are older workers it is certain that in a short space of time, they will acquire both social and ethical responsibilities. In addition, whatever decision they make will have a decisive influence on the team of people they lead. If to this is added the fact that their work will be carried out in a field as critical as electricity, this responsibility can be better understood; any mistake can have very serious consequences—not only material but, even more consequentially, personal.

3.2. Participants

The study of the new teaching methodology was carried out starting in the 2016/17 academic year, with statistical data available for five years: 2016/17, 2017/18, 2018/19, 2019/20, and 2020/21. The number of students in each of these courses was 35, 34, 33, 35, and 38, respectively.

3.3. Procedure

The subject is dedicated to the design, construction, and maintenance of electrical facilities. The first topic studied is safety, as a key part of any work in an electrical facility in terms of design, construction, or maintenance. In addition, it must be considered that this knowledge has very particular connotations in the electrical field and that the students have not acquired any previous training in this matter; therefore, it can be difficult for them to assimilate these concepts. The facilities analyzed are both distribution and transmission, as well as electrical generation facilities, with coverage of all the elements that compose them.

The methodology applied for each of the topics is based on the use of case studies and inquiry-based learning. First, the basic concepts that students have not yet mastered are explained. These, together with those to which they have already been exposed in previous courses, help them to develop the knowledge they need to acquire. New concepts are always related to others with which students are already familiar so that the connection between them is clear and the structure that forms all knowledge can be visualized. In addition, the corresponding SDGs are identified. Then, case studies are used to highlight the problems that students will encounter in the exercise of their professions. With these case studies, the students will have to finish modelling their knowledge, drawing on their previously acquired knowledge and finding solutions both from a technical point of view and with respect to SDGs, as the solution must be integrative.

The methodology is implemented in several stages that are covered successively. The first of these is the elaboration of case studies that illustrate the specific topic to be developed. These are prepared by the teacher and are fundamental in this type of teaching. Therefore, real cases are sought that teachers have had to face in their working lives, thanks to their experience as professionals outside of teaching. This circumstance allows for resolution of any doubts that students may raise with complete rigor.

The following phases are developed during the classes, and the protagonists are the students. As case studies are analyzed, there are two ways to act: all the information can be provided from the first moment or gradually, as would happen in real life, where, at the first moment, the professional may not have all the elements of judgment available and, even so, must make decisions. In the latter case, as new information is obtained, it may force other decisions to be made or the modification of previous decisions.

The chosen option is to solve the cases little by little, without going to the next point if the previous one is not completely clear to all students. In the second and successive phases, the teacher directs the learning by asking specific open questions on the point of interest at the time. The answers to these questions give rise to a debate in which each student can express their opinion, for or against, in response to the interventions of their fellow classmates. Not only is the technical component discussed, but the question of compliance with the previously identified SDGs is raised. These debates are always enriching, especially due to the participation of students who have already worked and who contribute their work experiences. The discussion is enhanced not only by students with work experience but also by the mixture of students of different ages and with different experiences, which allows for an interesting discussion. In this case, the teacher is very important and must motivate the students so that they do not get embarrassed and can express their opinions with total freedom. In addition, the teacher must help those students who are most reluctant to participate have no qualms about doing so. This can occur during the first classes among students who are younger and have no work experience. Next, the teacher must introduce new information that initially could not be known, as actually happens in field work.

3.4. Application Example

To clearly show how teaching is developed, in this section, we will describe the application of the proposed methodology to a safety chapter. Specifically, this chapter is relevant to the achievement of Goals 3, 7, 9, and 13 of the SDGs. Safety is an attitude that must always be present in any activity of a person, both for their own safety and that of others [55]. If responsibility is increased by having control over personnel in jobs with considerable risks, such as an electrical risk, the origin of which is something that cannot be seen, such as electricity, and if the consequences of any mistake are so serious that they can even lead to death, it is easy to understand the importance of safety. For all these reasons, the chapter dedicated to safety is of fundamental importance with respect to the subject and should be taught with special care. In addition, it must be considered that it is a new concept for students, and they must be aware of its importance for their future professional development.

The chapter begins with explanations of the basic concepts of safety applied to electrical systems. Once the students have acquired these concepts, several case studies are analyzed that are complementary to each other. Each shows a real case in which an accident related to an electrical activity has occurred. In this way, students are able to use all the concepts previously explained. To prevent a student from associating the people involved in the case with someone they know, some non-transcendental aspects were changed.

The information of the case study is not presented completely from the first moment, but what usually happens in the real world is done: when an electrical accident occurs, the responsible person is informed that it has occurred and receives the data available at that time. Thus, first, the students are given information about the place where the injured person was working and what the people who were nearby could have seen or heard. With this information, the teacher formulates the first questions to open the debate, and the students give their opinions about what happened, both for and against. The work of the teacher is very important with respect to facilitating the intervention of all students and directing the debate in the right direction. With this, the students have to find a way in which to approach the study of the accident. It should be borne in mind that after any electrical accident, an exhaustive study must be carried out to identify its causes. The objective is to detect what has not been done correctly when planning the work or what went wrong during its execution. In this way, the action procedure can be improved, and failure can be avoided in the future.

Next, the available information is completed with other circumstances that have come to light after a study was carried out at the scene. After carrying out the pertinent investigations, documentation that was not initially available can be provided. This is what actually happens after an accident: more information is collected after the first moment of the accident. With these new data, a debate is initiated again, during which students can reaffirm their initial hypotheses or change them in light of the new facts. Finally, the causes that produced the accident are listed, and a debate is conducted about which measures were not taken or implemented correctly to avoid the accident.

With all this, the students can achieve the desired competences: the acquired knowledge has been applied; problems have been solved in new environments; judgments have been made based on incomplete or limited information; and they have reflected on the social and ethical responsibilities linked to the application of their knowledge and judgments.

4. Results and Discussion

In each of the five years analyzed, two surveys were conducted for students to share their opinions anonymously. Both were administered at the end of the course. The objective of the first survey was to gather the opinions of students regarding the subject. It was involved open-ended responses. The comments collected serve to elucidate the aspects of the course that can be improved so they can be modified in the following academic year. The second survey was administered by the University in an institutionalized manner. In these surveys, students respond to established statements and rate them on a five-point scale: 1 corresponds to the least degree of agreement, and 5 to the maximum degree of agreement. There is also the possibility of not answering each question means of the NA option.

Although the purpose of the surveys with open responses was to detect the weaknesses of the subject, the responses obtained were generally favorable. Some referred to the similarity with the world of work:

> The methodology used to teach the subject has made me feel that indeed I was already in the world of work facing real problems. Although the theoretical explanations are useful to introduce us to a topic, the fact of trying to solve real problems makes us see the usefulness of what has been explained and understand the reason for each lesson.

In other cases, students referred to how what a priori could be thought to be correct answers, later in the debate, it was concluded that they were not:

> It is not the same that only the theory is explained to you or that you must face a real problem. When they explain it to you, you are not able to assimilate all the information. In fact, when we learned the theory, I only remembered a few points. However, when discussing a real problem together, the knowledge that the teacher wanted to transmit to us came out on its own. On the other hand, the teacher has made us reflect on many comments that the students made in class. And although a priori they might seem correct, we finally concluded that they were not.

In other cases, the emphasis was on the effectiveness of the cases presented, which are not merely theoretical examples. In addition, the importance of consolidating knowledge based on experience was highlighted:

> There are many subjects that are divided into a theoretical part and a practical part or problems. In general, the problems are artificial and are aimed at helping to establish theoretical knowledge. However, in this subject it seems the opposite: the theory is born from experience. The classes have had a very important practical component because we discussed among all the best solutions, and we managed to strengthen theoretical knowledge based on experience.

The second questionnaire was administered by the University to elicit the opinions of the students. It consists of 18 items that can be assessed between 0 and 5 and covers both the didactic aspects and the contents of each subject. With this survey, it is possible to analyze whether the focus of the subject is correct or whether the teacher adequately performed his task of facilitating student learning. The statements refer to the professor and are as follows [56]:

1. He has given me guidance to know the teaching project of the subject;
2. His teaching is adjusted to the planning foreseen in the teaching project;
3. He deals with me adequately in tutoring;
4. His tutoring schedule is adequate;
5. The bibliography and other recommended teaching material are being useful to me for the follow-up of the subject;
6. His teaching is well organized;
7. The means that he uses to impart his teaching are adequate for my learning;
8. The bibliography and other recommended teaching material are available to students;
9. Explain clearly;
10. He is interested in the degree of understanding of his explanations;
11. Exposes examples to put into practice the contents of the subject;
12. Solve the doubts that arise;
13. It fosters a climate of work and participation;
14. Motivates students to be interested in the subject;
15. Treat students with respect;

16. His teaching is helping me to achieve the objectives of the subject;
17. The evaluation criteria and systems seem adequate to me to evaluate my learning;
18. In general, I am satisfied with the teaching performance developed by this teacher.

Through a reliability analysis, the consistency of the results was analyzed, making it possible to identify whether the conclusions obtained are admissible or may be misleading. Cronbach's alpha coefficient was used for reliability analysis:

$$\alpha = \frac{\boldsymbol{K}}{\boldsymbol{K-1}}\left[1 - \frac{\sum S_i^2}{S_T^2}\right] \quad (1)$$

where: α, Cronbach's alpha coefficient; K, number of items; S_i, variance of item; S_T, variance of the sum of items.

A value of 0.932 was obtained for Cronbach's alpha coefficient [57], which shows a high degree of reliability [58].

The surveys were conducted in the year in which the subject was implemented, starting in 2016/17 until the last academic year for which data are available, i.e., 2020/21. The obtained results are presented in Figure 1, which compares the results achieved in the five investigated academic years with those also obtained at the degree level. In all cases, the results obtained in the subject are higher than those in the degree, ranging between 8% and 22%. This demonstrates the positive reception of the methodology, as almost none of the other mandatory subjects in the degree program were taught with a similar teaching method.

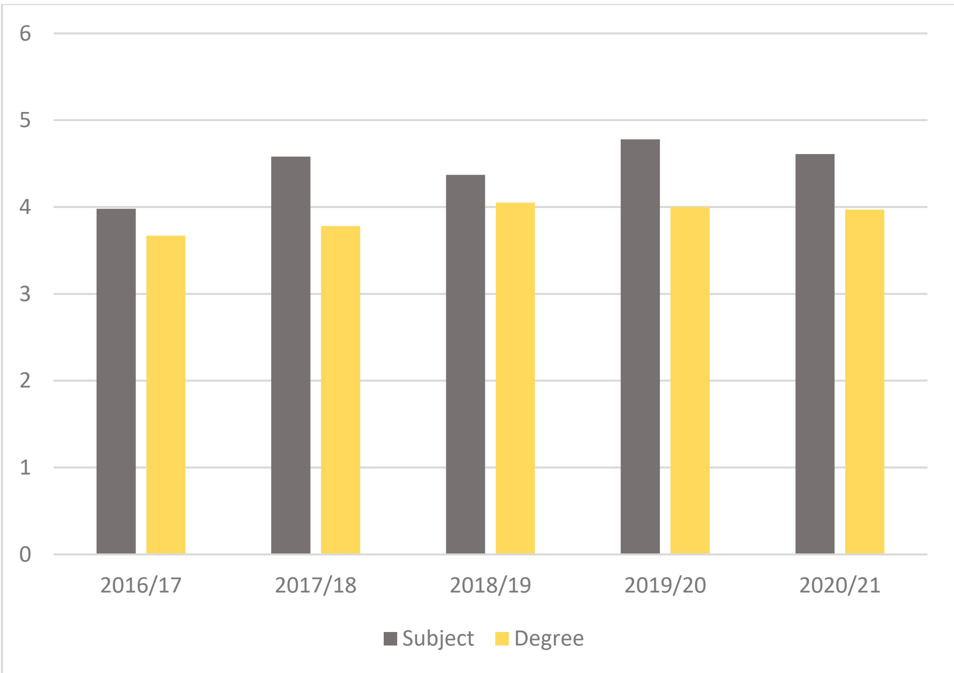

Figure 1. Results of the subject vs. results of the degree.

The scope of this survey covers different aspects of teaching. Thus, it includes issues related to teaching material, the interrelation between teachers and students through tutoring, teaching planning, and development. If only the items that provide information about the teaching methodology are selected (items 6, 9, 11, 12, 13, 14, and 18), positive acceptance by the students is observed. In this case, the assessment of the subject is between 8 and 26%, which is above that corresponding to the degree. Figure 2 shows the results considering only the items indicated above.

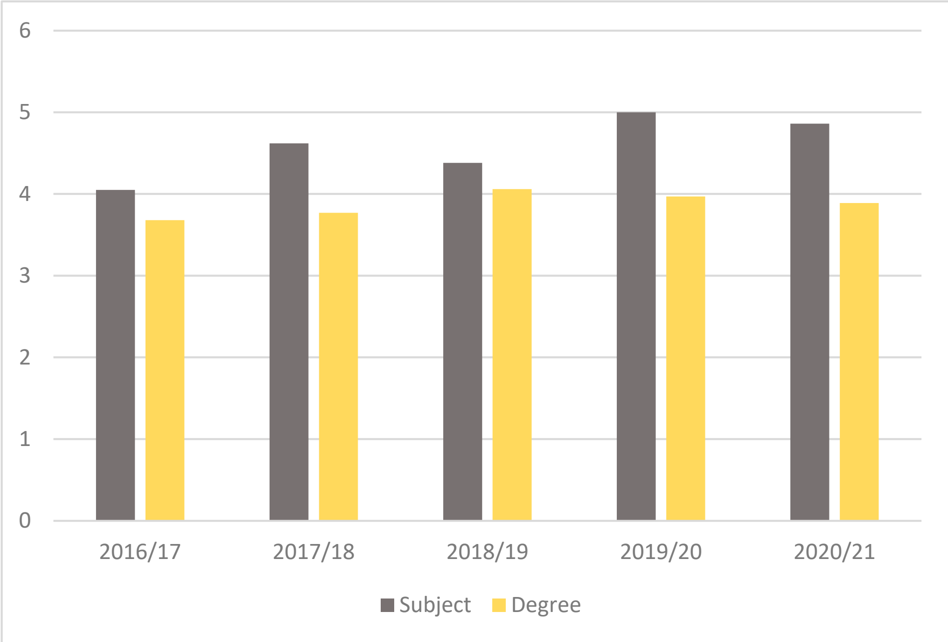

Figure 2. Results of the subject vs. results of the degree with respect to the teaching methodology.

The methodology applied, the assimilation of the contents by the students, and the high level of acceptance reflected in the surveys lead to the conclusion that it is suitable for application to the subjects that also transmit the values of the SDGs. In addition, thanks to the method based on student-centered learning, the practical cases, and the work knowledge provided by the students in the classes, the objective of facilitating the learning of complex subjects with a high degree of acceptance is achieved.

The use of the Socratic method has been commonly applied in non-STEM subjects. In some specific case, it has been applied in this type of subject but not in electrical engineering. In addition, the methodology used in STEM subjects has not been inquiry-based learning but, rather, problem-based, case-based, or project-led learning. Therefore, to the best of our knowledge, this type of methodology, in the context of engineering, is completely new. In addition, surveys administered to elicit the opinions of students regarding STEM subjects are scarce. For this reason, in this study, we aimed to provide such information through the two surveys we administered. In this sense, the results of these surveys coincide with others in which the opinions of students were favorable with respect to non-traditional teaching methods.

It is necessary to highlight the limitations of this study. One of the main limitations is the fact that the proposed method was only applied to one subject at one university, which makes it difficult to generalize the results. However, the form of teaching can be easily extrapolated to other subjects. In addition, the depth of the study (carried out for five years) and the responses of the students contribute to knowledge on the difficult task of teaching older people who already familiar with the labor market. For this reason, it would be desirable to contrast the results by applying the procedure in other STEM subjects.

Another possible limitation is the fact that the study was conducted in Europe according to the recommendations of the European higher education system. However, the proposed method was not applied to other globally contexts. Despite this limitation, the methodology was applied to a complex subject in the STEM field, and the assimilation of the contents by the students and the high acceptance reflected in the surveys lead to the conclusion that it is suitable for application in other STEM subjects.

It would be of considerable interest to continue implementing the proposed methodology, first in other subjects at the same university, later in other STEM subjects at European universities, where the teaching system is the same, and finally, in other countries.

5. Conclusions

Higher education centers are ideal places to train people on the SDGs, who, when they finish their studies, will have responsibilities. Thus, the way they must do things in their professional life will be focused on their achievement. Furthermore, the high unemployment rates caused by global crises have led many older workers who have lost their jobs or want to improve them to seek a means of labor market reintegration through higher education. Thus, the number of students older than 29 years of age who are studying master's degrees has increased considerably, especially in countries with higher unemployment rates. This has created the need to search for new teaching methods adapted to the new circumstances and the new student profile. Thus, the model of a master class given by a teacher in which the student is simply a listener has evolved to a teaching methodology whereby the student is an active and essential part of their own learning.

To achieve the first of our two objectives, we presented the methodology to be applied in STEM subjects corresponding to a master's degree in Engineering. The concepts faced by students are complex and new for the most part. As an example, we presented the case of the methodology being applied to the safety chapter in the electrical field, a very complex area with high responsibility and that affects several objectives related to the SDGs. We found the conjunction of two key elements to be essential for the application of the proposed methodology: the use of case studies as a way of bringing the reality of work to students and inquiry-based learning as a means to help students reach the correct conclusions.

With respect to the second of the objectives, we also covered the knowledge gap in terms of the opinions of STEM students regarding this type of teaching. The validity of the methodology was verified through two anonymous and voluntary surveys for five consecutive years. The first of the two surveys was open-ended, and students were able to express their opinion and suggest possible points for improvement. The other survey, administered by the university institution itself, allowed students to assess defined items on a scoring scales. In both cases, the results corroborate the positive reception of the methodology despite the complexity of the subject. In addition, in this latter survey, the results obtained with respect to the subject were compared with those relating to the overall degree program, with the subject surpassing the degree by more than 25%.

The applied methodology applied to a complex subject in the STEM field, the assimilation of the contents by the students, and the high rate of acceptance reflected in the surveys lead to conclusion that it is suitable for application in other STEM subjects.

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