

## Article

# Mentoring in the School of Mines and Energy to Cover Student Needs: From the Newly Enrolled to the Near-Graduates

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**Abstract:** University students face situations throughout their careers that are sometimes difficult to overcome due to their lack of experience or preparation. Mentoring programs in university education have been proven to be a great accompaniment tool to solve these difficulties in addition to helping students' personal and professional development. Our study aimed to show the complete mentoring process that accompanies students in the most crucial stages of their university education at the School of Mines and Energy of Universidad Politécnica de Madrid. Three stages of interest were identified in which mentoring projects have been implemented through training activities at the Unit of Social Entrepreneurship, Ethics and Values in Engineering (UESEVI). At the beginning of their studies, two welcome actions are offered: Mentor and Monitor projects that provide administrative and academic support; during the development of their studies, the Mentoring with Energy project offers professional tutoring that helps students in their incorporation into the labor market and provides them with tools to select a specialty; and in the last stage, professional accompaniment is provided by the Gray Angels project that helps students to develop their future careers. The activities of UESEVI are a strategy in our School to guarantee the development of soft skills and compliance with quality education processes. The usefulness of these programs can be measured through the participation and interest of the students. A positive evolution of these projects has been observed over the years. They have been growing according to the demand and needs detected in the successive evaluations of the programs.

**Keywords:** mentoring; ethics and values; soft skills; engineering; educational innovation



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## 1. Introduction

With the establishment of the European Higher Education Area, universities have committed to the design and organization of a welcoming and orientation plan which will allow new students to move into this new stage and minimize dropout situations generated by academic failure [1]. In order to fulfill this goal, mentoring projects have appeared which ease students' transition from high school to university by guiding them in academic, administrative, and social aspects [2]. Mentoring projects help integrate students effectively within the university routine, and students who integrate themselves into the campus culture, both inside and outside the classes, are less likely to drop out [3].

Mentoring is about ongoing personal and professional development [4] and represents an intentional interaction between at least two individuals that fosters the growth and development of the mentee [5,6]. Mentoring is not only an insightful process in which the protegee acquires and applies the mentor's wisdom, but it is also a supportive, protective process to ease difficult transitions. In the transition phase to higher education, peer mentoring provides a climate of greater confidence in which to resolve such situations, smooth the path, take advantage of the resources, and recognize opportunities [7].

Mentors can have very different profiles. A near-peer is a mentor with a similar educational level and of a similar generation. This near-peer mentoring relationship improves the cognitive and psychomotor development of students [8]. However, mentors can be people with career experience that are willing to share their knowledge, or people who give emotional and moral encouragement. On the other hand, mentors can be masters, in the sense of employers to whom one is apprenticed, or they can give specific feedback on one's performance [9,10].

The work of Crisp and Cruz [11] highlights three general features of mentoring that have been reinforced by the literature: The first is that the process focuses on an individual's growth and achievement. Secondly, it includes broad forms of support, such as assistance in professional and career development, role models, and psychological support. Finally, it indicates that the actions should be personal and reciprocal. Other authors have focused on aspects of academic support and have emphasized the student's ability to learn from the mentor's present and past actions and accomplishments or failures [12,13].

Mentoring projects have benefits for all participants. Among them, these can include easy integration into a new environment and also professional, academic, and emotional benefits. Mentors become more empathetic, improve social competences, improve problem-solving, responsibility, and communication skills, and are more conscious about time management [7,8,14–16].

Because of the great advantages they offer, mentoring projects are a widespread reality around the world, with universities, research institutions, and large companies offering formal mentoring programs [17–22]. Nevertheless, each mentoring program requires adaptations to the specific circumstances of each context for mentoring relationships to be successful [23]. There are three contexts in university education in which guidance intervention may be necessary: entry into the university, during the student's stay at the university, and at the end of a student's studies [24].

The School of Mines and Energy identified the need to implement mentoring projects to help its students at each critical stage they face in their academic years. The Mentor Project began in 2010–2011, the after a need for administrative and academic support for newly enrolled students was identified. In 2020–2021, the Mentoring with Energy project was implemented to offer professional mentoring about the labor market and to provide students with the tools to select a specialty. Finally, in 2021–2022, the Gray Angels project of professional accompaniment that will help students develop their future careers will begin. These projects have been implemented progressively. These projects have been adapted to the contextual needs of each student's steps. Although each project has its objectives and goals, all of them have as a common objective the accompaniment of students in their critical transitions within their studies and their training in soft skills, given that mentoring is a proven option for training students in soft skills [25,26]. One of the strategies to be developed with these projects is to make the participants internalize a culture of help and accompaniment in their university life as well as in their professional life.

The objectives of our study are:

- To demonstrate a complete mentoring process throughout a student's stay at the center. This process allows the development of decision-making mechanisms that help the student to make decisions in his academic life and professional future;
- Percentage analysis of the participation of the different groups that make up the university community of our center in these projects (students, teaching and research staff (PDI), administrative and service staff (PAS));
- Check if there is gender parity among the different groups participating in each of the projects under study. The significance of these data is related to the Sustainable Development Goal 5, gender equality;
- Establish a relationship between the number of participants and the degrees from which they come.

This work provides an example of mentoring from the newly enrolled to near-graduates which can be replicated in other engineering education centers.

The structure of the article consists of seven sections. The first section introduces the background, problem statement, study aim, objectives, and contributions. Next, the case of the School of Mines and Energy is presented with a brief description of the context of each project: Mentor Project, Mentor with Energy, and Grey Angels. In the following sections, for each of the projects the results obtained concerning the above indicators are described, followed by an analysis and discussion. Finally, a series of conclusions are drawn, and future lines of research are proposed.

## 2. Context

The institutionalization of this project has its roots in the verification process of the degree's study plans by the National Agency for Quality Assessment and Accreditation (ANECA). The verification requires the establishment of mechanisms where new students are guided and supported in every degree. In our case, these welcoming actions were developed according to the European Higher Education Area, and they experienced an evolution through the years that will be described in the following subsections.

### 2.1. Mentor Project

The Mentor project is the first step as it is part of the welcoming actions as part of the first courses. In 2010, when the European Higher Education Area arrived, UPM decided to establish inside its Inner Quality Guarantee System (SGIC) the procedures related to the welcoming actions. The different schools are the responsible agents who adapt those procedures. These actions are focused on decreasing the teaching gap which exists among students from different origins, and they also rely on the students themselves to convey the information to each other.

The Mentor Project has as its general objectives the improvement of the integration of the new students and the reduction in absenteeism and school dropouts. The mentor students receive specific training in order to perform the mentoring successfully. In this way, commitment, social responsibility, and empathy are the values which are fostered. The activity is 2 ECTS and is developed in one semester.

### 2.2. Mentoring with Energy

The second step in the mentoring activities is focused on the needs of the students who are about to finish their university degrees so they can receive professional mentoring to help them in their incorporation to the labor market or in making decisions about the continuation of their studies in master's degrees.

The Spanish Association of Women in Energy (AEMENER) is a non-profit organization which was built in 2018 with the goal of increasing the presence of women in all areas within companies, and the human teams are as diverse as possible due to the fostering of female vocations in science, technology, engineering, and mathematics (STEM). One of the goals of the association is helping employability by strengthening the presence of women in the energy sector at every level, especially in those with major difficulties, as well as fostering the promotion and development of women in their careers in the energy sector.

In 2019, AEMENER signed a collaboration agreement with UPM to start developing joint activities related to the promotion of STEM careers and to attract female talent in the schools of engineering.

In this context, the activity "Mentoring with Energy" ("Mentoring con energía" in Spanish) was developed as a non-formal methodology. It is a mentoring program involving professionals from AEMENER and ETSIME students in the last stages of their of bachelor's and master's degrees. The activity is 1 ECTS and is developed in one semester. There are several objectives:

- Support and guide the students in their incorporation to the professional environment;
- Guide academically those students who want to continue studying;
- Facilitate an understanding of which competences and abilities are demanded in the labor market;

- Identify the personal motivations and objectives of every mentee;
- Define an action plan to begin a professional career.

### 2.3. Gray Angels

This is a project that combines the service-learning methodology and support for ETSIME-UPM students who are in the last stages of their bachelor's or master's degrees.

Gray Angels are defined as engineers who have had an extensive professional career and are either retired or at the end of their professional lives. They can act as tutors for a reduced group of students since they are experienced and mature professionals. They guide the students at the beginning of their professional lives through their wisdom, common sense, and tolerance. The objective of this project is that the knowledge acquired throughout the professional career of the tutors is put to use and shared among the students of our degrees. To this end, direct collaboration is established with the Professional Association of Mining Engineers and the ETSIME alumni association. It is an ideal opportunity for students to initiate contact with the labor market and professionals in the engineering sector. The activity is 1 ECTS and is developed in one semester.

## 3. Materials and Methods

This paper is a case study where we present an analysis of a progressive mentoring process at different crucial stages for students. The authors studied the results obtained from each of the three projects detailed in the context section. In this section, we describe and analyze all the relevant methodological aspects.

These methodological aspects were analyzed through the indicators established for each of the projects. Thus, in the Mentor Project, the indicators studied focus on the average dedication per student, the number of participants per group (students, PDI, PAS), the division by gender per group, the grade from which the students participating in each of the projects came from, and the identification of the main problems and benefits. All these data were provided by the participants and extracted from quality surveys that were carried out. In the Mentoring with Energy project, the indicators studied focus on the degree of satisfaction of the mentors and mentees, the time dedicated to the project, and the relationship between participants. In the Gray Angels project, the indicators refer to the number of students, their degrees of origin, the number of tutors (angels), and their professional profiles.

### 3.1. Mentor Project

The main goal is the enhancement of the welcoming and guiding process for new students (mentees) during their first year at university through the mentoring provided by experienced students who have overcome this situation in previous years. The mentors attend formation seminars which help them to face their role as well as promoting their own personal and academic development.

The secondary goals are the following:

- Teaching on leadership through seminars with a special focus on social and soft skills;
- Involving the administrative and services staff (PAS) jointly with the teaching/research staff (PDI) in the welcoming process for new students and in the formation of soft skills;
- Establishing a tool to detect the needs and motivations among the students who participate in the program through satisfaction surveys;
- Fostering commitment, personal/social responsibility, and respect among the people involved in the learning process (PDI, PAS, Mentors and Mentees);
- Generating a collaborative environment among all the members of the university community. This can facilitate the networking among the students.

A fundamental part of the formative process for the mentors and the mentees is the collaboration with the psychological team of the school.

The program can be divided in the following phases:

1. Diffusion phase and mentor selection.

The project mentor is advertised during the months of May and June through e-mail, web, social media, and posters in those places where students most often go.

Moreover, in the welcoming day organized by the ETSIME management team on the first day of class, new students are encouraged to sign up for the program. From this day applications are received through e-mail.

2. Mentor Formation phase.

This phase is developed from July to December, when the mentor students have already been selected and the mentees have been engaged.

In this phase, the mentors are trained in technical and soft skills. This training is carried out through seminars whose topics and contents are configured to the mentor profile. Among the contents, empathy, emotional intelligence, social skills, emotional management, communication skills, and collaborative work are covered in at least five seminars of ninety minutes long.

Meanwhile, coaching sessions take place with the aim of identifying the means to achieve the objectives specified by the coachee. The coach will help him to discover by himself how to reach the goals proposed by providing him with the tools to face the challenges of his future.

3. Mentoring phase.

The mentoring phase itself is developed during the first semester of each course for conventional students from the first year of bachelor's degrees, and during both semesters for exchange students. This phase focuses on three aspects: orientation, formative seminars for mentees, and attention for mentees from the Psychology Attention Service (SAP).

4. Project Assessment.

The assessment is performed in two levels through a procedure and using mentors who are the main target of this evaluation.

The assessment of the mentors must be performed considering the following criteria: submission of reports that mentors must complete jointly with the opinion of the tutor professor who has been in charge of the student mentor. Moreover, this information is complemented with the data provided by the mentees through satisfaction surveys.

5. Closing and concluding thoughts of the project.

With all the evidence collected through the application of the program (reports, surveys, etc.), the coordinator of the program writes a report about the Mentor Project during that year and includes possible improvements which will be considered in future courses.

### 3.2. Mentoring with Energy

The specific objectives of the activity are:

- Design a career plan to go into the energy professional sector with the help of an experienced professional;
- Improve the knowledge of different professional activities and profiles which are demanded in the energy sector;
- Reinforce the necessary skills to successfully start a professional career.

Regarding the learning outcomes, we can highlight the following:

- To have a clear and objective vision of the labor opportunities in the energy sector;
- Acquire knowledge of the basic tools needed for access to the labor market, such as CV preparation, employment channels, and how to prepare for a job interview or a selection process.

Specific competences such as collaborative work, oral and written communication, organization and planning, leadership, analysis, and synthesis are developed during the program.

The activity took place 2020 November 2020 to April 2021. Initially, a publicity campaign was launched through social media (LinkedIn, Twitter, Instagram, and ETSIME web) and the first informative session was scheduled in a webinar format where the coordinators of the activity were informed about it and answered questions from the students.

The program started with 8 students, 4 women and 4 men, 7 from bachelor's degrees and 1 from a master's degree. The mentors, one per student, that is, a total of 8, were female professionals from the energy sector and members of AEMENER. The management of the process was carried out in TEAMS.

The mentor–mentee pairing process was performed using the results of an initial questionnaire that aimed to establish the mentee profile. The questionnaire was developed in Microsoft Forms and consisted of 20 questions related to:

- The degree of the student, other types of formation, hobbies, and areas of interest;
- Previous participation in the mentoring process;
- Motivations, goals, priorities, areas to improve, and expectations in the program;
- Values to be considered in the relationship with the mentor.

Once the pairing ended, the individual sessions began. The mentee started this process by establishing in a document his/her visions and goals. These individual sessions took place in the time frame that every mentor–mentee pair choses. The individual sessions were confidential, and they will not be discussed in detail in this work.

With the aim of completing the formation and the information of the mentees, three group sessions were organized:

- Informative on-line session about master's degrees: this was imparted by the post-graduate subdirector and director in the ETSIME. General legal aspects about master's degrees, ETSIME offers of master's degrees, and the differences between them were covered in this session. Moreover, questions from the mentees and mentors were answered. It had a high participation rate and lasted 2.5 h.
- Online session about effective communication: this was imparted by one of the mentors and her mentee. In the session, general aspects about effective communication were covered and a role play between a mentor and a mentee was used to study a couple of cases. The mentees participated by commenting on the two role play situations and pointing out the mistakes in communication that they observed.
- Online session: "Get to know your vocation and improve your employability": imparted by Catalina Díaz Freire, professional in the human resources sector and very experienced in the selection of engineering profiles. Catalina talked about those competences demanded by the job market and she pointed out several tests that students could take online to get to know their abilities and skills.

The individual mentor–mentee sessions ended in the month of April. On 7 May 2021, the activity concluded with the delivery of certificates to mentors and mentees.

### 3.3. *Gray Angels*

The general objectives of the project are:

- Learning from the direct experience of professionals from the mining and energy sector, retired professionals or those who are about to finish their professional careers;
- Easing the transition of the students to a job search;
- Creating multigenerational networks where knowledge is shared, and the need for permanent learning is transmitted;
- Establishing a tool for detecting the needs and motivations of last year's students;
- Fostering the values of compromise, social/personal responsibility, and respect among all the involved people in the learning process.

The learning outcomes expected are the following:

- Capacity for teamwork: develop skills and tools for work in the framework of multidisciplinary teams;

- Comprehension of ethical and professional responsibility: being efficient in the design of engineering solutions and in the practical application of engineering fundamentals by assessing their economic consequences, considering their global impact on society and the environment, and developing skills for entrepreneurship;
- Capacity to provide new ideas and problem-solving: developing the capacity to create new ideas that are appropriate and of a high quality.

The program is structured through ten online sessions where different topics are covered such as the professional experience of the mentors (Gray Angels), the importance of continuous learning during professional life, knowing the professional associations for the development of a regulated profession, how to build a CV, how to face a job interview, and other topics of recent interest, for instance, the application of the SDGs (Sustainable Development Goals) in the development of professional life. In short, it is about training the students to build a proper CV, developing strategies for job searching, exploring new professional niches and therefore, training the future leaders of our society.

All the described objectives will be addressed with strategies previously mentioned through the following planning:

- Student recruitment;

This will be performed by means of an informative talk at the beginning of certain courses of the last years in bachelor's and master's degrees. The program will begin at the start of the second semester.

- Development of activities;

At least two meetings will be organized every week with a duration of 1.5 h.

- Assessment of the project;

The assessment of the project is carried out through Google forms which are sent to the students and the mentors after every activity. In this way, information on which topics are of most interest is collected.

- Closing and concluding thoughts of the project;

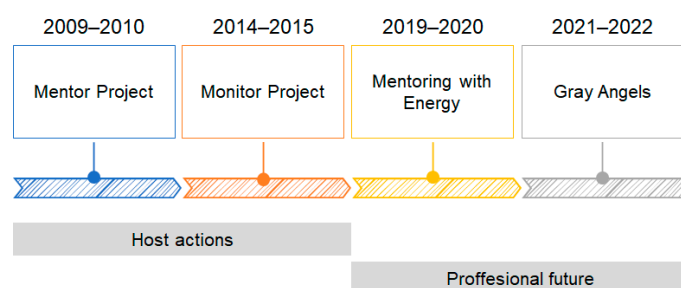
With the evidence collected during the program, the activity coordinator writes a report which includes possible improvements that will be considered in future actions.

Mentors and mentees are encouraged to write a journal where they can reflect on the learning they experienced and the emotions both collectives felt.

#### 4. Results

In this section we will describe the results obtained for every project separately, taking into account the indicators studied.

Since the mentoring programs are implemented at different times (Figure 1), the results analyzed in each project are different. We intend to show a general idea of all the measurement methodologies used.



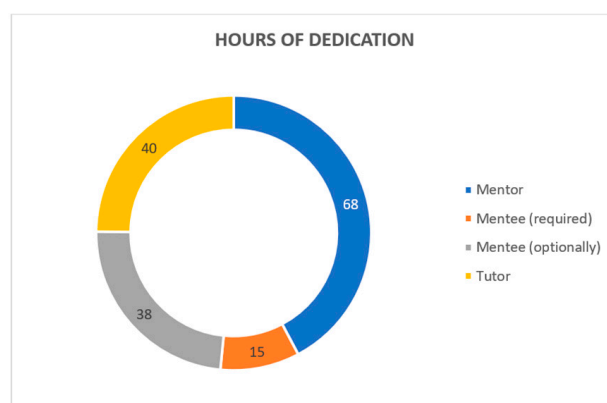
**Figure 1.** Starting date of the different programs of the mentoring activities in ETSIME divided into two main blocks: host actions, and professional future.

#### 4.1. Mentor Project

The average dedication needed for a mentor student to fulfill their goals must be around 68 h; 6 h for the recruitment process and 14 h for mentee assistance. The latter is divided into 7 h of mentoring meetings, 3 h of social media, and 4 tutoring hours with assigned professors. Regarding the training, a total of 38 h is used. Additionally, the coaching process takes 10 h.

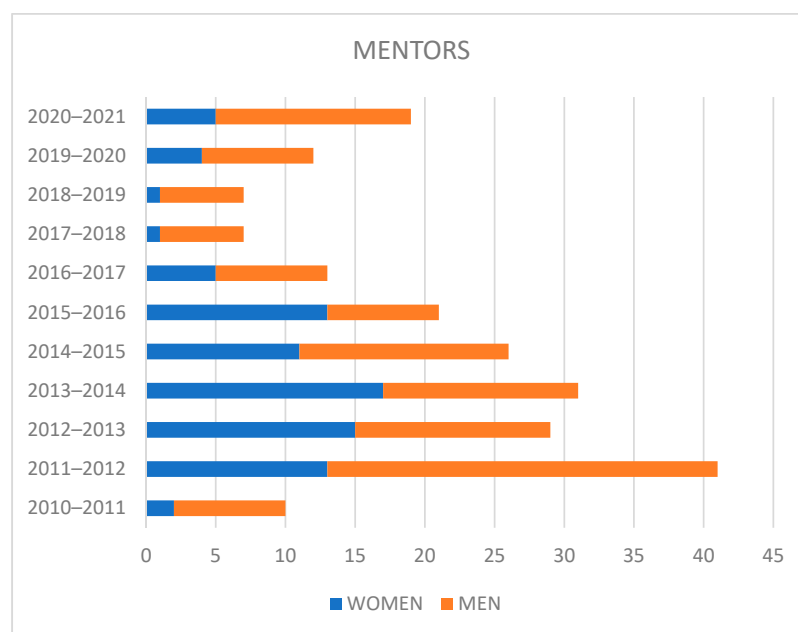
Regarding the hours used by the mentees, there are 15 h of meetings with the mentors and the tutors if they need it, as well as training talks lasting 38 h which are optional.

The tutor's dedication is about 40 h divided into tutoring time and mentoring and administrative work (See Figure 2).



**Figure 2.** Total hours dedicated to the Mentor project per year.

Regarding the participation of the students over time, the number of involved people has changed (see Figure 3). At the beginning of the project, the number of mentor students was very high. The mentor training and the project itself were less efficient due to the fact that the project was still young.

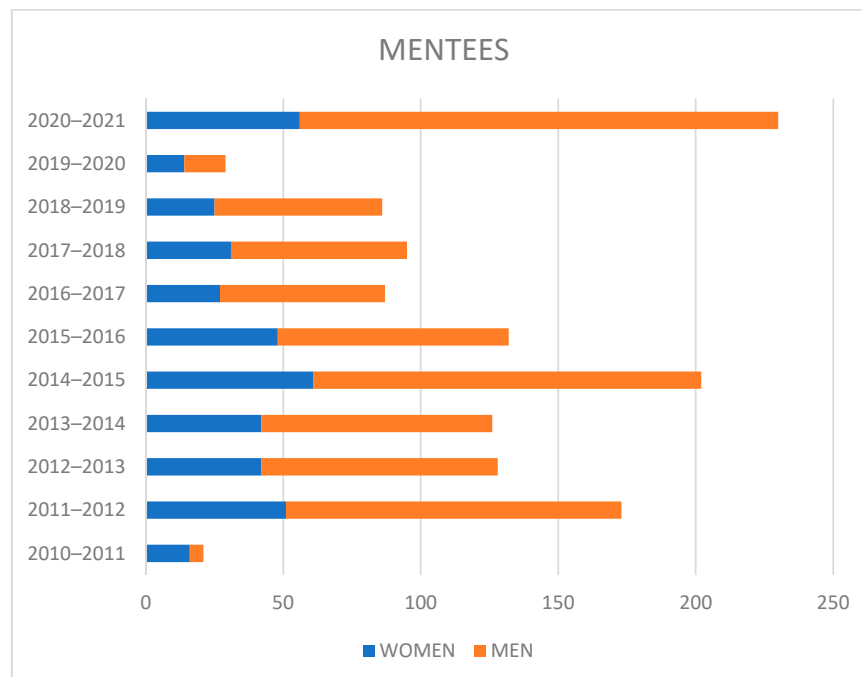


**Figure 3.** Number of mentor students.

Regarding the mentees, the number has increased since 2010–2011, where among 21 students, 76% were women and 24% were men. This pattern was inverted in the follow-

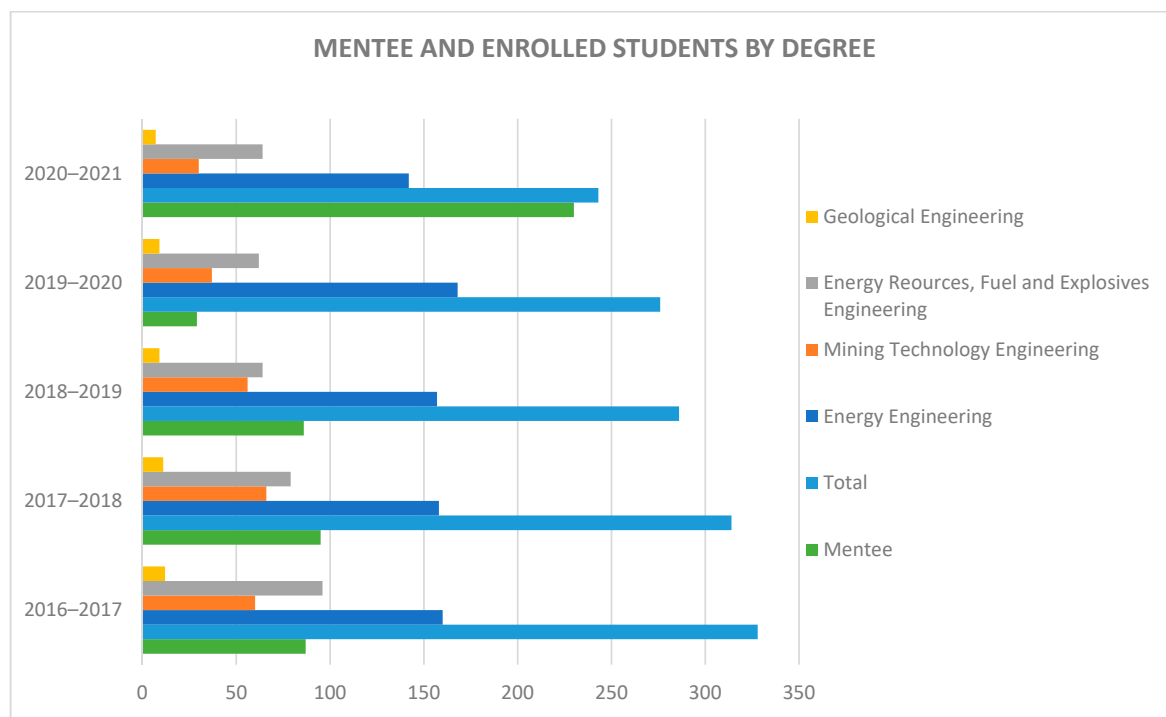


ing years and the number of men was clearly higher than the number of women (Figure 4).



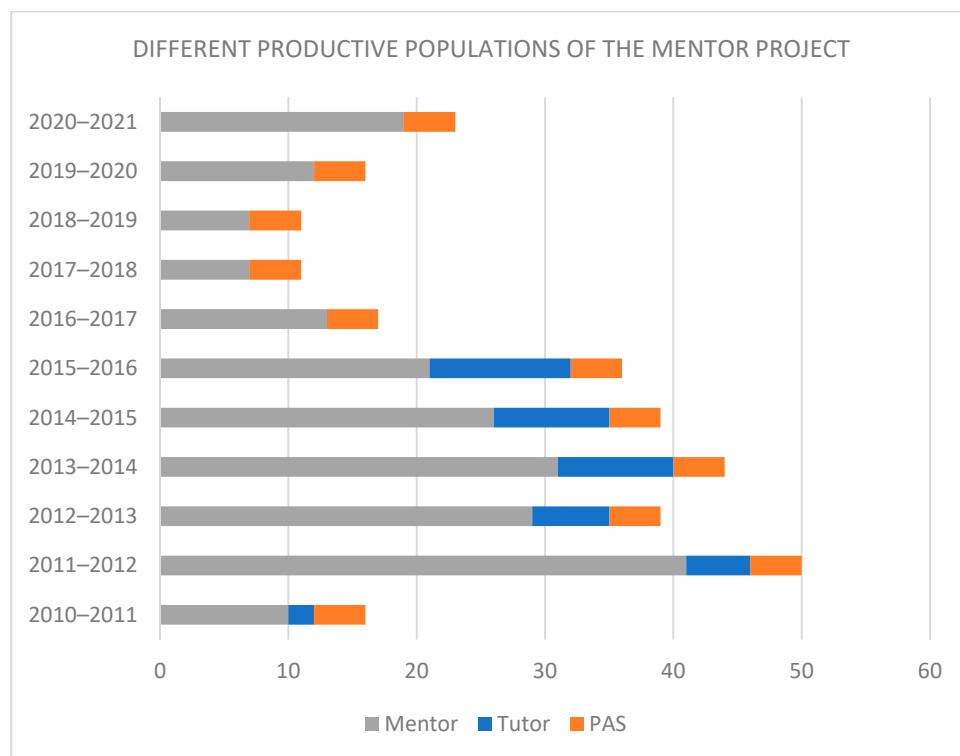
**Figure 4.** Number of mentees.

There was no correlation between the total number of students in ETSIME and the number of students who entered the program, as can be seen in Figure 5. While the number of total students decreased, the number of mentees was kept stable until 2020–2021, where this number increased considerably as previously mentioned.



**Figure 5.** Comparison of the number of mentees (green), the number of total students (light blue), and the number of students in every degree in ETSIME (yellow, grey, orange, and blue).

Regarding the different productive actors of the project, there was an evolution towards the optimization of resources (Figure 6). It is important to mention the high number of mentors used in 2011–2012 when the process was not mature enough. As the project developed in subsequent years, the training resources were optimized, and fewer mentors were needed to assist a higher number of mentees.



**Figure 6.** Comparison between the different productive populations of the mentor project. PAS refers to administrative staff.

#### Innovative Process: Generating the Monitor Project

Due to the reflections of the participants in the mentor project, a new program was launched: The Monitor Project. This was presented as an activity which complemented the Mentor Project and it was meant to provide academic support to the new students in some courses.

Taking advantage of a UESEVI social entrepreneurship project activity, “Entrepreneurship and Social Innovation: Interethics and Values”, the students and course coordinators designed the Monitor Project as a leveling and academic reinforcement tool.

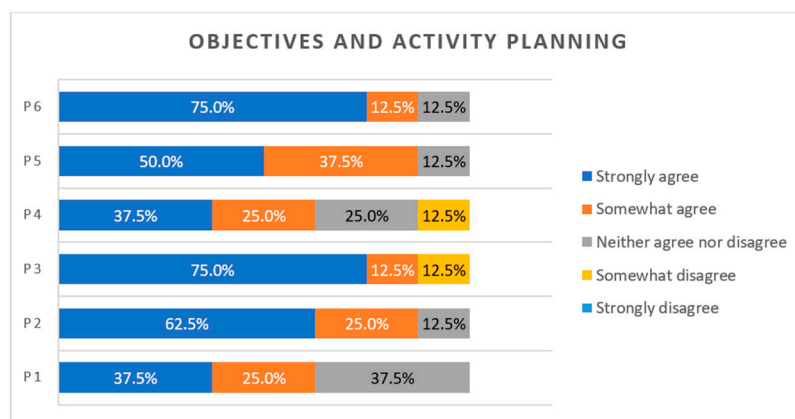
#### 4.2. Mentoring with Energy

The results from this activity are analyzed by means of two surveys that were designed, one for the mentors and one for the mentees, to assess the activity and the degree of satisfaction of both mentors and mentees. The surveys were anonymous and were developed in Microsoft Forms.

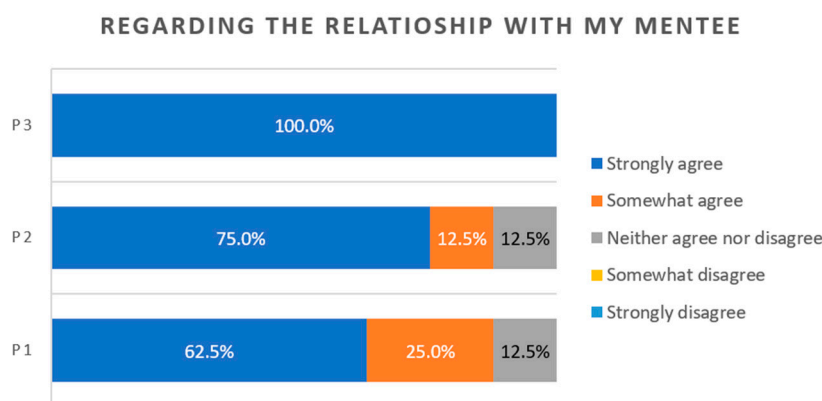
Regarding the satisfaction of the mentors, the results are shown in Figures 7–9.

As can be seen, most mentors strongly agreed or somewhat agreed in the questions addressed, except question P4, where 37.5% of the mentors neither agreed or disagreed and somewhat disagreed regarding whether they had sufficient means to carry out the mentoring.

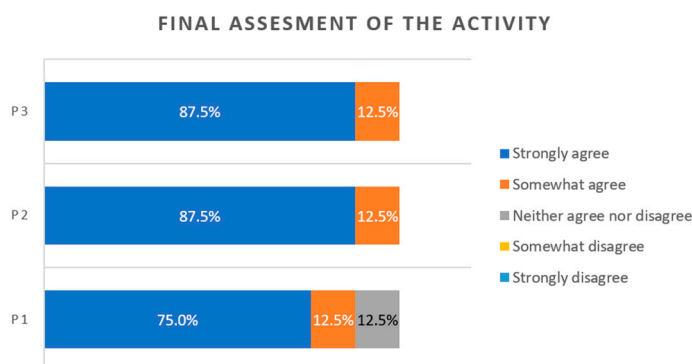
As can be observed in Figure 8, the relationship with the mentees has been very satisfactory in general terms.



**Figure 7.** Results from the mentor's survey regarding the objectives and the general planning of the activity where the questions are: P1: It is well designed and organized, P2: The foreseen planning has been fulfilled, P3: The duration has been correct in relation with the needs of my mentee, P4: I have had sufficient means for the development of the mentoring activity, P5: The objectives have been fulfilled, P6: The coordinator has supported me whenever I needed support.



**Figure 8.** Results of the mentor's survey regarding their relationship with their mentees where the questions were: P1: The relationship with my mentee has been satisfactory, P2: The mentee has collaborated in the proposed actions, P3: The confidentiality has been kept. As can be seen, the relationship with the mentees has been very satisfactory.

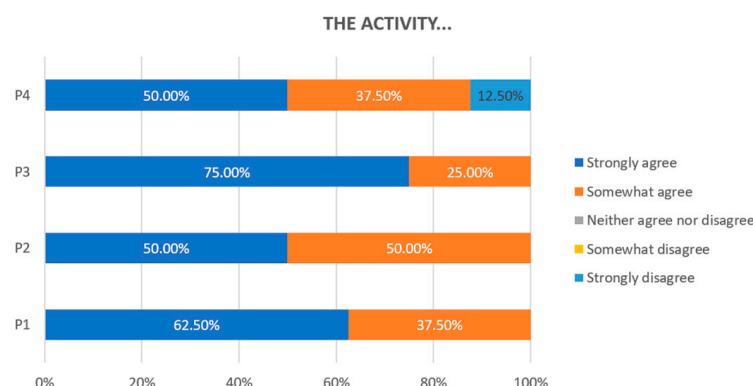


**Figure 9.** Results of the mentor's survey regarding the general assessment of the activity. Being: P1: You would recommend the program a friend to act as a mentor, P2: I would participate again in a program of this type, P3: In general, I am satisfied with the development of the activity.

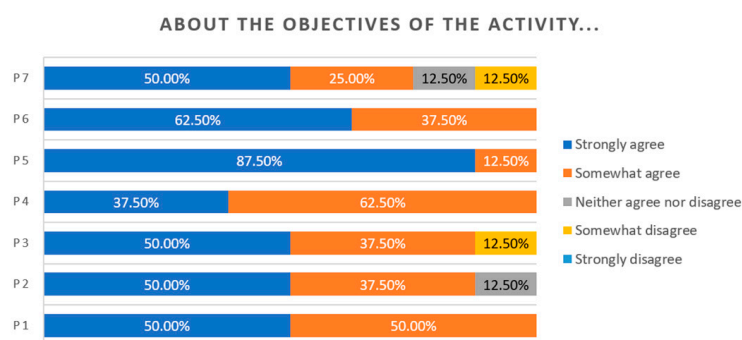
Finally, regarding the general acceptance of the activity, the responses are shown in Figure 9, where the high degree of satisfaction can be appreciated.

Regarding the time dedicated by the mentees, 50% spared around 10 h, 37% spared 20 h and 13% dedicated 30 h approximately.

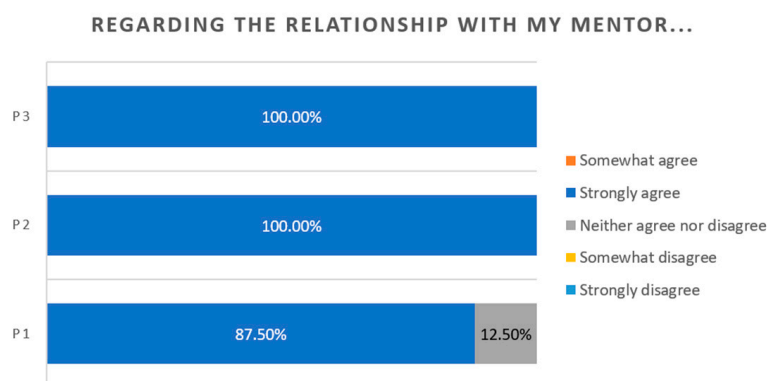
Regarding the satisfaction of the mentees, the results are shown in Figures 10–13.



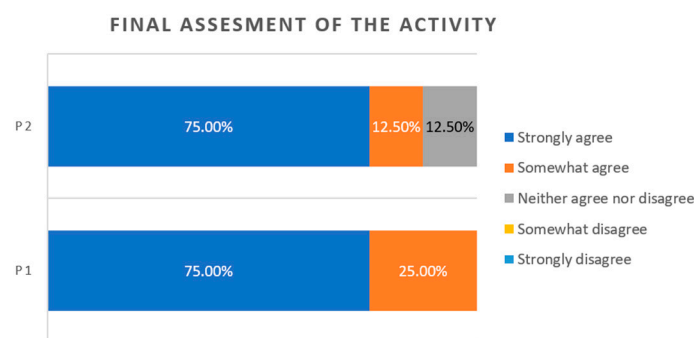
**Figure 10.** Results of the mentor's survey regarding the activity planning. The questions were: P1: It is well designed and organized, P2: has oriented you in academic aspects, P3: has oriented you in labor aspects, P4: has helped you to reinforce your self-esteem.



**Figure 11.** Results of the mentees survey regarding the objectives of the activity where the questions were: P1: The foreseen planning has been fulfilled, P2: The focus has been correct, P3: Your objectives/expectations about the program have been fulfilled, P4: You have identified an ambitious and a reachable goal, P5: New ideas have been released, P6: The activity has contributed to achieve a change of perspective, P7: The program duration has been adequate in relation with my needs.



**Figure 12.** Results of the mentees survey about their relationship with their mentor where the questions were: P1: The support from my mentor has been satisfactory, P2: An honest and sincere bond has been created with my mentor, P3: The confidentiality has been kept.



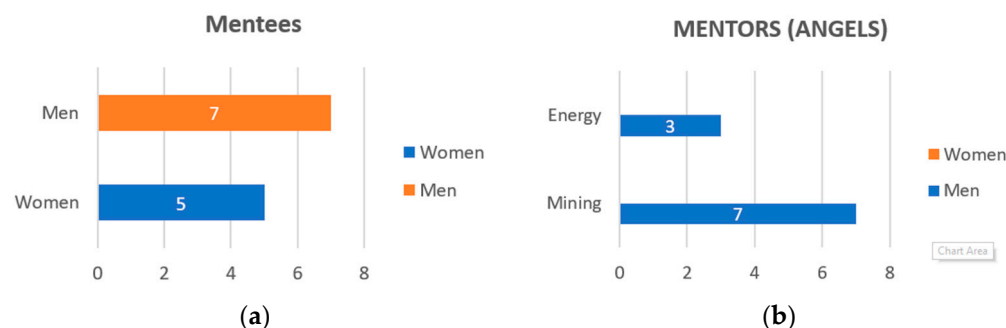
**Figure 13.** Results of the mentees survey regarding the activity assessment where the questions were: P1: You would recommend the program to a friend, P2: In general, I am satisfied with the development of the activity.

Regarding the hours dedicated, 50% of the students dedicated between 20 and 30 h, 25% dedicated between 40 and 50, and 12.5% did not know how much time they had dedicated.

In general, the mentees showed a high degree of satisfaction, though there 25% neither agreed nor disagreed and somewhat disagreed that the duration of the program was correct.

#### 4.3. Gray Angels

The information that will be provided in this mentoring process is not complete since the first edition of this activity is currently taking place at this moment (second semester of 2021–2022). Figure 14a shows the number of students participating in the project according to gender. Figure 14b shows the number of tutors (angels) and their professional profiles.



**Figure 14.** (a) Number of mentees; (b) Number of mentors (angels).

## 5. Analysis and Discussion

### 5.1. Mentor Project

The following is an analysis and discussion of the results of the project.

As time went by, a higher efficiency was achieved with a lower number of mentor students. It must be mentioned that the increase in the mentors in the 2020/2021 course was probably due to the fact that the classes were online due to the SARS-CoV-2 pandemic. This increase coincided with a high number of mentees, as can be seen in Figure 3. This is likely related to a higher need for support in uncertain and complex situations.

The number of men was higher until the edition in the 2013–2014 course, where the number of women and men was equal. The mentors at the beginning were mostly students from the Mining Engineering Degree (96 plan) until the 2013–2014 course where students from other degrees, such as Energy Engineering (GIE), began to participate. In this degree, the number of women was higher and that was also translated in the number of mentors. Nevertheless, since 2017/2018 the number of women began to decrease again. Therefore, there was no gender parity in the intervention of students either as mentors or as mentees.

The participation of professors has increased since 2010–2011, reaching a total of seven male professors and four female professors in 2015–2016. From this year, the role of the tutor was no longer needed, and the responsibilities relied on the students who were strongly supported by the activity coordinators. The participation of the administrative staff (PAS) has been the same throughout the years, reaching a total of two men and two women. There was no gender parity in the case of professors. However, in the PAS there was parity with 50% participation of men and 50% of women.

It is important to mention that more than 70% of the mentor's students were mentees initially.

Once the surveys had been collected and analyzed, the results from the mentors highlighted the following points of improvement:

- Mentors' training should begin before the start of the program;
- Within the program, more meetings than needed are scheduled;
- Schedule conciliation;
- Updating the contents of the training seminars for the mentors;
- More online meetings;
- Strategies to keep the mentees' interest in the project;
- More Mentor–Mentee–Tutor meetings.

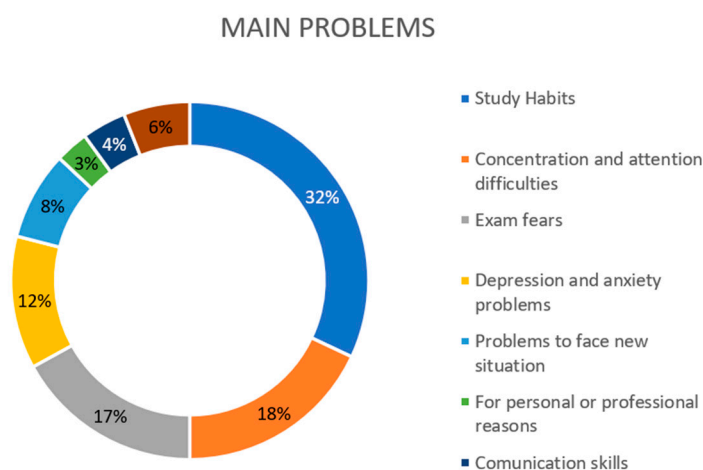
Regarding the observations performed by the mentees, we can highlight the following:

- The project is very useful at the beginning of the course and less useful at the end;
- Within the program, more meetings are scheduled than are needed;
- Form groups according to degrees and schedules;
- The great effort of mentors is highly appreciated.

PDI and PAS provide the following:

- The training of mentors should begin in the second semester;
- Help for the mentors in their task to motivate the mentees after the first month of the program is needed;
- Provide mechanisms that allow online meetings;
- Make a meeting at the beginning of the course in order to gather mentors and mentees within the same degrees or schedules.

The main problems that are faced within the SAP in ETSIME (Figure 15) were normally problems related to study habits (32%), difficulties related to concentration and attention (18%), anxiety before the exams (17%), other problems of anxiety or depression (12%), problems facing certain personal (8%), and professional situations (3%), communication problems in the interpersonal relationships (4%) and adaptation problems, both emotional and behavioral (6%).



**Figure 15.** Main problems which are observed by the SAP.

### Monitor Project

Both the students and the professors observed that the initial knowledge of the pupils was very different. The clearest example was found in the Chemistry course, as not all the students will have taken a chemistry course in high school, and it is one of the most important courses in the degree. Therefore, it seems necessary to implement a levelling tool which will allow the specific competences and the learning outcomes of certain courses to be achieved.

From a cognitivist point of view, it is necessary for learning to have in mind not only the teaching itself, but the circumstances around the teaching, such as the knowledge that the student has initially when he or she begins a certain learning stage (constructivism) [27].

This new project has a preventive character, since it is meant to avoid academic failure, low self-esteem and the course dropouts. Besides, first year students learn certain techniques to optimize their study and their learning [28]. It is about developing helping and guiding mechanisms for newly arrived students by means of their student colleagues.

The project starts from the fact that students are specifically qualified and motivated to help other students. Moreover, students learn better in a friendship and stimulating environment.

The monitor project began in 2014/2015 and it is introduced in four courses of the first year of the Energy Engineering degree and the Mining Technology degree. As can be seen in Table 1, more courses have joined the project throughout the years.

**Table 1.** Courses where the Monitor Project is implemented, and number of monitors involved.

| Courses              | 2014–2015 | 2015–2016 | 2016–2017 | 2017–2018 | 2018–2019 | 2019–2020 | 2020–2021 |
|----------------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|
| Graphical Expression | 7         | 8         | 24        | 26        | 26        | 17        | 7         |
| Chemistry I          | 8         | 3         |           |           | 2         | 3         | 8         |
| Chemistry II         |           |           | 4         | 8         |           | 2         |           |
| Calculus I           | 8         | 7         |           |           |           |           | 8         |
| Statistics           |           | 3         | 4         | 2         | 6         | 1         |           |
| Geology              |           |           | 2         | 2         | 4         | 4         |           |
| Physics I            |           |           |           |           |           | 1         |           |

Source: own elaboration.

### 5.2. Mentoring with Energy

The number of students involved in this activity was eight, four male and four female. Due to the nature of this activity, which involves mentors from outside the university, only three professors from ETSIME were involved either in the activity coordination or in the master's seminar. Regarding the origin of the students, six out of eight were from the Energy Engineering degree, one from the Mining Engineering degree and one from the Energy Engineering master's degree. In the current year, the activity is also taking place and the number of students has increased up to seventeen; this means the mentees have doubled compared to last year. The results from the current year are not analyzed in this article.

As was seen in the results section, 37.5% of the mentors neither agreed or disagreed and somewhat disagreed regarding whether they had sufficient means to carry out the mentoring. It seems that the mentors at some point felt they did not have sufficient means to carry out their mentoring task. One of the aspects that the coordinator noticed was that the mentors were a bit lost regarding their knowledge on the study plans that appear with the Bologna Plan. So, they feel they sometimes cannot advice the students well enough in this respect. This is the reason why a seminar about master's degrees was organized for both mentees and mentors within the activity.

The dedication of mentors as an average is 10 to 20 h per semester. Regarding the relationship between mentors and mentees, both were very satisfied; confidentiality was

kept, and they would repeat the activity and even recommend the program to a friend. This indicates that the actions in the mentoring process have been personal and reciprocal as Crisp and Cruz mention [11].

The surveys gave the mentors the chance to leave open comments and the majority of them made observations related to the homogenization of the methodology so that all of them used a similar approach. It is true that though there were some common things in all the mentoring processes, once the different mentor/mentee pairs were created, every couple could work independently, evolve differently from each other, and cover different aspects depending on the needs of every mentee. From the coordination of the activity, it was decided this way so that every couple could focus on the needs they observed but it seems there is a demand to homogenize more this process. This will be taken into account for future editions.

Mentors also recommended adding extra sessions on specific topics such as:

- How to look for a job/professional guiding/trends in the market/internationalization;
- Communication skills in the working environment.

One last thing to point out about the mentors is that most of them were students in the school of Mines and Energy in UPM some years ago.

Regarding the responses of mentees, in general there was a high degree of satisfaction in respect to the objectives of the activity and the general organization, but it was observed that some mentees would have preferred the activity to be longer. Obviously, if the mentees find the process enriching, they want it to last longer, but taking into account the hours dedicated by them, the duration seems correct. Most of the mentees took 20 to 30 h per semester in the activity. This is consistent with a 1 ECTS activity. It could be considered to increase the activity up to 1.5 ECTS but it has to be kept in mind that mentors are volunteers, so this increase should be agreed with them.

The mentees also commented in the open questions that it would be good to add in the activity specific sessions about soft skills, about facing a job interview or even about self-esteem, motivation, communication and overcoming frustration. These recommendations are very similar to the ones made by the mentors.

The mentees have also provided their opinion openly as follows:

“This activity has given me great value. I hope that the mentors are also happy with the program to continue in future editions.”

“I liked the efficient communication session and the one about masters very much. I am very happy for participating, it has been very useful for me”.

“Very good initiative and very grateful for everything I learnt from the mentor.”

“I think the course is very complete and it has helped me a lot. It would be nice to have more group sessions and exchange sensations and opinions. Thanks for offering this great opportunity!”

“I liked the experience very much. I feel it is the type of complementary activities that everyone should experience. It opened my eyes in many aspects, I feel more confident and now I have more tools to face life both personally and professionally. Thanks for giving us this opportunity.”

“I think it was a very good idea, personally it has helped me a lot, even my mother is happy for me for having participated in it. The group sessions have been very useful and very interesting. I want to thank the coordinator.”

“I think it could be very beneficial for the students that the mentors could have a previous guiding on how to reinforce the self-esteem, motivation, communication, support or about helping others on how to improve their perception about themselves. Maybe, this could be done by involving someone who studied psychology, I don’t know. The mentors are wonderful but in that sense, I felt I had liked something more. Also, I would like to thank the coordinator of the activity for giving us this chance, for her work and enthusiasm.”

So as can be appreciated from the open comments and the survey, after the mentoring activity, students felt more confident to make decisions about their professional and academic life. The activity not only provided the mentees with knowledge about their future



academic or professional steps but also with motivation, self-esteem and confidence. In this sense, aspects such as individual growth, assistance in professional and career development, and psychological support mentioned by Crisp and Cruz [11] are demonstrated in this program by the survey results.

Regarding the limitation of this study, the number of students in Mentoring with Energy was low compared to the total number of students in ETSIME. In the current year, the number has doubled mainly due to two reasons: there are more mentors than the previous year and there is more presential activity which has probably eased engaging more students. Despite this, the number of voluntary mentors limits the total number of students for this activity.

### 5.3. Gray Angels

The number of applicants was not very high, as usually happens in projects that are starting to develop and that are meant for a particular niche of the students (last year of the course of a bachelor's or master's degree). An ideal number for a first edition would be 15–20 students.

Regarding the number of tutors (Gray Angels), we have established a first contact with the Engineering Institute of Spain (IIE), since they already have a similar program for one year now and the Mining Engineers Association where there is a high interest in participating in the program.

## 6. Conclusions

This conclusions section will be divided into a first part about reflections on the program and a second part on the difficulties detected during the development.

Our mentoring program in ETSIME is composed of several projects where all the university community is involved: from the first-year students to master's students, from administrative staff to professors and researchers. Besides, these programs are very well seen by old students and retired staff with mining, geology and energy profiles.

Regarding the mentor Project, we think it is an optimal welcoming tool and it diminishes the methodological gap between high school and the first year of university. Moreover, as was previously mentioned, this program is complemented by the monitor Project which allows academic levelling in certain courses of the first year.

Once this stage is over, the students need another type of support that is more focused on their future professions, so that they can choose based on their vocations. For that, the mentoring program in collaboration with AEMENER is very effective. It is an intermediate step where the student still has time to reflect on their futures and to get to know the labor market to be able to make decisions based on solid reasons.

In this study, it was proved that the mentoring process designed in ETSIME has a good reception among the students, since they obtain clear benefits in the three projects developed. These benefits have permitted the continuous development of the projects along the years.

Besides, these projects are a complement to the formative actions in ETSIME as they reinforce certain soft skills which are covered less during the standard courses of the degrees. Another added value is that they allow decision making about the continuous learning that every student must design to guarantee a higher professional success.

All our programs focus on the growth and achievements of the mentees as individuals, as students, and as future professionals. Personal relationships are established between mentors and mentees with reciprocal benefits. We have proved that this type of activities fosters the relationship between students of different courses and different degrees. It includes extensive forms of support: assistance in professional and career development (mainly in the Mentoring with Energy and Gray Angels projects); as well as psychological and academic support (in the Mentor and Monitor projects).

One limitation that all our mentoring programs have in common is that they do not reach all students. In other words, the programs are not mandatory and, therefore, the results may be biased.

For every specific program, some generic recommendations are described below:

#### *6.1. Mentor Project*

Since it is a voluntary activity for first year students, sometimes it is difficult to have a balanced commitment during the whole process. Firstly, the new students require a lot of attention by their mentors, but after some weeks, this need decreases. Although the mentors keep a weekly contact with them, there is no other peak of activity until the exams period.

On the other hand, we have also detected that the communication between mentors and tutors is not as fluid as it should be. Maybe, the tutor figure is not as relevant, since this is a project from students to students. In the last few years, it was decided to create a WhatsApp group where doubts can be solved through the coordinators of the activity, and only mentor–tutor meetings are scheduled in specific cases.

It is important that the students create a confident environment between them and that they know for sure that they have a network they can rely on when certain problems such as anxiety arise. This is why the SAP and the professors act in certain cases to support the students.

Regarding the tutors, more female professors are involved every year, but in general it would be easier to engage a higher number of professors if there was an institutional reward to participate in these programs.

#### *6.2. Mentoring with Energy*

From the open comments by the mentees and the survey carried out, students feel more confident to make decisions about their professional and academic life after the activity. They explicitly recommend the activity to future students, and they consider the program as “a complementary activity that everyone should experience”.

For future editions, more group sessions are recommended and if possible, in a face-to-face format. The mentees pointed out that it would be convenient to reinforce the soft skills with more specific sessions. Besides, with the aim of homogenizing the methodology of the mentors, it is advisable to enhance the mentoring community in AEMENER, where materials, good practice manuals, etc., should be added.

Most of the mentees were from the energy engineering degree (GIE), so it seems these students are more committed to their future academic or professional lives than those from other degrees. In fact, GIE students enter ETSIME with a higher grade. Although there is a higher percentage of male students compared to female students in ETSIME, in this activity there was complete parity. It must be pointed out that female mentors led the informative talks about the program and that most of them were students in ETSIME some years ago.

The activity has been very enriching in general for the mentors, the mentees and for the ETSIME and the proof of that is that in the current year the number of mentees has doubled compared to last year.

#### *6.3. Gray Angels*

The level of interest observed makes us think that it will have a great development in the following years. It is a project that covers the need to support the students in their last years, where they have to make important decisions and they will face new challenges. Therefore, an experienced professional provides the students with great benefits. In future editions, the activity will be monitored to detect possible problems and to perform improvements according to the results obtained. One point to improve would be the participation of female mentors in the project.

## 7. Future Lines of Research

Measuring the impact that these activities have on our students is difficult; however, it would be of great interest to know the impact that students perceive on their job search and performance in the workplace. This research could be carried out through questionnaires of graduates who participated in mentoring projects during their student years.

Another point for improvement is to unify the measurement systems in the three mentoring projects in order to be able to evaluate the entire program more homogeneously. Due to the different implementation of the projects over time, unified measurements have not been carried out so far.

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**Informed Consent Statement:** Express consent is not required to indicate the number of men or women who are going to participate in the programme.

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