

# Effectiveness of a Peer Mentoring Program in Engineering Education

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**Abstract**—The Mentoring Program of the *Escuela Técnica Superior de Ingenieros de Telecomunicación (ETSIT)* is intended to establish a mechanism based on peer mentoring provided by upper-class students (*Mentors*) to provide help, support, and resources to incoming first-year students (*Mentees*). This paper focuses on the experience gained in the creation and development of the ETSIT Mentoring Program during five years. The evolution of the results obtained from the evaluation of various aspects of the ETSIT Mentoring Program, is also presented.

**Keywords**—engineering education; engineering student retention; peer mentoring;

## I. INTRODUCTION

Nowadays, with the number of students entering engineering degrees programs declining, it is important to focus efforts not only on attraction, but also on student retention. In this sense, student support during the transition to University is one of the main influences on whether a student stays or leaves. The challenges for someone transitioning from high school to university can be significant. These challenges can be even greater when the student is entering into engineering. As a support mechanism, successful *peer mentoring* can impact students' desire to remain in engineering and at the University [1].

The term *mentoring* refers to a supportive relationship that is characterized by constructive role-modeling, encouragement towards raised aspirations, and by positive reinforcement for the achievement of goals. *Peer mentoring* at University typically involves the support and guidance for new students from more experienced students within the same discipline. *Peer mentoring* is an important strategy for assisting first year students during their transition to University in order to minimize the attrition rates that are typically high at engineering degrees [2]. The benefits of mentoring programs are both personal and professional, offering the satisfaction of helping peers and increasing the confidence of experienced students.

This paper focuses on the experience gained in the creation and development of a peer mentoring program at

*ETSIT (Escuela Técnica Superior de Ingenieros de Telecomunicación)* from the *University of Las Palmas de Gran Canaria (ULPGC)* during five years, giving a detailed description of the program, the logistics involved in its implementation, or the modifications introduced throughout its successive editions to improve their key elements – including the selection and training of *Mentors*, the organization of the *Mentor* and *Mentee* meetings, or the content of the reports that the *Mentors* have to complete after each meeting–. The evolution of the results obtained from the *Mentor* and *Mentee* satisfaction evaluation of various aspects of the ETSIT Mentoring Program, are also presented.

## II. THE ETSIT MENTORING PROGRAM

The ETSIT Mentoring Program is intended to establish a mechanism based on peer mentoring provided by *Mentors* to provide help, support, and resources to incoming first-year students throughout their first semester at the university on a range of academic, social and administrative issues, under the supervision of *Teaching Tutors*. This peer mentoring program has been in existence since the academic year 2004-2005 and has proven to be successful promoting student involvement and enabling success in *Mentees'* academic, social, and personal endeavors, as soon as developing in *Mentors* professional and transferable skills to take into engineering practice. For the academic year 2006-2007, improvements based on feedback from the participants in previous editions were introduced in the ETSIT Mentoring Program to its actual form.

### A. Organizational structure

The organizational structure of the ETSIT Mentoring Program is shown in Fig. 1. *Mentors* are in charge of group of a maximum of 6 *Mentees*, reporting to their *Teaching Tutor*, who is an experienced lecturer preferably teaching on the first year course. Each *Teaching Tutor* provides guidance and supervision to the *Mentors*. *Teaching Tutors* and *Mentors* report to the *Coordinator*, who has oversight of the program and is responsible for the assessment, holding the training and weekly mentor meetings, ...

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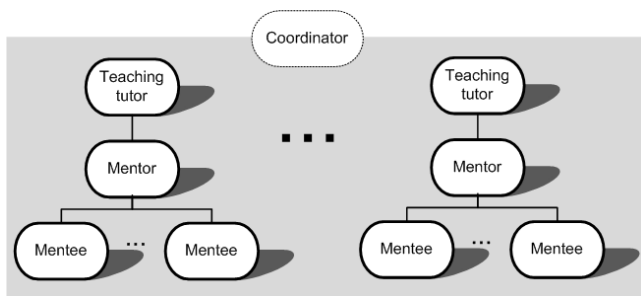


Figure 1. Organizational structure.

In addition, a technical committee coordinates the implementation of the different activities comprising the ETSIT Mentoring Program. This committee is composed by the Dean of the ETSIT, 3 lectures, and 2 undergraduate students. The *ETSIT Mentoring Program Technical Committee* meets at least two times throughout the duration of the program in order to select *Teaching Tutors* and *Mentors*, ...

### B. Recruiting and selection of Teaching Tutors & Mentors

The success of any mentoring program depends in large part on the skills of the *Mentors*. It is therefore important that care is taken when recruiting and selecting lecturers and students that will be involved in the mentoring program. The recruitment and selection of *Teaching Tutors* and *Mentors* commence at the end of the previous academic year, as *Mentors* need to be have been recruited and trained prior to the start of the academic year.

There are many strategies that can be used to make contact with the students whom *Mentors* will be selected. For the particular case of the ETSIT Mentoring Program, potential *Mentors* are contacted by publishing announcements on notice-boards, and by sending a mass email to students in later years of the degree. Potential *Teaching Tutors* are contacted by email.

Before agreeing to participate, potential *Mentors* are fully informed about the ETSIT Mentoring Program and about their role in it via an *information sheet* and an *information meeting*. The *information sheet* clearly identifies the aims, objectives and structure of the mentoring program, what will be expected from students who participate as *Mentors*, and especially how much time will be required of them. The *information sheet* also tells potential *Mentors* about the ongoing support they will receive. Finally, students are made aware of how their participation will be acknowledged. The *information meeting* is a session to which all students who have an interest in participating as *Mentors* are invited. The overriding purpose of such a meeting is to ensure that any student is fully informed about what is involved. The information meeting begins by welcoming and thanking all students for their interest in the mentoring program and having their attention drawn to the details that are provided on the *information sheet*.

Students who, having heard the detailed information, continue to believe they are able to make the necessary commitment, are asked to complete an application form. The application process consists of completing the application form with contact details, writing a short essay regarding the skills and experience they believe will enhance their ability to be effective *Mentors*, or the motivation for being involved in the mentoring program, and submitting a copy of their academic grades.

After the applications are received, the *ETSIT Mentoring Program Technical Committee* reviews the applications. The program faced several challenges when it began regarding how to organize the application and review process. Nowadays, students are selected mainly based on their academic progress and perceived interest in mentoring, since the importance of *Mentor's* appreciation of the value of mentoring for the success of the program has been proved to be significant. In this sense, the technical committee members are familiar with most of the students who indicate that they would like to be *Mentors*, so it is not necessary asking them to attend any personal interview. The number of chosen *Mentors* depends on the available flexibility, that is, the number of applicants in relation to the number of *Mentors* required. *Teaching Tutors* are mainly selected based on their experience in mentoring, with special emphasis on the enrolment of lectures of first year subjects, since their participation in the ETSIT Mentoring Program has proven to be very important, as it allows closer links with lecturers and staff [3].

### C. Training

Before meeting with the first year students, it is necessary to ensure that *Mentors* undergo appropriate training. The effectiveness of any mentoring program depends on the degree to which *Mentors* have the appropriate expertise, that is, both the skills and the knowledge. The greater their confidence in their skills and knowledge, the higher the likelihood that mentoring will be effective [4].

Training at the ETSIT Mentoring Program addresses issues related with the facilitation or conduct of the mentoring sessions, and others related to the content of the mentoring program. In this sense, *Mentors* have training in generic interpersonal communication skills, including building empathy, actively listening, or asking appropriate questions. Training identifies the strategies that *Mentors* might use for making their initial contact with their *Mentees*, for setting up the first meeting, and for running the first mentoring session. Interpersonal skills are put into practice in small group situations at the orientation and one-to-one in follow-up correspondence. In addition, *Mentors* are versed on campus resources, university activities, academic rules and resources, student associations, ETSIT organization, grants, exchange programs, ...

## D. Initial coordination session

The ETSIT Mentoring Program is established with a structure and relatively formal program to follow. The content of weekly mentoring sessions is agreed from *Coordinator*, *Teaching Tutors* and *Mentors* during an *initial coordination session* held before recruiting of *Mentees* and the start of the mentoring meetings. An outline of the topics that should be covered during the program of mentoring sessions is planned along with some suggestions for the week in which they must be addressed. This *initial coordination session* focuses on the content of the mentoring program, including the material, an identifying specific strategies and suggestive activities that might be used for each of the topics or areas of material.

## E. Recruiting of Mentees

One of the major challenges when the ETSIT Mentoring Program was implemented was how to inform incoming students about this opportunity. The chosen method is based on a flyer distributed during an announcement in a lecture in the first week of the course, ensuring that students are contacted early and in time for mentoring to begin from the second week of class. The flyer draws first year student's attention to the existence of the ETSIT Mentoring Program that is designed specifically for them. In addition, the information in the flyer includes the rationale for the mentoring program and its objectives, and briefly describes the expectations of participants in the mentoring program. Students are encouraged to attend a *welcoming session* during the second week of the course to learn more about the program and enroll in it.

## F. Welcoming session

Before agreeing to participate, potential *Mentees* are fully informed about the ETSIT Mentoring Program, about what would be expected of them, and what they might hope to gain from being involved in it. The purpose of the *welcoming session* is mainly to ensure that any student interested in being a *Mentee* is fully informed about the mentoring program, and to mark off the start of the mentoring program for participants. The *welcoming meeting* begins with a welcome from the Dean of the ETSIT and covers a brief reiteration of the aims and objectives of the program, a comment about the efficacy of mentoring programs and the possible benefits of participating in mentoring, and a few remarks about being an effective *Mentee*.

Having provided students with the opportunity to ask questions about any aspects of the ETSIT Mentoring Program, those who decide to participate are asked to complete an application form. The form simply asks potential *Mentees* to record their contact details and about their permission that the information be provided to their *Mentor*, who will then make contact with them. Mentoring groups are formed just at the end of the *welcoming session*, providing the *Mentors* and *Mentees* with the opportunity to get to know each other before the start of the weekly mentoring sessions. *Mentors* are in charge of group of a maximum of 6 *Mentees*, with *Mentors* and *Mentees* being matched at random.



Figure 2. ETSIT Mentoring Program Portal.

## G. Supporting tools

Once the mentoring program is underway –as soon as *Mentor* and *Mentees* groups are formed–, an intranet web-based portal is established by the *Coordinator*, shown in Fig. 2, as a supporting tool for *Teaching Tutors* and *Mentors*.

The ETSIT Mentoring Program Portal is exclusively available to the program participants and includes, among other, information related to the ETSIT Mentoring Program, a list of all the *Teaching Tutors*, *Mentors* and their *Mentees* with their contact details, and indicating the mentoring group to which they belong. In addition, a news forum is set up, so that there can be regular contact between the program *Coordinator* and all *Teaching Tutors* and *Mentors* who are involved in the program. Also, supporting information related to the topics proposed to be covered on the weekly mentoring sessions is provided. Finally, the web-based portal eases uploading and reviewing the reports being elaborated by the *Mentors* at the end of every weekly mentoring session.

## H. Weekly mentoring sessions

The *Mentors* meet *Mentees* weekly during the first semester, beginning the second week of class. The first meeting typically lasts 45-50 minutes, with subsequent meetings typically lasting 30 minutes. At the first meeting, *Mentor* and *Mentees* get to know each other better and set up a weekly meeting time. It is important for the students to know they can terminate the relationship for any reason at any time.

Each week there are certain topics that *Mentors* will discuss with their *Mentees*, according to the planning agreed during the *initial coordination meeting*. These topics regard how to succeed in their first semester classes, being timed to provide the right information and support at the right time. With each meeting, *Mentees* gradually assume more responsibility for the weekly mentoring sessions. Main topics include academic rules, characteristics of subjects, structure of the first course, search for academic resources, student associations, ETSIT organization and services, ... Other topics cover study habits, how to put a bad exam score

in perspective, not repeating the same mistakes, organizational skills, dropping classes, exam survival, ... *Mentors* discuss any issue of concern with the *Mentees*, not being limited to the topics to cover in any weekly mentoring session according to the planning agreed during the *initial coordination session*. In addition, *Mentees* complete three forms during the weekly sessions regarding previous knowledge of the degree and the motivation of the first year students for its election, their adaptation to the University, and the subjects covered on the first semester. The information obtained from these forms is used, i.e. to detect problems on the lectures of the subjects covered on the first semester of the degree. The second part of the first semester, *Mentees* have grown substantially, so topics cover some visits to research laboratories or telecommunication-related enterprises. Finally, the last meeting is held after the exams, in order for the *Mentors* to review the academic progress of the *Mentees*, being sensitive to students who appear to be at academic or personal risk.

In addition to weekly mentoring sessions, *Mentors* meet monthly to share experiences. Also, in order to involve *Teaching Tutors* with the *Mentor* and *Mentees* weekly meetings, they are recommended to assist to some specific planned meetings covering critical topics for the first year students, allowing closer links with lecturers and supporting *Mentors*.

After each meeting with their *Mentees*, *Mentors* elaborate a report of the session and sends it to the *Coordinator* and their *Teaching Tutor*. This report is based on a template provided by the *Coordinator* of the mentoring program, including the meeting date and duration, along with the name of the assistants, the covered topics, and any comments or problems from the *Mentees*. Once fulfilled, *Mentors* upload each report using the web-based portal. Reports are available for the *Coordinator* and the *Teaching Tutors*.

### III. ETSIT MENTORING PROGRAM EVALUATION

The overriding objective of any evaluation process of a peer mentoring program is to determine the extent to which it has been effective [3]. The success of a mentoring program depends on how well it is able to assess its effectiveness, address any weakness and demonstrate that it is complying established goals and objectives. However, evaluations of mentoring programs tend to exclusively assess *Mentees* satisfaction with a *Mentor*, with very few studies examining the impact of mentoring program on outcomes [5]. To ensure the quality and effectiveness of a mentoring program, it is necessary to develop a plan to measure program processes and expected outcomes, and create a process to reflect on and disseminate evaluation findings. To ensure the quality and effectiveness of a mentoring program, two different types of evaluation can be conducted depending on the purpose of the measurement [4]:

- *Process evaluations (formative evaluations)* focus on whether a program is being implemented as intended, how it is being experienced, and whether changes are needed to address any problems. Process evaluation is an ongoing data collection process that

yields information about the successful activities and those needed to be determined. This information can help to improve the mentoring program. A well planned process evaluation is developed prior to the beginning of the mentoring program, and continues throughout the duration of the program.

- *Outcome evaluation (summative evaluations)* focus on what effects mentoring programs are having and help to determine objectively the benefits, costs, and necessary conditions to reach program objectives, and determine whether the mentoring program caused an improvement among the participants on certain aspects of interest.

Despite the importance of the information provided by the *Process evaluations* for self-monitoring and continuous improvement of program effectiveness, this paper will mainly focus on the issues and decisions involved in conducting an *Outcome evaluation* to assess the effectiveness of the ETSIT Mentoring Program in achieving pre-determined objectives. An *Outcome evaluation* implementation involves the specification of expected outcomes, the selection of appropriate instruments to measure outcomes, and the selection and implementation of an evaluation design.

#### A. Outcome evaluation

*Outcome evaluation* is a crucial part of any effective mentoring program as it provides information to increase its effectiveness through a feedback/continuous quality improvement process. *Outcome evaluations* of mentoring programs generally are of two major types [4]:

1) *Single-group designs* are the simplest and most common types of evaluation, since they are less intrusive and costly, and require less effort to complete. An example of a single-group evaluation is a survey completed by all participants at the completion of the program (*post test*) or before and after the program (*pre-post test*).

- *Post test.* Mentoring programs commonly use this design to determine how *Mentees* comply some aspects of interest at the completion of the mentoring program. *Post-test* evaluations can help determine whether the *Mentees* have achieved certain goals – according to the implicit or explicit objectives established during the planning of mentoring program–, or whether *Mentors* are satisfied with the mentoring program, among other issues.
- *Pre-post test.* Mentoring programs use this design to determine whether *Mentors* and *Mentees* actually improved during the mentoring program by comparing the results of a *pre test* and a *post test*. Even if *pre-post* evaluations can't indicate whether the mentoring program was responsible for the improvement, a *pre-post test* can be useful to detect differences within the group or to determine whether certain participant characteristics are related to achieving mentoring program goals.

2) *Comparison group designs* allow to determine whether the mentoring program is the cause of change in program participants, using controls to eliminate possible biases. An example of a comparison group evaluation is a *pre test* completed by all participants at the beginning of the program and a *post test* at the completion of the program to both the target mentoring group and a matched comparison group that does not receive mentoring. By including a comparison group it can be possible to isolate the effects of the program from the effects of other plausible interpretation of change. However, this type of evaluation requires finding a comparison group that is sufficiently similar to the mentored group. In this sense, students who enlist in a mentoring program may differ –in terms of motivation, compliance, ...– from those who do not enlist. Many mentoring programs are not willing to deliberately withhold their program from participants, mostly with the number of students entering engineering degrees programs declining.

The evaluation design adopted determines the confidence in the mentoring program to be the cause of improvements of potential in all participants. *Outcome Evaluation* of the ETSIT Mentoring Program is based on a *single-group* design with *post test*, since all first year students are invited to participate as potential *Mentees*. The outcomes are mainly measured using anonymous satisfaction surveys completed by *Teaching Tutors*, *Mentors* and *Mentees* after the fall meeting, as surveys of student perceptions provide just some information. These surveys have been elaborated as part of the activities of a mentoring network in university environments which includes most of the universities developing mentoring programs in Spain, including the University of Las Palmas de Gran Canaria (ULPGC) [6]. The elaboration of these common surveys has allowed the comparison of the results obtained from different universities on the same issues. The items on the survey cover different aspects of the ETSIT Mentoring Program, including *Personal Benefits*, *General Benefits*, *Development of the Program*, *Program Recommendation*, *Teaching Tutors/Mentors/Mentees evaluation*, and a *General Appraisal* of the mentoring program.

The results obtained for the 2008-2009 ETSIT Mentoring Program show that it is considered as helpful or very helpful by more than 90% of *Mentees*, 95% of *Mentors* and 88% of *Teaching Tutors*, with a general appraisal of 8.63, 9.12 and 9.37 (over 10), respectively. In addition, 70% of *Mentees* consider that ETSIT Mentoring Program has a positive influence on their academic, social, and personal endeavors, and more than 75% recommend to be enrolled in it, with an 83% willing to participate in the near future as *Mentors*.

However, as various issues covered through the implementation of mentoring programs are not directly used during the first semester at the university, and in many cases the incoming first-year students don't have an adequate temporal perspective to value all the aspects in which the mentoring program have influence, the ETSIT Mentoring Program also involves anonymous satisfaction surveys completed by *Mentees* after staying three years at the university in order to evaluate their perception about the effectiveness of the mentoring program on that period. Some of the results obtained from these surveys are shown in Fig. 3

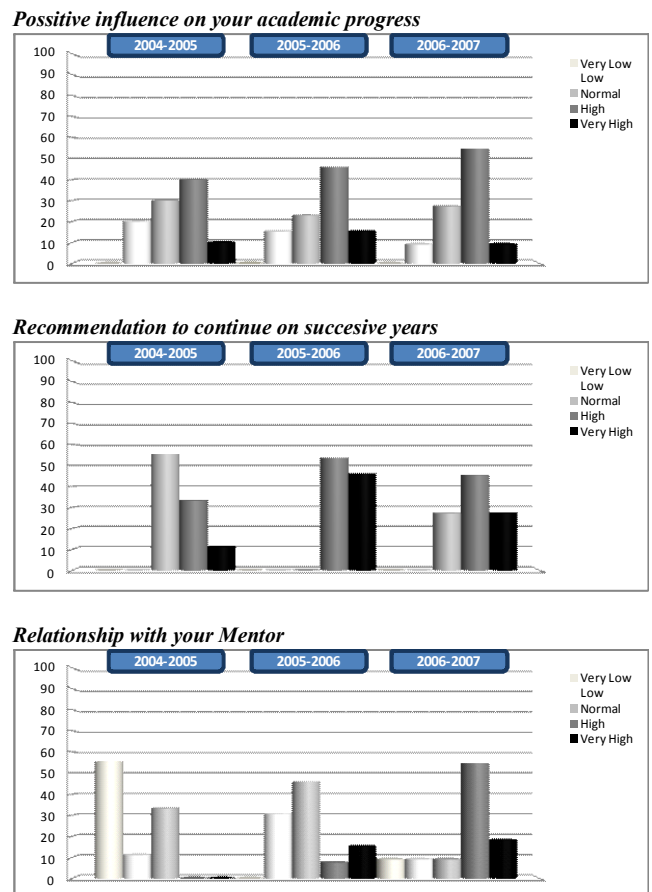


Figure 3. Results obtained from satisfaction surveys completed by *Mentees* after staying three years at the university.

for *Mentees* who participate in the ETSIT Mentoring Program along the academic years 2004-2005, 2005-2006 and 2006-2007, after staying three years at the university. From these results, 57% of students consider that ETSIT Mentoring Program had a high positive influence on their academic progress in mean, more than 72% highly recommend its continuity on successive years, and a 51% of students still continue the relationship with their *Mentors*.

However, satisfaction surveys often show that participants are at least somewhat satisfied, so results must be interpreted with some caution. High program satisfaction does not equal positive program outcomes, thus satisfaction surveys should be considered as just one part of an overall evaluation. In this sense, retention rate is tracked each academic year as a method of measuring retention of first-year students. In Table I, the overall first-year retention rates of *Mentees* for the last five academic years are shown. From these results, improvements introduced from the 2006-2007 academic year indicate that the ETSIT Mentoring Program successfully impacts retention.

TABLE I. OVERALL FIRST-YEAR RETENTION RATES OF MENTEES

Academic Year				
2004-2005	2005-2006	2006-2007	2007-2008	2008-2009
37%	32%	36%	56%	60%

In addition, a set of measurable indicators are being elaborated within the referred mentoring network in order to evaluate whether or not the mentoring program caused an improvement among the participants, including the degree to which the needs of the incoming first-year students are met, the skills gained by the *Mentors*, or the degree to which the university as a whole benefits from the mentoring program. These indicators will be used to improve *Outcome evaluation* of the ETSIT Mentoring Program at the current academic course 2009-2010, in order to verify the feasibility in collecting the required data and the relevancy of each indicator in determining the effectiveness of the mentoring program.

#### IV. CONCLUSIONS

The ETSIT Mentoring Program helps *Mentees* to develop an enhanced sense of student identity as an engineer, to become effectively integrated into the ETSIT, and to acquire the necessary skills to become independent. Regarding *Mentors*, the ETSIT Mentoring Program introduces them to skills in leadership, teamwork, problem solving, time-management, or communication, helping them get a leg up into professional practice. The effectiveness of this peer mentoring program can be attributed to several factors, including proper *Mentor* selection and training, weekly targeted meetings with *Mentees*, well timed information and mentee support, or the enrollment of lecturers teaching on the first year course.

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