

# Soft Skills for Science and Technology Students

## A pedagogical experience

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**Abstract** – In the academic year 2012–2013, the Faculty of Science and Technology of the New University of Lisbon (FCT/UNL) conducted a complete revision of its curriculum, with the goal of enhancing the training of its students and increasing the employability of its graduates. In its new profile, the FCT/UNL now includes three distinct teaching periods in an academic year, with the introduction of a five-week period between the two traditional semesters. During this period, several transferrable skills courses are taught in an intensive regimen. In this article, we present the motivations that led to the creation of the course entitled “CTCT – Transferable Skills for Science and Technology”, its incorporation into the new curricular profile of the FCT/UNL, its main objectives, and its syllabus. We also present the methods used in the allocation of students to classes and groups and the feedback from teachers and students participating in the course.

**Keywords** - FCT/UNL; Academic Curriculum; Transferrable Competencies; Soft Skills.

### I. INTRODUCTION

The Faculty of Sciences and Technology of Universidade Nova de Lisboa (FCT/UNL) was established in November 1977. Currently, the FCT/UNL has 14 departments (Environmental Sciences and Engineering, Materials Science, Mechanical and Industrial Engineering, Physics, Computer Science, Mathematics, Chemistry, Earth Sciences, Life Sciences, Electrical Engineering, Civil Engineering, Social Sciences, Conservation and Restoration, and Science and Technology of Biomass), 16 research centres, 8 support services, 535 teachers and researchers, and 169 other staff. The faculty serves a community of over 7500 students of which about 1400 are graduate students (MSc and PhD). Students are distributed across a wide range of three-year courses (Cellular and Molecular Biology, Biochemistry, Conservation-Restoration, Mathematics, Applied Chemistry, and Geological Engineering) and five-year courses (Environment, Biomedical, Civil, Electrical and Computer, Physics, Industrial Engineering and Management, Information Technology, Materials, Mechanical, and Micro and Nanotechnologies), denoting a

significant heterogeneity of cultures and preferences. As a result, significant differences can be found in motivation, communication skills, working habits, and interpersonal skills, strongly affecting students’ academic performance.

To mitigate these asymmetries between students and to better prepare them not only to achieve better performance levels during their university life but also for the labour market, a general restructure of the FCT/UNL courses was performed in the 2012–2013 academic year. In the context of this restructure, the Soft Skills for Science and Technology course was created. This course aims to provide students with a wide range of complementary skills in the middle of the first academic year of all FCT/UNL courses.

### II. THE NEW FCT/UNL CURRICULA PROFILE

Competitiveness in the labour market is now higher than ever before. Therefore, a professional engineer or scientist needs to be much more than someone who just dominates his or her area of expertise. In the academic year of 2012–2013, and being aware of the need to provide its students with soft skills, the FCT/UNL decided to innovate and create conditions for their students to receive a more varied and comprehensive training. Without compromising the fundamental training in each course, a full curricular restructuring was implemented, leading to the creation of a new curricular profile. The first step of this reorganization was the homogenization of the number of ECTS (European Credit Transfer and Accumulation System) credits of all the courses in multiples of three ECTS credits. This standardization helped to allow a more efficient and clear organization of the curricula of the different degrees offered.

To allow students to be trained in cross-cutting areas and to develop complementary skills in addition to the traditional training in science and engineering, it was necessary to find a way to introduce new courses in the different curricula (which traditionally have been very intensive, leaving students little free time). Upon deciding that it was impossible to increase students’ workload during either of the two semesters in a year, it was necessary to find an alternative solution that would allow

the new soft skills courses to be inserted into all degrees. An analysis of the structure of the academic year prior to this restructuring (see Figure 1) shows that there were two semesters with a period reserved for exams at the end of each semester.

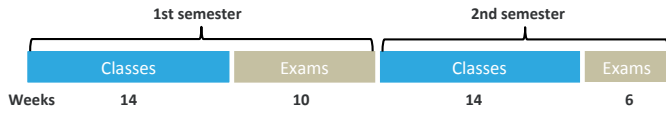


Figure 1. Organization of the academic and examination periods prior to the 2012–2013 restructure.

The considerable duration of the two examination periods (ten and six weeks, respectively) was due mainly to the existence of the first and second exam calls aimed at ensuring that all students had a minimum of two assessment opportunities for each course.

To reduce the length of the assessment periods, it was decided that all courses should adopt continuous evaluation during the semester. Consequently, the second exam call was removed, reducing the exam period duration to three weeks in each semester.

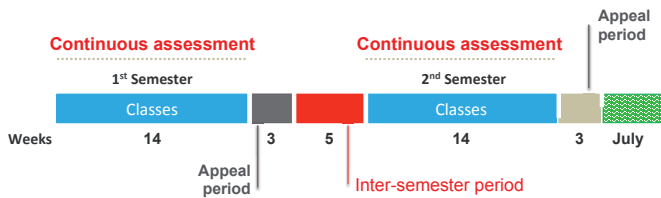


Figure 2. Semester organization for the new FCT/UNL curricula.

Using this strategy, it was possible to free up five weeks between semesters and to leave the month of July free (see Figure 2).

It was then decided to use the five-week period for teaching a set of soft skills courses, mandatory for all students. In these courses, the students acquire diversified skills that enrich their studies and better prepare them for subsequent learning activities. Therefore, the following set of courses for the inter-semester period was created:

First year: CTCT – Soft Skills for Science and Technology

Second year: Science Technology and Society

Third year: Introduction to Scientific Research / Introduction to Professional Practice

Fourth year: Entrepreneurship

In the fifth year, students are usually preparing their master’s theses, so it was decided that they would not attend any course in the inter-semester period.

Based on eight conferences dedicated to current (and commonly controversial) issues, the second-year course “Science Technology and Society” aims to give students an understanding of the contemporary technological–scientific world, motivating them to consider the impact of science and technology in today’s society. The third-year course “Introduction to scientific research / Introduction to

professional practice” (final year for the students doing a three-year undergraduate degree) allows students direct contact with companies or research teams through a five-week internship. At the end of this period, students produce a report describing the activity developed and on which they are evaluated. Finally, the course “Entrepreneurship” aims to stimulate students’ potential for the creation of value from an idea to the creation of a new business. In 2012–2013, more than 500 ideas emerged and 160 business projects were presented.

### III. COMPLEMENTARY ACTIVITIES, FREE CREDITS, AND AN “ERASMUS-FRIENDLY” SEMESTER

With the aim of expanding students’ training and making it more comprehensive and varied, the FCT/UNL decided to make available to students a large number of extra-curricular activities during the inter-semester period. These activities extend from language training (e.g., English, French, Japanese, and Mandarin) to sports activities (such as archery, climbing, rugby, and futsal), artistic activities (including theatre, jazz, and musical instruments), leadership, and many others. To allow students to diversify their training, a number of ECTS credits (6 in the first cycle, 6 in the second cycle, and 12 in the integrated masters) have to be fulfilled from a list of units from the “free block” where students can find thematics from other technical and scientific areas (Figure 3).

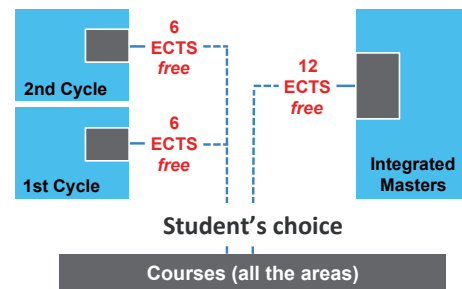


Figure 3. Distribution of the free block units during the training of FCT/UNL students.

As international experience is an asset for many students, the FCT/UNL also introduced the concept of an “ERASMUS-friendly” semester by deciding that all courses should include in their planning a specific semester where student geographic mobility should be facilitated.

### IV. CTCT – SOFT SKILLS FOR SCIENCE AND TECHNOLOGY

The “Soft Skills for Science and Technology” (CTCT) unit is mandatory for all first-year students of any of the FCT/UNL degree courses (the sole exception is the Degree in Conservation and Restoration). This led to the challenge of organizing a new course, quite distinct from traditional engineering courses, to be implemented in an intensive regime during the five weeks of the inter-semester period, with more than 1000 students scheduled to attend it (1047 students attended the first edition of the course).

To ensure proper preparation, a four-member coordinating committee was nominated by the FCT/UNL in March 2012, a year before the start of the course. This committee was in charge of defining the course syllabus, producing the

supporting materials, and building and training a team of professors to teach the course.

#### *A. Course syllabus*

From the outset, the coordinators of CTCT decided that the course should be as enjoyable as possible for students, but with a serious and rigorous approach to the various issues. Five key themes were identified, one for each of the five weeks available.

##### ***1<sup>st</sup> week: Curriculum Planning for Employability***

The first week of CTCT is devoted to curriculum vitae (CV) planning for employability [1]. Apart from writing a CV and a letter of application, students watch videos with simulated job interviews, showing both positive and negative points to be identified and criticized by the students. Exposure to a psychometric test is also provided to the students to give them a feeling of what they can expect when competing in the job market. The main goal of this week is to emphasize to students the need of enriching their curricula as much as possible during their study period at the FCT/UNL. The concept that “hard-skills guarantee the interview” but “soft-skills guarantee employment” is stressed though this week [2].

##### ***2<sup>nd</sup> Week: Time Management, Teamwork, and Leadership***

The second week is devoted to time management, teamwork, and leadership [3]. Students are directed towards the need to differentiate between what is urgent and what is important, what are SMART goals [4], and how to use different tools to support planning and time management. They are taught about typical procrastination behaviours and the associated disadvantages for a successful career. The advantages and disadvantages of social network integration are discussed. IT tools for collaborative work, useful for facilitating good performance both at university and for subsequent employment, are presented using practical applications. Leadership and individual management skills, positive language, expressions to eliminate, and active listening are other topics that are addressed during this second week through practical exercises.

##### ***3<sup>rd</sup> week: Advanced Spreadsheet Use***

During the third week, students develop their skills in using Excel<sup>®</sup> spreadsheets, particularly in the context of Science and Technology. A review of the use of different types of graphics is made. Information lookup functions are explored and the solver is applied to solve a medium-complexity problem. A brief introduction to the Excel<sup>®</sup> Visual Basic module with the programming of some simple functions is also provided. Finally, a presentation on the utilization of Excel in different areas of Science and Technology is provided with a demonstration of animated graphics.

##### ***4<sup>th</sup> week: Library Research, Information Analysis, and Ethics and Deontology***

The fourth week of the course is dedicated to the importance of good literature in the development of scientific activity. Students have the chance to search scientific databases and select the most interesting and scientifically sound information. Academic and professional ethics are

discussed and their relevance is clearly shown not only in academia but also in a future career in the fields of science and engineering. The information collected by the students during this week is the basis for the work developed during the fifth and last week of the course

##### ***5<sup>th</sup> week: Communication of Science and Technology***

The fifth and final week is dedicated to communication in science and technology. Using the information collected during the previous week, the students prepare textual summaries of scientific dissemination articles and create oral presentations, short papers, and scientific posters describing the most relevant points of a TED talk ([www.ted.com](http://www.ted.com)) [5]. During lessons, subjects as diverse as internet communications (emails, chats, and social networks), the elements that should be included in a scientific paper, and the care that must be given to the preparation of oral presentations are discussed with the students. During the week, the students prepare short oral presentations and posters on these subjects and present them to the class.

#### V. METHODOLOGY AND PREPARATION

Because the CTCT course has three ECTS credits assigned to it, the number of classroom-based lessons could be large. Thus, it was decided that classes would take place from Monday to Thursday during each of the five weeks, leaving Fridays free, so as to not overwhelm students. This also had the goal of facilitating the return home of travelling students during the weekend. The schedule consisted of two hours of practical classes on Mondays (from 10.00 to 12.00) for introducing the topic of the week and motivating students, four hours of practical classes on Tuesdays and Wednesdays (from 9.00 to 13.00), and two hours of theoretical classes on Thursdays. For the practical classes, students were divided into rooms with a maximum of 36 students. The two-hour theoretical classes were held on the final day (Thursday) of each week as they were intended to summarize the week's activities and to review the good aspects of the week and those needing improvement.

Taking into account the physical limitations of the available rooms, the theoretical classes were planned to hold between 150 and 200 students, with a total of eight sessions being run to accommodate all the students.

To enrich the students' experience during the course, it was decided that practical classes should have the greatest possible diversity in terms of gender and of degree course, and that students' groups in practical classes should be changed each week to maximize mutual contact between the students. Each group is therefore always composed of up to four students from different courses, with both genders represented.

To teach the 32 practical class sessions, it was necessary to form a team of 32 teachers from the different departments of the FCT/UNL. This large team received prior training on the topic areas of each week in sessions held during September and October 2012. Included in training activities available to this teaching team was a session taught by Dr Odete Fachada, an expert in human resource management. The contribution of Dr Fachada was extremely important for the success of this

course, as it brought into the academic environment the perspective of someone with a deep knowledge about the labour market and all its particularities. During this training period, well in advance of the starting date of the classes, the CTCT coordinating committee distributed to each teacher a set of over PowerPoint® 500 slides to support classes, scripts of lessons, statements, and supporting materials for the various activities, serving to support the entire course. To ensure that teachers would have adequate logistical support and that any unexpected event could be solved, four graduate students were hired to act as monitors of the course. The monitors also received thorough training to enable them to replace any teacher who, for whatever reason, might be unable to teach a particular class. It is important to note that the way in which the course has been arranged does not allow any alternative or recovery (“make-up”) classes to be held, because all the sessions must be completely synchronized.

Because practical classes require many group activities involving different support materials, it was necessary to prepare the “CTCT kit”, a teaching and support resource that was distributed to all teachers, monitors, and coordinators before the start of the classes. A total of 40 kits with all the materials necessary for teaching a practical class were prepared.

The efficient and uniform evaluation of the work of more than 1000 students is a difficult but extremely important task for the feasibility and prestige of the course. Because the practical activities were considered essential for students to achieve the proposed goals, the possibility of holding a final examination was ruled out. Therefore, continuous assessment was the only solution possible. However, it was necessary to find a way to achieve an accurate continuous assessment without becoming an immense task for teachers of practical classes. More than 60 assessment activities have been defined and organized into three types of evaluation according to the characteristics of the activity:

- Binary evaluation: for simple activities (about 30)
- Three evaluation levels: attributing 1, 2, or 3 points, designed for assessing activities of medium complexity (about 20)
- Five evaluation levels: attributing 1 to 5 points for the more complex activities (about 10)

In all assessment situations, a student’s non-performance of an assessed task corresponds to a zero grade for that task. During the continuous assessment, the students are evaluated on different skills such as oral communication skills, individual capacities, and group-work abilities. The evaluation process was enabled by using the Moodle platform, where many of the assessment activities were designed and performed. Some of the individual assessment activities were designed to allow students to perform the required work outside the university and to be automatically evaluated. The results of the weekly evaluations were made available in Moodle at the beginning of each following week, allowing each student to continuously follow his or her performance over time.

## VI. IMPLEMENTATION AND RESULTS

With a total of 1047 students enrolled in the first edition of the course, classes started on 22 January 2013 and finished on 21 February 2013. Although there was some prior concern that students would be discouraged with respect to the abolishment of the holiday period caused by the introduction of CTCT, the adherence of the students to the course was highly commendable from the very first day. The contact with topics of general interest surprised many of the students, who reacted very positively to the fact that classes were formed by elements of the different courses and that student workgroups were built to be as heterogeneous as possible. In addition, the intensive teaching and learning regime with one fixed teacher for each practical class helped to create a strong teacher–student relationship. Although it was acknowledged from the very beginning that the demands of the course might be high regarding both attendance and assessment, students demonstrated surprising dedication. This attitude is reflected in the final results of the course, which show an approval rate of 92% of the students (966/1047), a failure rate of just 4% (43/1047), and an absence rate of 4% (38/1047). During the subsequent editions of the course (2013–2014 and 2014–2015), the approval rate has increased, reaching 99.4% of the attendees (1035/1041) for the 2014/15 edition. The distribution of the final grades of the first edition (on a 0 to 20 scale) is shown in Figure 4.

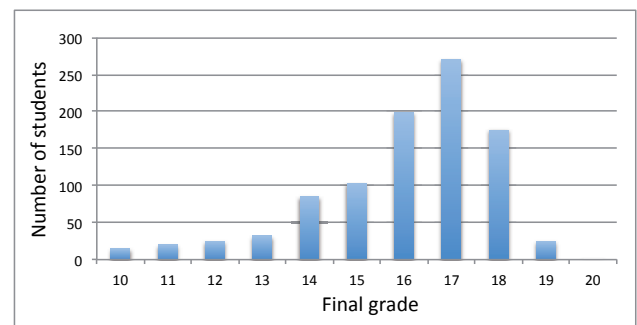


Figure 4. Distribution of the final grades for the first edition of the CTCT course.

A good indicator of student satisfaction is students’ responses to anonymous surveys conducted by the course coordinating committee. The vast majority of students found the course very interesting and useful for their future, both for their university degree and for their anticipated career. Students also felt that practical classes were well prepared and that teachers showed a high level of preparation and capability to stimulate the attendees. The diversity of classes and groups was highly praised, as was the good relationship established between students and teachers, particularly those teaching practical classes. The high number of assessment tasks was one of the points listed by surveyed students as needing improvement (by reducing the number of assessments), as was the timing of the course, which in 2012–2013 did not allow any break between the end of the inter-semester period and the beginning of the second semester.

## VII. CONCLUSIONS

The objective of the new curriculum implemented in the FCT/UNL was to optimize students' efficacy and proficiency by eliminating unnecessarily prolonged examination periods (which are of questionable value) and by improving the soft skills education and capability of enrolled students. The implementation of the "CTCT – Soft Skills for Science and Technology" course in the first year of undergraduate and integrated master's degrees enables students to become accustomed to labour market requirements long before they are faced with the reality of it. Therefore, they obtain a clear message about needing to enrich and broaden their CVs during their studies at the FCT/UNL.

The course was implemented with a very practical profile, with the completion of dozens of group activities planned to favour a high level of academic achievement. The feedback obtained from the students who have participated in all three editions of the CTCT course up to now, and from the professors of the courses, clearly indicates the effectiveness of both the methodology applied and the suitability of the syllabus.

## VIII. ACKNOWLEDGEMENTS

The committee that coordinated the creation and implementation of the CTCT course expresses gratitude to the

Dean of the FCT/UNL for placing confidence in the organization of the course, to the entire team of teachers and monitors who taught the practical classes with enormous spirit of dedication and camaraderie, to Dr Odete Fachada for the extraordinary support given to this initiative, to Commandant João Simões for his contribution on leadership, and to engineers Manuel Santos Carneiro and António Nascimento Ribeiro from SHARE for their contributions on business requirements and employability. CTCT was partially funded by Fundação para a Ciência e Tecnologia project 159/ID/2014.

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