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Promoting 'Soft Skills' from the Start of the Engineering Degree and the Case Study of the Special 'Projeto FEUP' Course*

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The so called 'Soft Skills' (SSs) are the set of non-technical skills that enable a given individual to interact effectively and harmoniously with other people. These skills are also interesting for the promotion of deep knowledge and to foster academic success. The case study analyses the very special 'Projeto FEUP' course that promotes SSs across all engineering programmes in the Faculty of Engineering of the University of Porto (FEUP), in Portugal. This is done right after the arrival of students at the institution by means of producing several communicational items over an adequate technical work. The study involved 781 students. The presented results hint that Soft Skills are, in fact, improved after half-semester but this is not the sole product of the mentioned course.

Keywords: engineering education; professional skills; soft skills; curricula design; academic success

1. Introduction

A number of different issues contribute to difficulties in ensuring that engineers have a full training of both social and personal skills as well as technical knowledge at the end of their formation period(s) in Higher Education Institutions (HEIs). This paper discusses the importance of 'non-technical skills', also called 'professional skills', here referred to as 'Soft Skills' (SSs) and presents a study of a special initial course dedicated to promoting them.

SSs may be briefly defined as the skills that enable any given person to interact effectively and harmoniously with other people [1]. Such skills are needed in many kinds of technical work and include skills such as listening, communicating (within a team and to other people), thinking (critically), summarizing information, etc.

The study presented here discusses the importance of the development of SSs by students of technical expertises (namely engineering) and endorses the idea that this learning process should be addressed explicitly from the very beginning of the engineering programme. The 'Projeto FEUP' course does exactly that and its implementation and learning outcomes are presented. The pertinence of a curricula design that promotes SSs from the start is discussed and results of the assessment students make of their own learning process is presented.

The following section will further contextualize and characterize SSs and their development. Then, the case study of 'Projeto FEUP' is presented as well as the research questions. After referring the methodology of the study, some results and findings are stated that lead to the conclusions presented in the last section.

1.1 Context

The Bologna Reform of the European Universities brings the explicit development of students' SSs to the frontline of all Higher Education Institutions' (HEIs) concerns, namely those which are mainly technical, as Engineering Faculties. In a broader perspective, teaching technical issues involves not only the making of things, but also the abilities to justify, argue and communicate ideas [2, 3] and such skills are the mentioned SSs. This realization means that the learning paradigm in those technical areas and respective learning outcomes are changing, namely those which are connected to communication and argumentative skills [4, 5].

In America, the engineering accrediting organization ABET, formerly known as Accreditation Board for Engineering and Technology [6]; [7] similarly includes 'SSs' as must-have skills and surveys rank these skills as important in professional skills. Also American based, the 'Conceiving,

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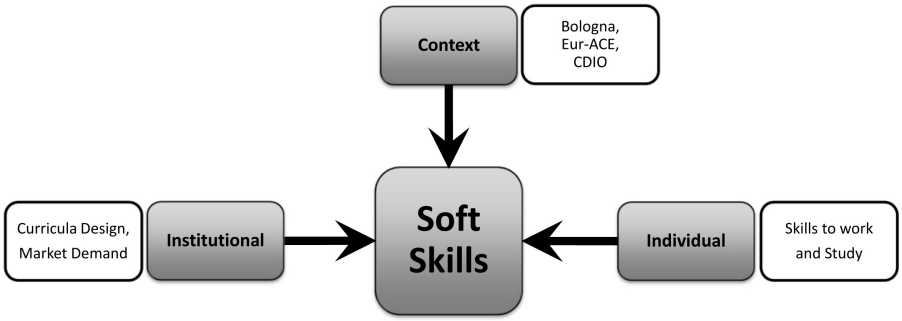


Fig. 1. Soft Skills relations at different dimensions.

Designing, Implementing, Operating' [8] organization likewise contains 'SSs' as essential skills.

Similarly, the European EUR-ACE [9] framework for certification also includes the importance of 'SSs' in the engineering courses' curricula [10]. The EUR-ACE [9] reference model also identifies technical and non-technical issues of importance and lists topics as: (1) Knowledge and Understanding; (2) Engineering Analysis; (3) Engineering Design; Investigations; (4) Engineering Practice; (5) Transferable Skills. Even for the lowest graduation level in engineering, the Bologna First Cycle of Engineering (or Eng. Bachelor), the previously mentioned 'transferable skills' state the importance of the ability to 'function effectively as an individual and as a member of a team' (team work skills) and the skills to use 'diverse methods to communicate effectively with the engineering community and with society at large' (communication skills) clearly recognizing the importance of the mentioned 'SSs' [10]. Additional importance is recognized by endorsing the challenge of multicultural, multi-language Europe, the EUR-ACE model states clearly the importance that Masters in engineering (2nd cycle of Bologna) should be able to 'work and communicate effectively in national and international contexts' [10, 3]. FEUP currently has most of its programmes accredited under the EUR-ACE framework.

1.2 Early training of SSs in engineering education

The previous discussion leads to the consideration also present in research that deficiencies in these SSs tend to have a detrimental effect in success throughout life (during both education and professional life). This is truer than ever due to the fact that society is demanding more and more in terms of global efficiency and shortcomings in communicational skills are known to lead to poor team work, hence it makes sense to treat them as related issues. Communication to stakeholders is also essential for all (large) engineering projects and increased competition makes it important to quickly gain the interest of candidate clients and decision makers, by making use of adequate communicational strategies and technological mediums—the curricula of engineering schools cannot be blind to such challenges, related to knowledge society demands [11].

The importance of SSs is made clear at different dimensions (Fig. 1): taking the *context dimension*, the Bologna Reform and the engineering accrediting institutions dictate their presence; at an *individual dimension*, they are lifelong important both for citizenship, for technical studies and for professional practice; lastly, at an *institutional dimension*, the employers for the graduated engineers require fast learning, rapid integration and easy communication in teams, as well as the ability to justify decisions or promote solutions and these issues drive curricula design.

SSs are of paramount importance for the development of critical thinking, argumentative thinking and the capability to read and produce high quality scientific literature (*individual dimension*). In-depth scientific studies are necessary for the development of scientific skills under ethical constraints and to create a conscience of adequate communication for a given communication media and recipient of the communication. If such issues are important and they are admittedly hard to learn by students, then, the training for development of such topics should start at beginning of the engineering curricula. The added benefits for the rest of the programme include proper formation of the scientific mind and every time work and studies are reported to someone (higher quality in the production of scientific proof and sharing of knowledge). SSs are also relevant for the ability to healthily classify data (associated with critical thinking capabilities). They are also important to help reaching valid conclusions by recognizing a scientific writing style where frequent steps are clearly identifiable. It is important although not easy to transmit to new science and technology student the importance of

stating clearly context, scope, assumptions, hypothesis, the separation of experience and the extrapolation of conclusions—these are very important issues stated clearly by Bologna intentions (*context dimension*) that makes it mandatory to include such topics in the curricula.

Given the importance of such 'formal' matters, institutions should explicitly plan for inclusion and development of SSs in their curricular plans (*institutional dimension*). Market demands it and they are an indicator for the quality of the institutions (students with better SSs behave better in the work market and are more successful in life). Naturally, the success of the 'clients' (students and society) is, in the long run, the success of the school itself.

Admittedly, SSs are difficult to promote and assess. Nurturing them is a task to be taken in the long run and this nourishment is most likely best if taken right from the start to provide the time and the experience needed for the personal growth needed by such skills. It is commonly understood today that these skills are not innate but are, in fact, a product of personal learning and development—that should be instigated by the Higher Education Institution.

1.3 Importance and difficulties to the development of SSs

The so-called SSs are important and may often mean the difference between failure and success [12]; [5] in such important matters as, to give some examples, getting the only job position available or convincing a client of the advantages of a given product or convincing the public that a given facility needs safety rework. It seems natural that, in the current societal context, being able to explain a situation, make a point, defend it competently, argument or advocate a given solution to a job prospector, a client or a mass media member is likely to be determinant in nowadays lifestyle of any technical agent and much more so in the life of a recent graduate engineer—even more so in a multicultural, global world, see for instance the challenges referred in Dąbrowski [13] or Warnik [14].

SSs are also associated with argumentative reasoning ability and relate to the development of scientific literacy. Scientific reading and analysis of high quality scientific contents is of the utmost importance. This task is expected not only to promote the specialty areas of the analysed contents but also to induce a soundness of analysis (scientific treatment) and a depth of treatment (formal analysis) by exposure to significant examples of adequate content structures that will enabling deep learning on what is expected to be profound scholar knowledge. Reading sound scientific articles seem to be an adequate means to minimize the growing speed in communication that quickly becomes a 'Soundbite'[1] or a 'tweet'[2]. All young technical agents such as engineers will, most likely be familiar with short sentences frequently used by social networks, blogs, posts and so on but it seems adequate not to restrict ourselves to these short sentenced mediums . . . consider a world where scientific breakthroughs were to be distributed instantly and uncontrolledly to hand held devices around the world: how would society promote deep knowledge and how would hoaxes[3] be deterred or identified? Clearly, society welcomes new communication methods but not all methods are adequate for all types of messages. SSs to be developed in such environments must also cover this critical awareness.

Furthermore, deep analysis of scientific work also drives the will and the capacity to transmit ideas on work related issues, both for team mates and for team-aliens. The structured flow of ideas will enable logic deductions and reaching logical conclusions which is, most likely, the ultimate goal of whole process: to promote high level reasoning skills.

The toll for not promoting SSs is a larger dispersion of results, scholar and social. Dispersion of scholar results includes problems with dissatisfaction, approvals and dropouts [15]. Social results are mainly perceived as the impact individuals have on society [16–17]. Addressing these issues fights off negative impact of massification in higher education and promotes levelling at higher degree of conscience of most students, therefore going beyond pure parental inheritance (reading habits, known vocabulary, accuracy on transmission of thought, communicational style, etc.). Literature finds that new social asymmetries (market maturity, unemployment, etc.) may deem SSs even more important

[1] 'Soundbite'—A short sentence or phrase that is easy to remember, often included in a speech made by a politician and repeated in newspapers and on television and radio (Definition of soundbite noun from the Cambridge Advanced Learner's Dictionary), http://dictionary.cambridge.org/dictionary/british/soundbite (visited May 31, 2011).

[2] 'Tweet'—Twitter (http://twitter.com) is a website, owned and operated by Twitter Inc., which offers a social networking and microblogging service, enabling its users to send and read messages called tweets. Tweets are text-based "posts" of up to 140 characters; a post is an internet message for diffusion on a group or to be stored and latter consulted. http://en.wiktionary.org/w/index.php?title=twitter&oldid=12705937; http://en.wiktionary.org/w/index.php?title=tweet&oldid=12977288; http://en.wikipedia.org/wiki/Twitter; http://en.wiktionary.org/wiki/tweet; (all pages visited May 31, 2011).

[3] Hoax—A plan to deceive someone, such as telling the police there is a bomb somewhere when there is not one, or a trick, example: The bomb threat turned out to be a hoax. Adapted definition of hoax noun from the Cambridge Advanced Learner's Dictionary, http://dictionary.cambridge.org/dictionary/british/hoax_1?q=hoax; A 'hoax' is a deliberately fabricated falsehood made to masquerade as truth. It is distinguishable from errors in observation or judgment or rumours and urban legends that are passed along in good faith by believers or as jokes. http://en.wikipedia.org/wiki/Hoax; http://en.wikipedia.org/w/index.php?title=Hoax&oldid=431465467 (pages visited May 31, 2011).

than ever at individual level, for example, when it comes to a job interview—in that situation, the prospective employer has to be convinced by the candidate that he or she is the best for the job offer [18–19].

2. Teaching-learning methodology: the 'Projeto FEUP' course

Given the importance for SSs at curricula level, FEUP [20] has decided to address this issue explicitly to all engineering students by means of an initial course named the 'Projeto FEUP' [21]. The aim is to maximize the efficiency of the learning experience among about the 1000 new students that the institution yearly receives.

The 'Projeto FEUP' is a normal course (Curricular Unit) transversal to all programmes that occupies 2 ECTSs[4] and is organized globally at faculty level. Main goals are to integrate students into working at the faculty and campus and to improve students' SSs (including communicational, team work, etc.).

Strategies for the course are initial training and latter team work for production of deliverables. Each of these deliverables targets the three very different types of communicational issues as follows:

- *Written Report*: The production of a healthy report is supposed to improve *scientific analysis* and allows a first approach at issues like structure of scientific reports, citations, info-literacy, ethics, plagiarism, etc.;
- *Poster*: A Poster is a frequent method for quickly presenting results transformed into visual stances. Visual Communication is demanding and requires *synthesis capability* to construct powerful figurative illustrations that summarizes complex issues (good, informative, trust worthy figures and charts, etc.);
- *Public Presentation*: An oral presentation (and associated preparation and support media) is important to disseminate results to large audiences (frequently followed by question and answer period).

This triple approach is supposed to cover a large spectrum of thinking and communication skills—write, organize and present (and defend) orally an adequate issue.

The summary for the workings of the 'Projeto FEUP' course are:

(i) To include all freshmen and be *team-work* oriented and include all types of integration—to minimize problems with massification of education;
(ii) Teams are constituted by unknown partners – to prevent alliances;
(iii) Course has an initial exclusive week plus half a semester along with other courses— in order to be initial and fast tracked;
(iv) In the initial week, students receive *training* in the three previously mentioned communicational issues (team work itself is not addressed in education time because students are supposed to already have that skill);
(v) During the remaining time of the course teams work in a *theme* proposed by a professor, imposed to the team; the *theme* should preferably be engineering programme oriented, interesting and challenging to newcomer students; strategically, *themes* are to be separable into two sub-*themes* to induce inter group curiosity and experience exchange;
(vi) Each team has a *monitor* (mentor) assigned to help the work— the *monitor* is an elder student, paid and trained for team management and integration issues, chosen to have a healthy speech and not be inaccessible;
(vii) The teams are to produce deliverables according to each communicational issue: *Written Report*, *Poster* and *Public Presentation* with discussion in a conference-like environment to a panel of three professors.

The difficulty level of the work in the *themes* and rigorous evaluation are of paramount importance for setting a high standard and still making the first course in university a positive experience.

The grading formula for the course is a sum of individual and team components. The individual component is related to performance during training period (that includes a short individual quiz). The team component is associated with the deliverables the team turned in and follows a rubric based scoring system known from start to students and professors. The final individual grade is calculated by adding an 'Individual Offset' to the score of the team that measures the commitment of the individual inside the team, amount and quality of work delivered. In order to improve transparency, peer evaluation is used twice during work time but the final grade is assigned by a professor.

3. Research methodology

The identification and characterization of what could be the most significant issues introduced by 'Projeto FEUP' in engineering students' curriculum related to SSs constitutes the main goal of this paper.

[4] ECTS—European Credit Transfer System, an European standard; for short and in this case, 2 ECTS mean 54 total hours of work in the course

The specific objectives are: (1) to evaluate the real importance of 'Projeto FEUP' to develop SSs, needed by engineering courses; (2) to analyse articulation between SSs developed during 'Projeto FEUP' and demands from other courses; (3) to assess importance given by students to SSs developed during 'Projeto FEUP'; (4) to identify possible improvements.

3.1 Research model

The model from Stufflebeam and Shinkfield [22]: Context, Input, Process and Product (CIPP), was used in order to evaluate the course. The special format of the course and planning decisions are used as an important part of the Context of the evaluation. A second dimension is Input dimension, namely the framework of 'Projeto FEUP' and broad organizational decisions. Third dimension focus on Process, as it ran 2010/2011 first semester. The last issue takes care of Product, in order to have a larger and integrated picture of the outcomes of the course. Table 1 summarizes the approaches for each level in the CIPP model.

3.2 Research implementation

The presented results refer to data gathered by two questionnaires answered by the student at the start of the course (September 2010) and at the end, after 6 weeks of work. The questionnaires were based in similar instruments used by the university. Annotated interviews were also conducted with: the coordinator of the course, three monitors (elder students) and three professors. Interviews were semi-structured in nature and based on a framework that emerged from the CIPP model. The presented data was gathered as a part of a larger study that aims to evaluate the effects of the introduction of the mentioned course at transversal curricula level at FEUP, including the applicability and usefulness of the learning outcomes of the course.

Both questionnaires were given to the same potential students of the course, namely those that are for the first time at the first year at FEUP in the scholar year of 2010/11, admitted from the first phase of national applications—such students are the vast majority and constitute the main target of the course.

The questionnaires were delivered in paper, in Portuguese language. The first questionnaire was distributed at the initial reception and answers gathered at the end of the same session. The second questionnaire was given at the end of the course and was distributed at the final conference where students made their Public Presentations. Answers were also gathered at the end of each session.

The first questionnaire dealt mostly with expectations and 649 answers were processed (out of 781 possible). For the second questionnaire, 506 answers were validated and processed; this latter questionnaire dealt mostly with learning and satisfaction of expectations. The answers of the questionnaires were anonymous but a 'key' was asked for matching both questionnaires to a unique subject and 206 associations were possible (the suggested key was mother's name and birthdate but this key was sometimes left blank).

As mentioned earlier, the questionnaires were built to evaluate students' expectations and learning, specifically Questionnaire 1 (Q1) asked: (i) gender, age, home distance and programme; (ii) previous transversal skills and (iii) expectations about learning in this course. Questionnaire 2 (Q2) asked about (iv) satisfaction of expectations; (v) fragilities and (vi) evaluation of the monitoring process used.

Questionnaires used a 5 level Lickert scale where, for each topic, the importance or agreement to a sentence was asked. Processing was done by optical scanning except for the association key.

Statistical data processing was made by using SPSS v.18 software package to produce frequently used statistics: histograms, dispersions, etc. To probe for significance of differences in data, the T Student test was used.

The interviews were analysed with N-VIVO8 software.

4. Results

The presentation of the results will follow the mentioned CIPP model, starting with *Context*.

Table 1. Information sources for CIPP model

Dimension	Descriptors / Indicators	Instruments
Context	Characterize students: study habits, team work habits, self-confidence in their skills like organizational or communicational	Initial and final questionnaires to students; semi-structured interviews with students, monitors, professors and coordinator;
Input	Implementation of the course, components and expected outcomes; *themes* for the freshmen teams to work on	
Process	Contents and Training execution: schedules; Work during formation week and work on *theme*	
Product	Students' Satisfaction; results; satisfaction of direct participants and other stakeholders	

About 1000 students entered FEUP into the first year of many programmes in year 2010/11 and most of the incoming students have the 'Projeto FEUP' course in their programmes and it seemed important to know the starting characterization of the population of the study.

The initial characterization showed that 47.5% of the students were away from home and planned for new lodging in the city of Porto and weekend trips back to family.

The vast majority of the respondents, 92%, had 18 or less years of age and that hints previous academic success.

Transversal skills were broken down into the dimensions listed in Table 2 that also shows specific questions about each topic. It can be seen that students perceive their organizational skills in high consideration and admit difficulties in some communicative skills. The same data also demonstrates that pure individual skills seem to not be perceived as a problem but if context issues and interaction with others are at stake, respondents admit fewer skills.

Another aspect perceived by professors and monitors is that there is a lack of maturity in the personal attitude of the students in their first week at FEUP as, somewhat frequently, students were distracted or absent minded during classes. This situation proved itself to be accurate as monitors (elder students) had sometimes to explain again what was to be accomplished by the students in a given practical situation that was supposed to have been previously prepared. This posture is not compatible with the attitude required to complete an engineering degree at FEUP. During an interview, Monitor M2 stated that 'some students didn't seem ready for higher education because they wore headphones during classes and meetings and didn't care much for what colleagues, monitors and professors had to say'. It would be interesting that this course was to put up-to-speed these students and make them understand the need for a different, more mature, attitude toward classes and academic work. Monitor M3 stated that 'the problem upon arrival at FEUP is the enormous amount of new information. . . it is not easy to absorb it all (. . .)'.

In what regards to the *Input* part of the model used for the research, the formal outcomes of the course 'Projeto FEUP' may be summarized as integration into FEUP's work spirit and potentiation of SSs – professional skills in the terminology of the EUR-ACE reference model. It was recognized by several parties that one of the key strategies of the course is to make students active by solving an assigned work over an adequate technical *theme.*

During the interview, the coordinator stated 'I would have liked to push work *theme* to a higher level of thought on the students' part in order to clearly push toward critical thinking'. Some other collected statements made clear that not all work *theme* were ideal to foster integration and SSs.

The questionnaires also showed that 23% of the students agreed completely that the work theme did NOT relate to the enrolled programme while 57% of the population disagreed with the same statement. An informal survey suggested that work *themes* not relating to the enrolled programme generates some dissatisfaction.

Regarding the *Process* of the research, several items were analysed, mainly regarding work volume and schedules because these items were seen as possible fragilities. Table 3 shows the statistics

Table 2. Students' self-perceived transversal skills at the beginning of the course

Team Work and Team Integration	Agree Totally	MidWay	Disagree
I work easily within a new team	75%	20%	5%
I am organized and work well even if others aren't	40%	47%	13%
I rather be told clearly what I am supposed to do	46%	32%	22%
Organizational Skills	Agree Totally	MidWay	Disagree
I organize myself so that I keep deadlines	81%	18%	1%
I make plans and get job done on time	78%	21%	1%
I am able to analyse a given work process and improve it	60%	37%	3%
Belief in own skills	Agree Totally	MidWay	Disagree
I like challenges to do things I don't master completely	53%	41%	6%
I easily find the essential of the subjects proposed to me	70%	28%	2%
I am used to identifying the weaknesses of my work	65%	28%	7%
Communication	Agree Totally	MidWay	Disagree
I can easily explain my point of view to an auditorium	44%	33%	23%

Table 3. Possible fragilities

	Agree Totally	MidWay	Disagree
It was difficult to find a schedule for work meetings	33%	30%	37%
Excessive amount of work was demanded	29%	42%	29%
The time available wasn't enough for the proposed work	23%	41%	36%
It was difficult to meet the expectations of all the courses together	24%	38%	38%

regarding data associated with addressed fragilities. About one third of the students admit difficulties in finding a schedule adequate to all members of the team (total agreement with statement shown). The same statement generated about 37% disagreement. A significance test was run and revealed that younger students agreed more to this possible fragility ($t = 2.3$ for $p < 0.05$).

Regarding the *Product* of the research, the following issues were identified: (i) the questionnaires' data regarding student satisfaction together with the (ii) results (grades) of the course also bearing in mind (iii) interview data. These information sources were organized to reveal possible changes at the SSs level.

Table 4 summarizes the results from the questionnaires of those that answer the two applications (testing the expectations and the satisfaction) and clearly shows very, very high expectations on behalf of most students (average above 4.1 on all items) regarding learning for this course. This eagerness is to be praised but satisfaction is mostly 'negative', that is, only in one topic students half agree that they had improvements in the topics addressed. Most likely, the lack of satisfaction is related to the high expectations and the fact that the 'Projeto FEUP' course is very short (has only 2 ECTS).

Further investigations revealed that females tend to agree more on satisfaction regarding items 'Written Presentations' and 'Citation and Referencing' ($t = 2.3$ and $t = 2.2$, respectively, for $p < 0.05$).

The final scores of the course run on an integer scale of 0 to 20 and can be found in Table 5. More than 84% out of the total of 781 students targeted by this study had a grade of 'good' or above, defined as having 14 or above. Table 5 also shows instinctively that students that took on the course seriously were able to get 'good' grades and less than 2% didn't get approval (approval is grade 10 or above).

Details about grading in the course are summarized in Table 5. It can be seen that averages for the evaluation of the *poster*, *oral presentation* and *report* are all above the 'Good' threshold but there were still a few very low grades. The deliverables of the team are public teams show a certain proudness in 'showing-off' their work.

All participants in the process found the work produced by the students overall satisfying. The Coordinator stated that '. . . most students didn't find the work uninteresting (. . .) and produced some results'. Professor P1 mentioned 'I liked the work my students produced. They learned many details regarding poster, presentation and report (. . .) even if some of them didn't find them overwhelmingly relevant'. Monitor M1 also said: 'the students were very happy with their oral presentation (. . .) the professor and I agreed that they did well'.

Table 4. Statistical comparison for students' expectations and their satisfaction: 1 = disagree ... 5 = agree

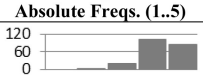
Items	Expectations		Satisfaction		T-Test ($p < 0.05$)
	Avg.	Histogram Absolute Freqs. (1..5)	Avg.	Histogram Absolute Freqs. (1..5)	
Contribute to improve organization skills	4.21		2.76		29.7
Contribute to improve report writing skills	4.37		2.74		23.8
Contribute to improve oral presentation skills	4.40		2.42		26.0
Contribute to improve written presentation skills	4.20		2.58		23.1
Contribute to improve citation and referencing techniques	4.12		3.24		13.0
I learned things useful for other courses	4.44		2.72		22.3

Table 5. Statistics regarding student final grades

	Individual		Group			Individual Offset (to be added to the grade of the group)
	Mid Term	Attendances	Poster	Oral Present.	Report	
Weigh ($\sum = 20$)	2	1	4	5	8	+/-
Range	*0..20*	*0..8*	*0..20*	*0..20*	*0..20*	*-17 to +17*
N = 781	764	770	130	130	130	340 (non-zero) / 781
Max	17.7	8	20	20	20	2
Avg	13.0	6.6	15.5	16	16.75	-0.5
Std dev	2.0	1.5	2	2	2.25	3.2
Min	9.6	0	6.0	5.2	10	-17

The Coordinator mentioned also that some of the final reports still didn't have the necessary quality and training 'has to be even more effective' in this topic that he considers as most important. It was also mentioned that making these skills transversal is a key issue to produce a beneficial effect on the academic career of the student. Other statements from professors and monitors point out the need to follow-up on the skills addressed in this course to others. About this issue, the coordinator stated 'I would like the professors of a given programme or department to contribute to shape-up students to be ready for other courses (of the programme and or department), that is, to promote the development of skills needed elsewhere'. On a similar subject, Monitor M1 stated clearly that 'Students will need to produce Scientific Reports and Posters in many other courses during their academic life. The gathered experience right from start will benefit them'. Still on the same issue, the Professor P1 mentioned 'when they get to the fourth or fifth year[5], then, at that point, students will be faced with the dire need for correct referencing and the need for a formal study of the structure of a report—only at that point will they really think about such issues; (. . .) regarding the production of a poster, that will most likely only be needed again near the end of their degree'.

An interviewed Monitor stated 'I think they learned a lot. Maybe not all things . . . but that is to be done over time! Even they, themselves, won't know if they learned anything or not until a reasonable amount of time has elapsed'.

Another Professor, P3, mentioned 'not all professors follow the ideas presented (. . .) this necessarily means something is wasted', thus hinting that usefulness could be further improved. The last item of Table 4 shows that students are also aware of this issue.

4.1 Findings and discussion

The discussion of the results shown in the previous section will also follow the mentioned CIPP model, although some discussion is not separable into components.

The main findings for the *Context* part of this study that Projeto FEUP must deal with a very large number of students and consequently a large diversity of Soft Skills levels are to be expected. Even though they state otherwise, student's SSs are not as developed as they state about themselves, mainly because they were used to a lower set of criteria. Therefore, all SSs need to be promoted in order to level knowledge upwardly. Among other issues, 'Projeto FEUP' is expected to lessen the diversity, make personal inheritance less important and contribute to curricular fairness [23].

With respect to the *Input* of the research, the findings include that foundations for 'Projeto FEUP' are based on technical team work and production of different persistent communicational deliverables, useful to promote SSs development.

Due to the diversity of *themes* inside a single programme and given that the final presentation was in conference style, this moment for presentations (talks) was yet another enriching experience for newcomer students. Some of the parties involved considered that the work *theme* was not always adequate and not always on the subject of the programme and informal reports indicate this leads to some dissatisfaction. However this issue goes in the opposite way to the initial ideas of Projeto FEUP regarding the need for problem solving that knowledge society now demands [11].

Given the importance of the goals at stake and the difficulty in their promotion, it seems validated that this course should be initial and mandatory. It does not, however, validate its low ECTS count. One of the difficulties encountered is that intermediate leaders have not yet acknowledged the importance of the addressed issues. Some intermediate leaders in the departments and programmes are somewhat reluctant to accept a transversal course. That reluctance has to do with the fact that if the course is transversal to programmes, it may not ensure adequate scientific content (in the opinion of these reluctant parties).

Regarding the *Process* part of the research effort, some fragilities were studied like problems in scheduling of meetings, total work volume for this course alone and problems with overall simultaneous workload of all courses in the programme.

Benefits of the central organization of the course were also identified such as efficiency of scarce resources and more efficient secretarial work for example, in hiring students and organizing the final conference. The central organization seems valid despite minor control quarrels.

Reports from some parties state that students tend to spend much more effort than 2 ECTS of the course, which is an initial decision. If this is so, the course should have more ECTSs and to improve efficiency of work, schedules of all team members should be even more compatible to lessen this fragility. This is of the utmost importance given the multiple interfaces that SSs have been shown to have (Fig. 1) and the context of the EUR-ACE framework for accreditation of engineering curricula [10].

The *Product* of the research includes student satisfaction, with unrealistic initial expectations that were, of course, not met. Students admit the

[5] Most programmes at FEUP are integrated masters in engineering, with duration of 5 years

benefits of some topics that are 'new' to them like referencing and citation techniques.

Other stakeholders in the process are generally happy and saw the evolution of the students. This external evaluation is more trust-worthy than self-perceived assessment because external references are generally more stable and more accurate. Apparently, students are not that well in terms of SSs as they perceive themselves to be. There are reports that state that the final written report should have better quality than it has and evolution in students' attitude is also reported.

Students produced work with some quality as the results of the course demonstrate (generally high grades) and full proof is that conference talks also have high grades and these are graded by a panel of three professors. Other findings include that usefulness for other courses could be improved.

A detailed statistical analysis based on cross testing individual variables found correlation in the initial questionnaires tends to be much less important in the final questionnaire—this means less diversity and is likely to be a product of the development of having lived half a semester in a higher education institution (including the 'Projeto FEUP' course).

5. Future issues and final conclusions

Throughout this paper, the 'Projeto FEUP' course and its implementation has been presented and debated. One of its main purposes is to promote the development of SSs.

Engineering accreditation agencies emphasise that SSs are very important. Studies have proven these skills to be the initial basis for deeper knowledge and contribute to academic success. The present work is also expected to have provided more information regarding: the importance of SSs for academic work and throughout life; the importance of developing SSs at an early point in the Engineering programmes and Curriculum design when planned for a large amount of students of different programmes and where a single technical area is not at stake.

Since this research project examines the 'Projeto FEUP' course in its several dimensions, in search of evidence of opportunities and fragilities concerning SSs development while also trying to answer the question: to what extent does course 'Projeto FEUP' effectively promote the development of SSs?

The first finding is that (1) students have high expectations about their learning in Higher Education Institution such as FEUP but their satisfaction is not high—this is due to the fact that the course is initial and very short. Another finding is that (2) results indicate that SSs are in fact improved—high grades in academic assessment and high satisfaction on all stakeholders – this reinforces the trends found in cited literature. The third result (3) shows that SSs have a transversal character: opinions gathered hint that there is long term usefulness for other courses —admittedly, however, it is difficult to ascertain the impact at the level of the overall engineering degree. Finally, (4) some parties may not be fully aware of the benefits incurred and may be unwilling to credit them to the proficiency in SSs nor to the 'Projeto FEUP' course. Such unwillingness may be a residue of an elitist approach to HE that further elevates the importance of SSs in massified HE programmes.

The social construct of the course seems to be somewhat proven and learning outcomes achieved but the results seem not to be as useful as they could because of some lack of vertical coordination within the various programmes. The (Soft) Skills improved by the 'Projeto FEUP' course need to be continuously addressed and continuously improved throughout the entire programme in a consistent manner in order to maximize usefulness—these steps are to be the initial foundations for deeper knowledge in many aspects of the students' life.

However, some professors seem not to be interested in the development of 'Projeto FEUP'. The main reason is that they consider their own technical disciplines more important and starting point courses are of minute importance. As described by Emilsson [2], in such situations, it is difficult to dedicate ECTSs to the purpose of SSs enhancement.

Suggested improvements for the course include suggestions at three levels. Firstly, at curricula design level, suggestion are to address a broader set of SSs; addressing them separately; increasing the number of ECTS of the course; improving vertical coordination within programmes. Secondly, at an individual level, suggestions include making sure continuous improvement in this area is stimulated (and cared for). Finally, at institutional level, it was identified as very important that the development of SSs requires the full engagement of the intermediate levels of leadership and all professors that take part in the course. As mentioned, it would be adequate that 'SSs' were to be promoted during the entire programme, with endeavours such as, for instance, Writing-Across-the-Curriculum [24].

From the presented discussions, it follows naturally that SSs are very important for engineering degrees as is clearly recognized by the ASEE in their ''Attributes of a Global Engineer'' document [25] and there is still a long path to travel regarding the global acknowledgement of the relevance of the SSs. It is the responsibility of the institution to make sure that their training models are framed on the promo-

tion of the mentioned skills that seem to be of high and hard importance most likely for all technical degrees.

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