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Teaching Emotional Intelligence to Computer Science students

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Abstract— In this paper we present an experiment in which a competition is used in an attempt to motivate Emotional Intelligence in Computer Science students studying the subject of Databases. Computing professionals are, on an ever-increasing basis, being requested to acquire emotional skills in addition to, or even before, acquiring technical knowledge. The skills needed to work in a team or to speak in public, to attain leadership capacities or to adapt to change are important requirements in perhaps any job. However, these types of skills, which are characteristic of what is denominated as Emotional Intelligence, become indispensable in the profile of a Computer Engineer. This type of professional will have to work in a group, have to confront the project management, give talks and, which may be the most difficult, keep up to date with a technology whose new advancements will be obsolete in scarcely five years. Nevertheless, and in spite of the importance of this type of skills, Emotional Intelligence continues to be a subject which is pending in Computer Science students' curricula.

I. Introduction

THE classic teaching system used in Spanish universities does not appear to be the most appropriate method by which to transfer to students a type of knowledge that is increasingly considered to be important to the education of our future professionals. It involves, on the one hand, inverting the student's passive role such that it is the student who teaches him/herself. It must be borne in mind that teaching is not only the act of transmitting knowledge, since this would imply that the person learning plays a passive role, and this is not desirable, particularly when considering the current amount of information in any area of knowledge, and more so in the area of Computing.

Furthermore, and in addition to encouraging students to participate in their own learning, it is a question of fostering a series of skills (which could be referred to as emotional skills) in them which will allow them to better manage professional conflicts and problems, to make decisions, and to improve team work or leadership skills, etc.

European university teaching guidelines also point in this direction. Spanish universities have begun to make tremendous efforts to comply with the adaptations presented in the Bologna Declaration [9], one of the principal changes consisting of the concept of ECTS credits. A credit is currently measured by the number of hours taught by a professor during which the student is not a mere passive receptor. The ECTS credit is, however, a measure of the student's effort which includes not only the amount of time spent in academic classes, but also the time that the student needs to study the subject, research time, bibliographies, seminaries, etc.

In order to benefit the student it is necessary to pay attention to aspects which are not only intellectual, but also interpersonal and affective-motivational, since these dimensions concur in the student's output and personal motivation, and may affect the social climate of the class [12]. Nevertheless, and in spite of the importance of this type of skills, Emotional Intelligence continues to be a subject which is pending in Computer Science students' curricula. To address this issue, this work presents a competition-based experiment to train Emotional Intelligence in Computer Science students

The remainder of this paper is structured as follows: Section 2 goes deep into the problem addressed in this work; Section 3 describes a system of practices used in the Databases course of the Computer Science degree at the University Rey Juan Carlos, Spain, in which the types of skills that the system attempts to train are specified. Section 4 shows the results of the evaluation of the method through a survey of the subject's professors and students. Finally, in Section 5, we provide our principal conclusions and provide directions for future improvement.

II. Problem Analysis

The new tendencies in the domain of psychology term interpersonal and affective-motivational as emotional intelligence [6][10][20][15][24], and according to experts when its quotient is united with the intellectual quotient, it determines those students who will really triumph in their profession. In his book 'The Practice of Emotional Intelligence', Goleman explains that *"Academic learning serves to differentiate 'star' workers in very few of the five* or six hundred case studies related to competence that we have carried out. [...] What are really important to superior

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performance are the skills typical of emotional intelligence", ([12], p. 39). The hundreds of experiments carried out by Goleman also allow us to conclude that social skills are particularly relevant to programmers: *"One of the fields in* which emotional intelligence curiously has most bearing is in that of computer programming, a field in which the efficiency of the elite who occupy the highest 10% is 320% greater than that of average programmers, which in the case *of the 'rara avis' who make up 1% of the total reaches 1,272%!"*, ([12], p. 62).

In addition to training the student in the curriculum that is appropriate to each subject, one of the general objectives of university teaching, which is therefore common to all subjects, should be to train the student's emotional intelligence, since this would appear to be one of the greatest lacks in computer technicians [12]. Goleman points out that this training is fundamental in universities in which these techniques should be taught. *"All this evidence has spurred* universities on to ensure that new engineers and scientists who access the working world are more competent in the *field of emotional intelligence… Until now, the training of* engineers has not included this type of skills, but we can no *longer afford to do this"*, ([12], p. 74). One of the most significant pieces of data amongst the many provided by Goleman to support his thesis concerns the words of John Seely Brown, R&D director of the Xerox Corporation, in Silicon Valley, who states that: *"In all my years here I have never looked at anyone's university records because the two* skills that we most value are intuition and enthusiasm. We seek daring *people, who are bold but sure of themselves"*, ([12], p. 74).

The Northwest Missouri State University introduced a computing curriculum evaluation system in which the skills expected from computing graduates are stressed [13]: solid technical knowledge in computing; good communication skills, the ability to work well in a group; good problem solving skills; a high level of satisfaction with the computing programme of the university at which they are educated.

The need for this type of skills is also highlighted in the more recent report *"Future skills for tomorrow's world"* [8], in which the principal European companies[1] related to ICT (Information and Communication Technology) state the professional profiles that they require. The project, which is sponsored by the European Commission, stresses the need for professionals to be creative and artistic; enthusiastic about technology; to have mathematical and scientific knowledge; to have good communication skills; to be able to deal with people and to wish to work as part of a group.

The report also details the technical skills that are required (of which the concepts of DB are stressed) in addition to behavioural skills (which correspond with the emotional skills of Goleman): Analytical, Attention to detail, Commitment to excellence, Communication, Initiative, Creativity, Orientation towards the client, Leadership, Risk management, Negotiation, Persuasion, Capacity to relate to others, Strategy and Planning, Working in a team and Technical Orientation and Interest.

All of the aforementioned issues have led us to the conclusion that training students in this type of skills and emotional competences that will be definitive when entering, remaining and triumphing in the working world should be a priority objective. However, the majority of international curricula [13][14] do not propose subjects that explicitly train students in these competences, and Spanish universities in particular do not do so [3][21]. We therefore consider that it is essential to incorporate didactic practices that will allow students to be trained in this type of skills into the educational methodology of our subjects.

III. Learning Databases and Emotional Intelligence

It would therefore appear to be clear that it is necessary to train our students in the skills involved in emotional intelligence. Given that specific materials for this type of aptitudes do not exist in our curricula, it would seem advisable to include their training in the educational methodology of a purely technical subject. Many of us have already been doing this in one way or another, although perhaps not in a totally conscious manner, by including group works, oral presentations, seminars, etc., in our subjects.

Our approach has attempted to incorporate this type of training into the subject of Databases (DB) in a more direct manner since the contents of this subject could, a priori, be considered to be purely technical. We have done this by turning the practical aspects of the subject into a competition in which the students have to pass a series of tests. The intention of each test is to train a type of skill, and points are obtained for each activity. The points obtained at the end of the course will be included in the students' final course marks.

The following subsection provides a summary of the principal emotional skills which, according to Goreman, should be trained, highlighting those that we consider to be of particular relevance to Computing Engineers. The characteristics of the competition and the evaluation system used are then detailed in subsection II.A.

A. Desirable emotional skills in a Computing Engineer

Goleman [9] divides the framework of emotional skills into two types of competences: personal which determine the way in which we relate to ourselves, and social, which determine how we relate to other people.

In order to perform our profession in an exemplary manner it is only necessary to be skilled in some of the competences that are listed (approximately 6 out of a total of 25) and those competences that are necessary depend on the profession in question.

[1] IBM Europa, Nokia Telecommunications, Philips Semiconductors, Thomson CSF, Siemens AG, Microsoft Europa, British Telecommunications PCL.

Goleman divides personal competences into:

- Self-consciousness: emotional consciousness, appropriate evaluation of oneself and self-confidence.
- Self-regulation, which covers the competences of self-control, trustworthiness, integrity, adaptability and innovation.
- Motivation: motivation to achieve, commitment, initiative and optimism.

There is no doubt as to the importance of educating students in all these aptitudes. Firstly, so that they will successfully complete their university studies, and also so that they will later perform successfully in their chosen professions. Bearing in mind the profession for which they are being educated we believe that it is particularly necessary to educate students in the capacities of adaptability and innovation within the competence of self-regulation, since during their professional lives they will have to confront significant changes in technology.

Moreover, and owing to the fact that they will generally have to work in a group, it is important to train the aptitudes of commitment and initiative within the competence of motivation. It is equally important for the student to develop positive self-esteem, and to learn to value him/herself.

We believe that one way in which to train the capacities of innovation and adaptability is to explain the concepts independently of the products or concrete syntax of a determined language. It should be the students themselves, through the use of manuals and tools, who tackle the learning of the products or concrete languages that they will have to use. Moreover, practical work will be proposed which will include the use of the most recent products, such that it will be the students themselves who have to confront technological problems which have yet to be resolved and about which, in general, little or even no documentation exists.

Regarding social competences, Goleman divides them into:

- Empathy, in which we find: understanding of others, orientation towards the service, making good use of diversity and a political conscience.
- Social skills: influence, communication, leadership, catalyzing change, collaboration, and cooperation and team skills.

Of the social skills listed, we believe that it is of particular interest to train understanding of others and orientation towards the service, from the competence of empathy, which will permit, among other things, a better understanding of the user, one of the key problems in the development of the computing profession. Within the social skills, collaboration and cooperation are necessary, as are team skills, which are also stressed as being a priority for computing graduates, along with communication [18][19][25].

Goleman emphasizes that the skills which mark the difference in the field of computer programming, *"are not* strictly technical but are rather related to the capacity to *work in a team. […] To summarise, they are people who do not compete but who collaborate"*, ([12], p. 62).

We therefore believe it to be opportune to combine individually diverse instructional group approaches (presentations, group projects). These activities will train the development of social skills: the organisation of work in a group, the expression of ideas in public, active and empathetic listening, knowledge of how to ask questions and ask for help, or how to negotiate and integrate ideas. We also believe it to be important to evaluate not only the end result obtained but also this type of more subjective skills such as the capacity to work in a group.

B. An emotional education experiment

In order to train some of the emotional skills that are considered desirable for all Computer Engineers, we decided to test a new system for the realisation of theoretical and practical exercises in the DB course taught at the fourth year of the Computer Science degree at the University of Rey Juan Carlos. This system consists of a competition in which the students, via a series of both theoretical and practical tests, obtain points. The students' final marks are then calculated according to the final exam and the points obtained at the end of the course.

C. Characteristics of the course

The course is four months long, it is mandatory, and a total of 6 credits can be obtained from it (3 for the theoretical part and 3 for the practical part). It is important to emphasize that the students have previously taken the course on DB Design, which is also mandatory, and in which they have studied the basic principles of DB: the concept of DB and DB System Management, relational models and entity/inter-relationship (E/R), relational DB design, normalization theory, and DB security. They have also used CASE tools to design relational DBs.

The syllabus for this course therefore consists of advanced concepts of DB models: object-relational (OR) models, including active DBs and object oriented (OO) design of ORDB and relationships with the UML (Unified Modelling Language), [2][4][5][7][26]. The students work with Oracle, and always use the most recent version of the product (the 2010/11 course, with whom this experiment was carried out, used Oracle 10g). Given the speed with which DB technology advances, the principal objective of this subject is not so much that the students learn a specific DB model, but rather that they learn to use new concepts and new technology, and that they are capable of reasoning and designing different models, thus making the students capable of thinking at a higher level of abstraction which will facilitate their future ability to adapt to new models and technologies that will certainly appear.

Moreover, the practical exercises were not as guided and as determinist as in previous courses. By contrast, students have to confront problems that have not been resolved in class (in either text books or in the subject's basic

bibliography). They are thus obliged to play around with syntactic constructions and look for solutions in manuals, on the Web, etc.

D. The dynamics of the competition

Those students who decided to participate were grouped in teams of 6 or 7 people. Participation in the competition was not obligatory and the decision to participate was left to each student. Those students who did not take part in the competition did the final exam without accumulating any extra points, and their final marks depended exclusively on the exam, which was marked in the normal manner (between 0 and 10 points).

A series of tests were carried out, details of which will be shown as follows. Each test had a value. According to the marks accumulated, each team obtained a final result which would be used together with the mark obtained in the final exam, to obtain the student's final mark. That is to say:

FINAL MARK = CP + EM*(10-CP)/10

where EM is the mark from the individual exam and CP are the points obtained from the competition. These points range from 0 to 5 (the winning team received 5 points and the other points were proportional to the results obtained).

TABLE I.
TESTS SUMMARY

Test	Operations	Marks	Objectives
P1. Theory: OODB, Objects, ORDB	A series of questions are presented. The students are given 45 seconds to write answers to them.	Group 1: 3 pts Group 2: 2 pts Group 3: 1 pt	• To check the students' understanding of the theoretical themes. • To consolidate concepts. • To discover gaps and failures in explanations.
P2. Theory: OO Conceptual Modeling, OR Model, Active DB	A series of questions are presented. The first group to answer gains 2 points. If the answer is incorrect, 1 point is deducted.	Group 1: 5 pts Group 2: 3 pts Group 3: 1 pt	In addition to the objectives of the previous test: • To promote the groups' agility and mutual understanding.
P3. Exercises: UML Conceptual modeling	An assignment is handed out. Each group must submit the solution to a UML design in a maximum of 30 minutes. Only the first 3 groups to submit the correct solution will receive marks. If an invalid solution is submitted, the group will be eliminated.	Group 1: 5 pts Group 2: 3 pts Group 3: 1 pt	• To check the students' understanding of UML and conceptual OO modelling. • To train the students in the high level OO design.
P4. Presentation: DB/WEB/XML	Each group prepares a 5-minute-long presentation about a theme proposed by the professor (in this case, any theme related to DB, Web and/or XML –Extensible Markup Language-). The group decides who will give the presentation. The presentation must be based, at least, on the consultation of a BOOK. The marks are awarded by votes from the students and the professor. Two sets of marks are awarded: those of the students and those of the professor with the intention of correcting any deviations caused by affinities among students.	Students: Group 1: 4 pts Group 2: 3 pts Group 3: 2 pts Group 4: 1 pt Professor: Group 1: 4 pts Group 2: 3 pts Group 3: 2 pts Group 4: 1 pt All those who give presentation: 1 pt	• To train the students to search for and consult documentation. • To train the students' critical capacity by having to select a bibliography and focus on a theme. • To train the students in the capacity of synthesis (5 min presentation). • To get the students used to speaking in public. • To train the students' critical spirit when having to judge the work of other colleagues; their colleagues' mistakes will serve as a mirror. Being judged by their colleagues stimulates their interest.
P5. Practical Practical 1: Object Types Practical 4: Triggers	An assignment is handed out. Each group has only one opportunity to submit an answer. There is a time limit. Only those groups that submit the correct solution will receive points.	Group 1: 4 pts Group 2: 3 pts Group 3: 2 pts Rest: 1 pt Group with incorrect solution: -1	In addition to the learning objectives of the concepts in the contents of the practical exercise:: • Getting used to confronting an unknown product. • Getting used to searching for and consulting documentation in order to solve problems related to syntax and programming.
P6. Practical Practical 2: REF Types Practical 3: Collection types	An assignment is handed out. Each group has only one opportunity to submit an answer. There is a time limit. Only those groups that submit the correct answer will receive points.	Group 1: 5 pts Group 2: 3 pts Group 3: 1 pt	In addition to the learning objectives of the concepts in the contents of the practical exercises and the objectives of the previous practical exercise: • To promote the groups' agility and mutual understanding (task sharing, etc.).
Complete exercise	The students must complete an exercise in which they summarise and integrate the list of themes. This is carried out in various tests which are detailed as follows.		• To revise, consolidate and integrate concepts. • To train the students in the design and implementation of an ORDB, from the requirements capturing stage.

Test	Operations	Marks	Objectives
P7. Requirements	The students must write a requirements specification from the user requirements (the professor acts as the user). They have the whole class to complete this test (2hrs). The specifications are submitted, and only the best will receive points (in the case of a draw, various groups receive points	Group 1: 3 pts	• To get the students used to confronting an unspecified problem. • To train the students to deal with users.
P8. Conceptual modelling	The winning specification from the previous test must be used to create a conceptual UML model. Each group will have 45 minutes to obtain a solution. Each group will be split into two sub-groups, and will be mixed such that each of these groups will be formed from the members of the two initial groups. The new groups must find a solution from the two proposals provided. They will have approximately 45 minutes in which to do this. Three ratings bands will be established, and each solution will be in one of the bands.	SG- SubGroup The 2 SG in Band 1: 5 pts 1SG. in Band 1 and 1SG. in Band 2: 3 pts 2 SG in Band 2: 1 pt	In addition to the objectives of conceptual modelling: • To foment the working of the group as a whole. • To promote negotiation skills and the capacity to find solutions. • To get the students used to defending their points of view in the face of contrary viewpoints, and to make them capable of adopting better viewpoints if convinced by them.
P9-P10: OR & relational Design & Implementation	The best conceptual model from the previous test will be used to produce an OR design in UML for Oracle and its compilation. Time bands of 30 minutes will be established. Each group will have only one opportunity to submit an answer, and only those which are correct will receive points.	G in Band 1: 3 pts G in Band 2: 2 pts G in Band 3: 1 pt	In addition to the logical design and implementation themselves: • To acquire agility and skill in OR design and the use of the OR product.
Comparison	The students will make a comparison between the relational solution and the OR, indicating the advantages and disadvantages of one or the other, along with the possibility of uniting them with another solution or of creating a mixed design.	The best comparison(s): 5 pts	• To train the students in the critical capacity of making decisions regarding design and technology.

IV. Results and Lessons Learned

The experiment was begun, and was refined throughout the course using the professor's impressions, and the students' comments and suggestions as a basis for this.

Moreover, in order to obtain a more complete evaluation, the students were asked to fill in a survey at the end of the course. This survey was anonymous and of a voluntary nature. Its intention was to discover the students' impressions of how positive this learning system was, and to improve it in accordance with their comments and suggestions. Of course, this survey fundamentally served to complete the subject professor's impressions.

The survey consisted of 12 questions in which the students were asked their opinions of how the new system of practical exercises had affected their development in the subject as regards aspects such as their attendance and participation in class, continuous follow-up and a better understanding of the subject, the realisation of practical work and exercises and their agility when doing so, their better understanding of the theme, their general interest in the subject, team work, the search for documentation, and having to confront new technologies and products, etc.

The students had to respond on a scale of 1 to 7 (from least to most positive). Figure 1 shows the main results gathered about the evaluation of the method.

Broadly speaking, the marks were divided into 7, 6, 5 (the effect has been positive), 4 (there has been no effect), and 3, 2, 1 (little or no positive effect), and the general result was satisfactory. Almost all aspects were considered to be positive. The most highly valued aspects (above 4) were in the following order: the aspects related to the system of practical work made the subject enjoyable; the system contributed to and incentivised the realisation of practical work and exercises in class, and it contributed towards incentivizing and improving teamwork. Amongst those aspects which were most highly valued were also those related to a greater participation in class in all aspects (attendance, participation in classes and following the subject).

According to the professor, the students' participation in class rose very significantly, thus making the classes much more enjoyable and dynamic. This is perhaps the most outstanding benefit of the experiment.

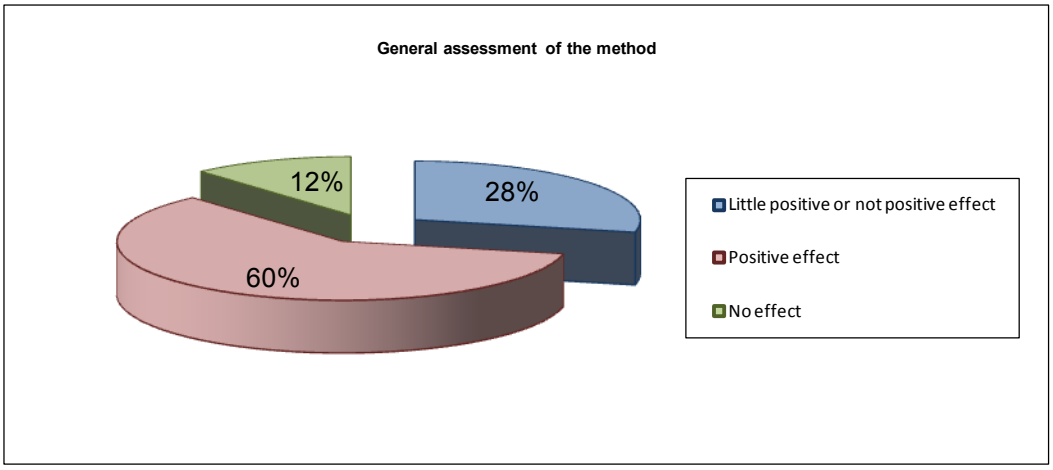

Fig. 1. Overall assessment of the method

Class attendance became more homogeneous as the course progressed. There was an important increase in the number of students who did the exercises and practical work proposed in class: in previous courses, when the professor had proposed an exercise in class, it was perceived that only a highly reduced group of students really made an effort to think about it; however, upon rewarding agility, the majority of the students made an effort to think of solutions. In spite of the fact that some of the students felt that more time was consumed, it also meant that more exercises were done than in previous years.

The fact that some of the students in the group did not work, and took advantage of the others' efforts, is a disadvantage which has no solution and which always occurs with group work (irrespectively of whether or not it takes place as part of a game). The correcting factor for this type of problem is the final exam mark, which is individual.

Another of the aspects that was criticised by some students was the competitive nature of some of the tests.

We estimate that competitiveness is, to a certain degree, positive and we have certainly noted this. It stimulates the students to work and make an effort in order to look good in front of their classmates, and this has also made some students stand out. The competitiveness was, moreover, among groups and not individual, which contributed towards improving teamwork, one of the objectives pursued. However, it is possible that the fact of having only one winning group might have incited excessive competitiveness. We believe that there is a simple solution to this problem: the groups should accumulate points, and non-exclusive bands should be established (as occurred in the later tests). All the groups in a particular band would therefore receive the same amount of points from the test.

Some students criticised the fact that speed was rewarded. We believe that it is good to maintain the agility factor, although it would be possible to reduce the weight of the tests by, for example, including only one activity of this nature or by using bands in the marking scheme.

Another aspect that we consider to be positive is that the system allows continuous evaluation to be carried out in classes with a high number of students (we refer to around 100 students).

V. Conclusions

This paper summarises an experiment that was carried out in the DB course of Computer Science at the University of Rey Juan Carlos. The intention of the experiment was to train students in certain emotional skills in addition to the intellectual skills that the subject implied. This was done by carrying out the subject's exercises and practical work in the form of a competition which allowed the students to accumulate points towards their final mark.

The main advantages of this system are: it foments the students' participation and their continual following of the subject; it permits evaluation throughout the course, which does not occur with the exam system; it foments both class attendance and teamwork.

However, the survey given to the students has highlighted some aspects that must be adjusted, of which we can emphasise the excessive competitiveness with which the competition was run, and the weight given to the agility factor.

In the current course we are trying to carry out the experiment with the inclusion of the modifications stated in Section 3 in order to eliminate these problems.

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