DEVELOPMENT OF MULTIDISCIPLINARY PRACTICAL LESSONS THROUGH RESEARCH-ACTION METHODOLOGY IN THE FACULTIES OF COMPUTER SCIENCE AND EDUCATIONAL PSYCHOLOGY

Maria Luisa Pertegal Felices [1], Ignacio Javier Navarro Soria [1], Antonio Manuel Jimeno Morenilla [2], David Gil Mendez [2]

[1]Departamento de Psicología Evolutiva y Didáctica. Universidad de Alicante (SPAIN)
[2] Departamento de Tecnología Informática y Computación. Universidad de Alicante (SPAIN)
jimeno@dtic.ua.es, ignasi.navarro@ua.es, jimeno@dtic.ua.es, dgil@dtic.ua.es

Abstract

Computer science studies possess a strong multidisciplinary vocation; most graduates do their professional work elsewhere of a computing environment, in collaboration with professionals from many different areas. However, the training offered in computer science studies lacks that multidisciplinary, focusing more on purely technical aspects.

The campus, a place where studies of very different nature exist side by side, may constitute an excellent basis for conducting multidisciplinary training without underestimating higher education rigor. The aim of the universities is to train their students in the skills demanded by businesses and companies. According to experts, students need to develop more the skills called generic in which can be found the interpersonal skills.

This paper presents a good example where computer studies and educational psychology find out a common ground and realistic working through laboratory practices.

Specifically, the work enables to students of computer science education the development of diagnosis support systems, with artificial intelligence techniques, that could then be used for future educational psychologists. The applications developed by computer science students is the creation of a model for the diagnosis of pervasive developmental disorders (PDD), sometimes also commonly called the autism spectrum disorders (ASD). The complexity of this diagnosis, not only by the exclusive characteristics of every person who suffer it but also by the large numbers of variables involved in it, requires a very strong and closed interdisciplinary participation. Moreover, for the enhancement of this software (and especially for the collection and creation of the database) it has been required the creation of a working framework which involves doctors and families, as well as those students of computer science and educational psychology already mentioned. The final purpose of this tool for the diagnosis is its applicability in primary schools to increase the early detection and diagnosis.

Meanwhile, students of educational psychology incorporate their knowledge to adjust the computer application successfully, incorporating it the qualitative and quantitative information needed for verification. As a result of this synergy, a good interdisciplinary teamwork has emerged, closer to the real world than the university and which all would be enriched.

In this sense, this work demonstrates that it is possible to intervene in a curricular perspective, in the university, to promote the development of interpersonal skills. It can be shown, in this way, a methodology for interdisciplinary practices design and a guide for monitoring and evaluation.

Keywords: multidisciplinary research, interpersonal skills, technology applied to pervasive developmental disorders, bioinspired systems modelling.

1 INTRODUCCIÓN

The new skills that companies require to the IT professionals are related to the management of technological equipment. In addition, they require new knowledge, social and emotional skills, strategic, organizational and planning capacities, etc. Among all of these generic skills, one of the most valued is teamwork [1].

The search for the best performance of employees in their workplaces has led to research the skills which the most successful employees have in order to increase business performance. In the analysis of these skills several authors [2, 3, 4] have concluded that the intelligence, not only general but also the socio-emotional and personality factors are part of the complex set of skills needed by people to develop their professional success. The relationship between interpersonal skills and performance has been supported by numerous studies, most notably the work of Koman and Wolff [5].

Some studies emphasize that a person's ability to adapt to the environment could be determined by the domain of interpersonal relationships and the ability to work with professionals from different fields and areas [4, 5, 6].

On one hand, a good adaptation could be the reason of job success. This is indicated by studies by Møller and Powell [7]; Rozeil, Pettijohn and Parker [8]; and Sjöberg [9], in the work world; Culver and Yokomoto [10]; Lam [11]; and Parker [12], in the education field; and Ciarrochi, Deane and Anderson [13]; Parker, Taylor and Bagby [14] and Salovey [15] in mental health. On the other hand, a bad adaptation could have negative labour consequences, such as the well known burnout syndrome, where a good stress control or other emotional variables could avoid or reduce the stress states or depression in the workplace. This is demonstrated by several studies which analyze and relate to these variables in different professional fields [16].

In education, the Bologna Declaration, which sets out the approaches towards creating a common European Higher Education Area (EHEA), "emphasizes the importance of education in terms of the acquisition by the student of capacities, abilities, skills and values, assuming a new approach geared to the learning of skills, including interpersonal relationships; and the project *Tuning Educational Structures in Europe* [17], which is funded by the European Commission under the Socrates Programme, it develops job profiles, learning outcomes and skills in terms of generic and relating to each area of study. Some of these skills are referred to social skills related to interpersonal skills as the ability to work as a team.

Professionally, it has been developed the Career Space Project [18], with the support of the European Commission. This project was created by the Career Space consortium which consists of eleven large companies of information technologies and communications (ICT)-BT, Cisco Systems, IBM Europe, Intel, Microsoft Europe, Nokia, Nortel Networks, Philips Semiconductors, Siemens AG, Telefonica SA and Thales; besides the European Information & Communications Technology Industry Association (EICTA). The Career Space Project provides a set of guidelines and recommendations as a basis for the developing curriculum program, analyzing 100 programs of study of the Information Technologies (IT) in nine European countries. It sets the need for people with behavioural professional skills and it recommends that the IT curriculums consist of a scientific base of ~ 30%, a technology base of ~ 30%; an application base and a systematic thinking of ~ 25%, and a component of behavioural and business skills up to ~ 15%. The Career Space Project states that "IT graduates need to learn teamwork and acquire good personal skills such as ability to solve problems, awareness of the need for lifelong learning, readiness to fully understand customer needs and of their project colleagues, and awareness of cultural differences when they act in a global context".

In Spain, it has been developed a series of studies called PATEP (Proposed Actions for Training Professional of Electronics, Computer and Telecommunications for the companies in the sector), to know the current situation and forecast the needs and profiles required by the sector companies, that provide a profile of skills and personality or personal skills. On the other hand, it has been prepared the White Book of Computer Science. This book is based primarily on the Career Space [18] and the curriculum of the Association of Computer Machinery [19, 20]. In it, it is provided a set of proposals with the aim to serve as a basis for the definition of the degree graduates of Computer Science Engineering and a number of skills are valued among which are reiterated interpersonal skills.

Pertegal, Castejon and Jimeno [21] indicate that IT professionals present less interpersonal skills; among teamwork is one of them. This is desirable according to the opinions of experts and professionals to successfully perform the job.

In the IT curriculum development, universities should first define the profile or profile group for which students want to be trained. This should be agreed in consultation with industry and other involved parts [18]. The Career Space consortium also believes that, ideally, the involved parts, such as local companies, representatives of professional accreditation, public administration sectors, the students and universities participate in this feedback mechanism so that what concerns the type of courses the universities need.

The objective of this research is to promote the development of interpersonal skills and in particular the work in multidisciplinary teams. To this end, we propose the design of interdisciplinary practices. Curricular performance will take place in a major subject of Computer Engineering degree where participate students of a compulsory subject of educational psychology.

2 METHODOLOGY

According to Latorre [22], "the term educational research-action is used to describe a family of activities performed by teachers in their classrooms for purposes such as: curriculum development, professional self-development, improvement of educational programs, systems planning or development policy. These activities have in common the identification of action strategies that are implemented and later subjected under observation, reflection and change. It is considered as a tool to generate social change and educational knowledge.

Among the key points of research-action, Kemmis and McTaggart [23] include improving education through change, learning from the consequences, and that planning, action, reflection allows us to give a reasoned justification our educational work, because you can show how we have obtained evidence and critical reflection that we have conducted, we have helped create an argument developed, tested and critically examined our approaches.

Within the sequential process know, act and change, research-action is just one part of the "global transformative action," we must bear in mind that the methodology itself now becomes a form of intervention in our teaching. Then, students will be more aware of their own deficits, deepen the analysis of their own situation and mobilizing the participants for the change.

From our perspective, the student is the principal agent of any change in the teaching-learning process and their active cooperation will depend on the effective change of the current situation to a new one. Therefore, the purpose of study or research problem begins in the best interests of the learners and not the mere interest of the investigator.

Consequently, once detected competence level students deficits, it will be based on the experience of participants, needs or problems experienced and then, it will involve teacher's role to encourage their motivation throughout the whole process of change.

This self-reflective practice becomes operational in the "dialogic principle" by Paulo Freire, in which the teacher and learners to establish relations of communication among peers, a horizontal dialogue among educators, based on reciprocity and becoming a teacher in guiding or guidance of collaborative learning that occurs between the students, which in our case also adds that they comprise a multidisciplinary team.

Some advantages of engaging in research-action processes are associated with an increased self-esteem, reduced professional isolation and enhancing motivation, encouraging all to a better professional development.

3 INTERDISCIPLINARY PRACTICES

The subject Computer Architecture (CA) is a compulsory subject in third year of degree in Systems Computer Science Engineering. Also, it consists of 3 theoretical credits and 3 practical ones.

So far (including the academic year 2009/2010) it has been developing a complete work of a system design that completes the three practical credits of the subject. The work, in general, involved the development of a system design in order to develop the skills and attitudes needed to face up to the integrated design systems. The application area chosen by the working team can be special purpose (automation, robotics, etc.), consoles, general purpose, scientific, etc. In this sense it performs a development of architecture by implementing all stages of the design: from analysis to testing in order to validate the architecture, allowing the development of a critical attitude to encourage the development of teamwork. The work, for their proper implementation, has required a series of regular deliveries:

- Analysis and specification document
- System design document
- Reviews of documents from other projects

- Final document (including presentation)

The objective for 2010/2011 is to extend this teamwork, which has been developing successfully in all academic years (including the current one), to the collaboration with other areas of knowledge, and in this case with educational psychology. The working structure is described in Figure 1 and the different work sessions (practices) in Table 1.

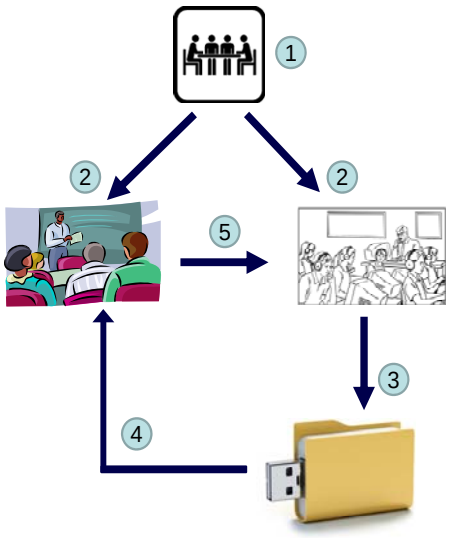

Fig. 1. Sequencing in the development of interdisciplinary practices of Computer Science and Educational Psychology degrees.

Practices	Sessions
1. Analysis and specification	2
2. Application Design	4-5
3. Application tests	2
4. Presentation to the Educational Psychology students	1
5. Feedback. Review document	1
6. Repeat steps 2 to 5	3
Total	14

Table 1. Practical proposals for the Computer Architecture course in the course 2010/2011.

Fig. 1 is divided into different development which indicates the process towards the final work. In 1) a meeting of teachers of the subject of CA of Engineering degree in Computer Systems and models for psychopedagogical guidance and care (MPGC) from Educational Psychology degree, as well as with the two coordinators students, one by each of the subjects (Item 1 of Table 1). This meeting is prior to the start of the practices of the subject of CA. The items discussed at that meeting will be explained in the early practice sessions of the subjects of CA and models for psychopedagogical guidance and care, as it is shown by the sections 2) and 3) in Fig. 1 as well as the items 2 and 3 in Table 1.

The next step is the point 4 of Fig. 1, which also is represented by the practice number 4 with a working session where the students of Computer Science degree show the practice developed and tested (Sections 2 and 3) during the seven sessions to the students in Educational Psychology degree.

During this session, the students of Educational Psychology degree take notes as well as the possible modifications and improvements required for the application (point 4 in Fig. 1 and Table 1). This feedback is carried out with a revisions document which will be treated. From that moment we create an iterative process of repetition (items 2 to 5 in Fig. 1 and table 1).

4 ADAPTATION OF INTERDISCIPLINARY PRACTICES TO THE EUROPEAN HIGHER EDUCATION AREA

According to the document "Proposals for the renovation of educational methodologies at the university" (MEC, 2006, pp. 140) "we we must approximate the teaching approaches that underlie the EHEA: give more prominence to the student in training, promote work collaborative, organize teaching in terms of skills that must be gained, increasing the acquisition of independent learning tools and so on".

Considering the multidisciplinary teamwork as fundamental to scientific and technological development and in response to the demands of new learning environments that define the criteria of Bologna and the convergence towards the EHEA, this project proposes to integrate a number of multidisciplinary practices courses in the subjects of CA and MPGC in Computer Science and Educational Psychology degree respectively.

The integration of two subjects in a multidisciplinary context involves the learning of theoretical bases, strategies and work techniques, and interpretation of the information developed in each of the disciplines. Their combination can be a synergy with different possibilities of interaction between the two subjects, so that this relationship may be subordinate or equal, the latter case that the partnership can achieve maximum effectiveness.

Moreover, we propose to carry out the experience in the last cycle of the degrees, which allows sketching the work of the learners in order to start the research, increasing student motivation, which is considered another crucial factor in the process of teaching and learning.

Because of the multidisciplinary team of professors and the nature of the project what it is intended to implement the work planning to follow for the achievement of objectives is:

1. Assessment of learning needs of students' competence level of the last cycle of the two disciplines.
2. Define learning evidences related to develop skills.
3. Review the existing teaching resources, experiences and teaching practices of teachers and collaborators student suggestions who have already passed the subjects.
4. Design and development of a multidisciplinary practices guide composed of introductory activities for each discipline and practices focusing on collaborative work among students of computer science and educational psychology.
5. Validation of the content of the multidisciplinary practices activity guide with a group of control students, with the aim of contrasting the skills developed by them and to incorporate the appropriate improvements.

In particular, the hardest part of the work will take place from March to December 2010, following these steps:

a. The teachers will make an inventory of skills to be developed and they will define how to demonstrate its domain and the method of evaluation. Period March-April 2010.
b. The team of teachers, advised by collaborator students, adapt several practices to promote the work in multidisciplinary teams. Period from May to July 2010.
c. The control students group validates and proposes improvements to the prototype version. Period October to December 2010.
d. The team of teachers, following the analysis of information provided by students and taking into account the results of practical activities, carry our relevant adjustments and they develop the definitive multidisciplinary practices guide. Period January to March 201

5 CONCLUSIONS

This paper has addressed the design of common practices in two courses of very different nature: computer engineering and educational psychology, in order to promote, before the students finish their studies, the work in interdisciplinary teams.

This work is in line with the results obtained in the Reflex Project [24] to the professional skills, which emphasizes that employers demand more skills than the ones are acquired by the graduates whereas say that while they rarely used the skills they have. Moreover, they highlighting the difference in the level of skills necessary for professional performance and the level of skills acquired in education, as well as how little used the skills acquired by graduates in the job.

Universities aim to train their students in the skills demanded by businesses. According to experts, students need to develop more skills names generic that would be found between the interpersonal skills.

In this sense, this work shows that it can be possible to intervene in a curricular way, in the university, to promote the development of interpersonal skills. It has been shown a methodology for the interdisciplinary practices design as well as a guide for its monitoring and evaluation.

Future research is aimed, obviously, to start the work here presented. The implementation of the practices will be held during the academic year 2010/2011 and it will measure the impact of these practices have on academic performance and the interpersonal skills, comparing the results of the students involved together with those obtained by a control group.

REFERENCES [Arial, 12-point, bold, left alignment]

[1] Agencia Nacional de Evaluación de la Calidad y Acreditación (ANECA) Marzo de 2004. *Libro Blanco de Informática*. [Online] Disponible en: http://www.aneca.es/activin/docs/libroblanco_jun05_informatica.pdf

[2] R. Bar-On y J.D.A. Parker (Eds.), (2000). *Handbook of Emotional Intelligence*. San Francisco: Jossey-Bass.

[3] Cherniss, C. (2000). Emotional Intelligence: What it is and Why it Matters. *Rugters University*. Annual Meeting of the Society for Industrial and Organizational Psychology, New Orleans, LA.

[4] Mayer, J.D. y Salovey, P. (1997). What is emotional intelligence? En P. Salovey & D. Sluyter (Eds.), *Emotional development and emotional intelligence: educational applications* (pp. 3-31). New York: Basic Books.

[5] Koman, E.S. y Wolff, S.B. (2008). Emotional intelligence competencies in the team and team leader: A multi-level examination of the impact of emotional intelligence on team performance. *Journal of Management Development*, 27 (1), 55-75.

[6] Boyatzis, R.E. (2008). Competencies in the 21st century. *Journal of Management Development*, 27 (1), 5-12.

[7] Møller, C. y Powell, S. (2001). Emotional Intelligence and the challenges of quality management today. *Leadership & Organization Development Journal,* 27 (7), 341-344.

[8] Rozeil, E. J., Pettijohn, Ch. E. y Parker, R. S. (2001). An empirical evaluation of emotional intelligence. The impact on management development. *Journal of Managerial Development*, 21 (4), 272-289.

[9] Sjöberg, L. (2001). Emotional intelligence: A psychometric analysis. *European Psychologist*, 6 (2), 79-95.

[10] Culver, R. y Yokomoto, Ch. (1999). *Optimum Academic Performance and its Relation to Emotional Intelligence*. Paper presented at the 29th ASEE/IEEE Frontiers in Education Conference, San Juan, Puerto Rico, Noviembre.

[11] Lam, L.T. (1998) Emotional Intelligence: Implications for Individual Performance. (Abstract) Texas Tech University. Recuperado de la Base de Datos ProQuest, CD-ROM.

[12] Parker, J. D. A., Taylor, G. J. y Bagby, R. M. (2001). The relationship between emotional intelligence and alexithymia. *Personality and Individual Differences*, 30 (1), 107-115.

[13] Ciarrochi, J.V., Deane, F., y Anderson, S. (2002). Emotional intelligence moderates the relationship betweeen stress and mental health. *Personality and Individual Differences*, 32, 197-209.

[14] Parker, J. D. A., Taylor, G. J. y Bagby, R. M. (2001). The relationship between emotional intelligence and alexithymia. *Personality and Individual Differences*, 30 (1), 107-115.

[15] Salovey, P. (2001). Applied emotional intelligence: Regulating emotions to become healthy, wealthy, and wise. En J. Ciarrochi, J.P. Forgas y J.D. Mayer (Eds.), *Emotional Intelligence in Everyday Life: A Scientific Inquiry* (pp. 168-184). Filadelfia: Psychology Press/Taylor y Francis Group.

[16] Aiken, L.H., Clarke, S.P., Sloane, D.M., Sochalski, J. (2002), Hospital Nurse Staffing and Patient Mortality, Nurse Burnout, and Job Dissatisfaction. *JAMA, 2002 - American Medical Association*, 288(16), 1987-1993.

[17] González, J. y Wagenaar, R. (Eds.) (2003). *Tuning Educational Structures in Europe. Final Report. Phase One.* Bilbao (España): University of Deusto and University of Groningen.

[18] Career Space. (2001). *Curriculum development guidelines. New IC-curricula for the 21st century: designing tomorrow's education.* Luxembourg: CEDEFOP. [On line] Disponible en: http://www.career-space.com

[19] ACM/IEEE-CS joint curriculum task force, “Computing Curricula 2001. Computer Science”, 15 de diciembre de 2001.

[20] ACM/IEEE-CS joint curriculum task force, “Computing Curricula 2005. Overview”, 2005.

[21] Pertegal, M.L., Castejón J.L., Jimeno, A. (2010). Personal and emotional skill profiles in the professional development of the computer engineer. *International Journal of Engineering Education*, 26 (1), 218-226.

[22] Latorre, A. (2003). La investigación-acción. Conocer y cambiar la práctica educativa. Barcelona: Graó.

[23] Kemmis, S. y McTaggart, R. (1998). Cómo planificar la investigación-acción. Barcelona: Laertes.

[24] [24]Agencia Nacional de Evaluación de la Calidad y Acreditación (ANECA). Junio de 2007. Ministerio de Educación y Ciencia. Proyecto Reflex. Informe Ejecutivo. [On line] Disponible en: http://www.aneca.es/estudios/docs/InformeejecutivoANECA_jornadasREFLEXV20.pdf