# AC 2010-703: MPSS: A SYSTEM FOR MOBILE AND VOCATIONAL EDUCATION AND TRAINING

**Manuel Castro, Universidad Nacional de Educacion a Distancia**

**Gabriel Diaz, Universidad Nacional de Educacion a Distancia**

**Eugenio Lopez-Aldea, NIEDAX**

**Nuria Oliva, Universidad Nacional de Educacion a Distancia**

**Catalina Martinez-Mediano, Universidad Nacional de Educacion a Distancia**

**Nevena Mileva, Plovdiv Universifty**

**Mihail Milev, Plovdiv Universifty**

**Slavka Tzanova, Sofia University**

**Edmundo Tovar, UPM**

**Martin Llamas, Universidad de Vigo**

# mPSS: a system for mobile and vocational education and training


## Abstract

Mobile devices are always available, are very popular and can be used for different learning functionalities, ranging from communication and collaboration purposes to providing access to contents, both informational and instructional. Performance-centered approach has been proven to be more effective than the traditional lecture-practice-test (expository inductive) in training higher order skills, for preparing learners for self-learning, improving, adapting for changing jobs.

The mPSS project applies performance-centered approach in mobile learning management system for educational and training purposes. Students receive a set of learning resources, consisting in description of adaptive scenarios performance centered assessment methods and criteria for evaluation and experts' advices. Evaluation plan/strategy and the measurement instruments are aimed at measuring the effect of the project on knowledge, skills and attitudes of students and trainees**.** We present the design and implementation of this project for several courses that will be used by different students of various matters in several European countries.


## Introduction

There is an old adage in distance education research which states 'It is not technologies with inherent pedagogical advantages which are successful in distance education, but technologies which are generally available to citizens'. This is nowadays closely related with mobile telephony technologies. It is not an outrageous statement to say that every student in every program in every institution possesses one and use them constantly for every aspect of life except their education. Mobile learning may be defined as the provision of education and training on mobile devices: PDAs (Personal Digital Assistants) smartphones, and mobile phones, including handhelds and palmtops, MP3 players and iPods. Dye[1] gives a much more conceptual definition saying that device should be 'able to be used wirelessly', 'able to be used standing with minimal effort', 'small enough to be held in one hand' and 'a device that a gentleman can hold in a pocket or a lady in a handbag'. We think that if several different industries (news, sports, and pornography) are able to provide without problem text and graphics to their customers, we can design our system being sure that it is clearly possible for mobile learning providers to provide mobile learning courseware to their students.

## What is mPSS?

Our group has been involved in the design, development, evaluation and implementation of PSS (Performance Support Systems) in higher engineering and vocational education[2], leading to the development of Internet-based Performance Support System with Educational Elements (IPSS_EE) [3], which exhibits all features of a Learning Content Management System.

IPSS_EE is an integrated electronic environment, which is available via Internet. It is structured to provide individualized online access to the full range of information, guidance, advice, data, images, tools and software to permit the user to perform a task with a minimum of support and intervention by others.

Afterwards we develop DIPSEIL (Distributed Internet-based Performance Support Environment for Individualized Learning)[4,5] as a second phase towards the stated learning objectives, based on the improvement of the learning methods of IPSS_EE. DIPSEIL applies Internet as a mean for integrating new technologies and as a method for a more direct synergy between the members of the project and their students. In this case the information, the IPSS_EE courses, were distributed (Figure 1) in various servers throughout Europe (Ireland, Holland, France, Bulgaria and Spain).

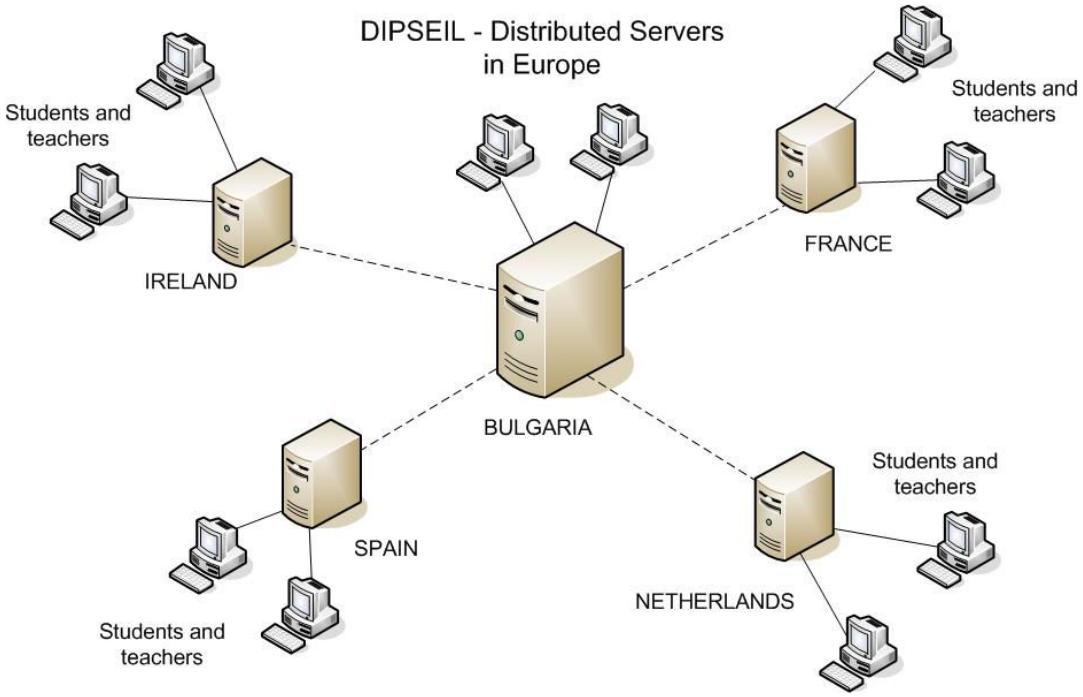


Figure 1. Distribution of the IPSS_EE servers for DIPSEIL project

With this learning infrastructure we achieved several goals having a combination of technologies, learning and different point of views coming from different cultures and languages. We tried to face the problems related with different languages, we offered a more attractive environment for course designers and also we balanced the workload and the traffic in the network, obtaining a quicker communication**.**

Finally the idea behind mPSS (Mobile Performance-centred Self-directed System for Education and Training) is moving the same philosophy to a mobile environment. We think that mobile learning can be a form of performance support system for educational and training purposes. The

advantages for trainees are derived from providing learners with a job aid in the context of their work:

- puts training and performance support where the actual work takes place
- allows new skills or knowledge to be immediately applied
- enables training when it is needed
- allows use of rich media when appropriate

There are of course advantages for students:

- they have more flexibility and choice in where and when they learn outside of the wired (or un-wired) classroom.
- they can use the technology in their study that would enhance their readiness for tomorrow's workplace where employers want graduates who know how to use technology for learning and working.

Given the trend to lifelong learning, many "students" are working adults with full- or part-time jobs. Mobility offers them an opportunity to maximize learning time.

**mPSS objectives**

The objectives of the project are designing, developing, evaluating and implementing a Mobile Performance-centred Self-directed System for Education and Training (mPSS) in engineering education. The project has the following specific objectives:

1. To build operational definitions and a model of performance-centred learning, performance-centred learning object and self-directed learning in the context of mobile learning.
2. To design a learning management system, translating the model of performance-centred learning, as in the case of DIPSEIL[4,5] into functional specifications of mPSS.
3. To implement mPSS in real educational and training settings. The pilot will be 2 semesters long, through 3 different universities at Austria, Bulgaria and Spain.
4. To assess usability, utility and effectiveness of the mPSS.

**mPSS design of courses**

While we have developed new courses for this new environment, also some of the courses at DIPSEIL have been revamped, taking into account some special considerations needed for the access from the mobile devices, but trying to reuse as much as possible our previous infrastructure (Figure 2).

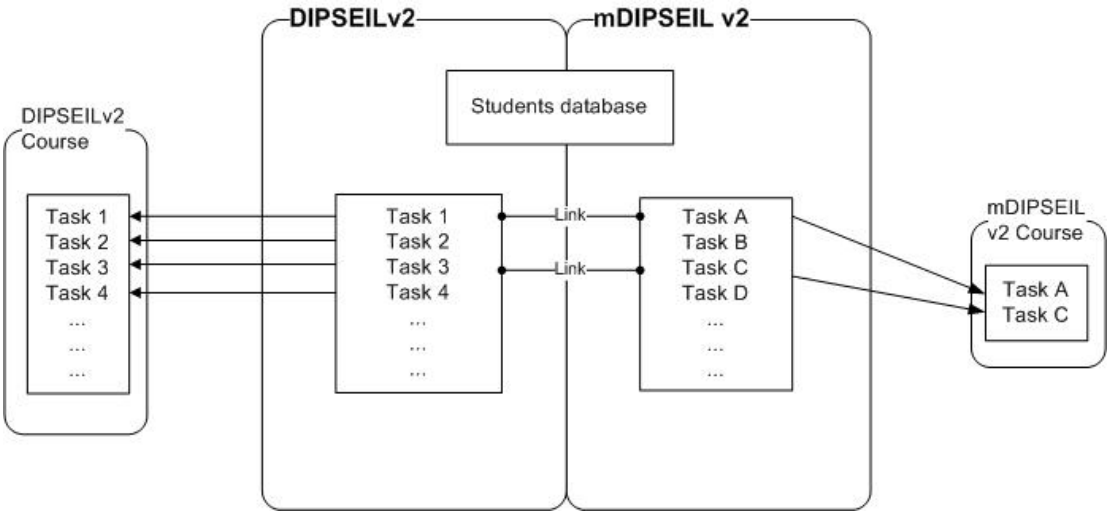


Figure 2. Integration of mPSS in our current system

The design of a typical course is illustrated in Figure 3. Each course follows the standard IPSS_EE structure: it is composed by modules and each module contains a number of tasks. The tasks are the containers of the performance provider part of the learning process. Each task is really a learning object (LO).

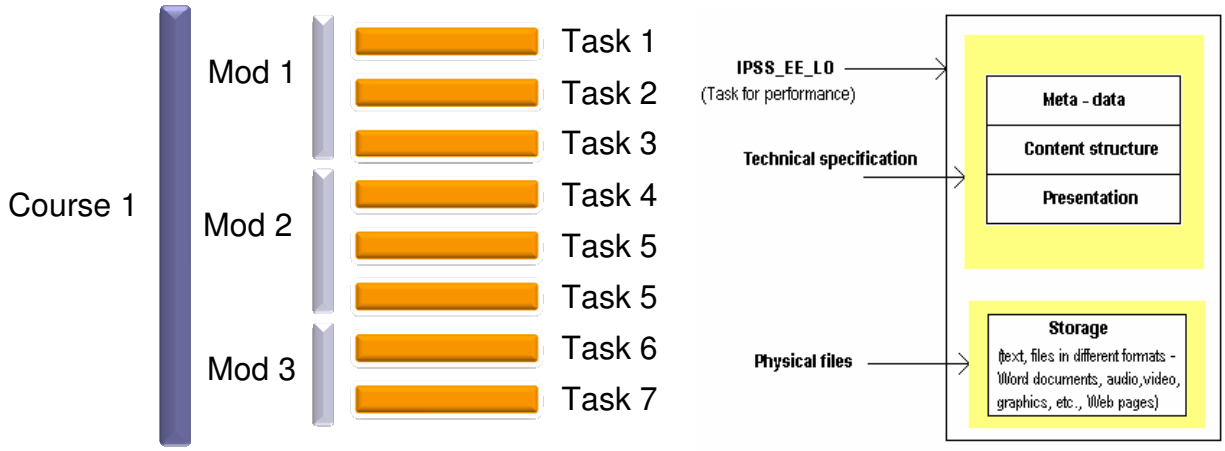


Figure 3. A typical design of an mPSS course

Content structure answers to the performance support systems requirements – the content is structured to provide individualized online access to the full range of information, guidance, advice, data, images, tools and software to permit the user to perform a task with a minimum of support and intervention by others. IPSS_EE LO consists in:

- reference information about a task or closely related set of tasks;
- task-specific training;
- expert advice about a task;
- instructions how to perform the task
- instructions how to use the software

For this new system we created a new level of abstraction, called objects that are the building elements of the tasks. Objects can be text, picture, sound or video and one task can have as many objects as desired by the teacher. The objects are also shared structures that can be used in different tasks and modules. They can be even shared by different courses and different teachers. Else it helps the student that has already made a task from a module and will find the same object in a new task, being easier the study of this task.

Obviously, due to the special features of the mobile devices, it is necessary to take into account some limitations for the different kinds of objects we can use:

- Text: it is not easy to read long texts on small displays.
- Image: limits are 240 pixels width and 320 pixels height.
- PNG: supported but not for every mobile device.
- Sound (WAV): encoding configuration 8 kHz, mono, 7 kb/sec.
- Video (3gp): resolution should not be bigger as the user's screen (240 x 320 pixels)

**The structure of mPSS: technical aspects**

The mPSS (Figure 4) consists of three main, dependable from each other, modules: a J2ME client application, which must be downloaded and installed to the client's (student's) phone; Database Engine – such as MySQL, for storing the educational data and a Web-Engine - such as Apache, for managing the data.

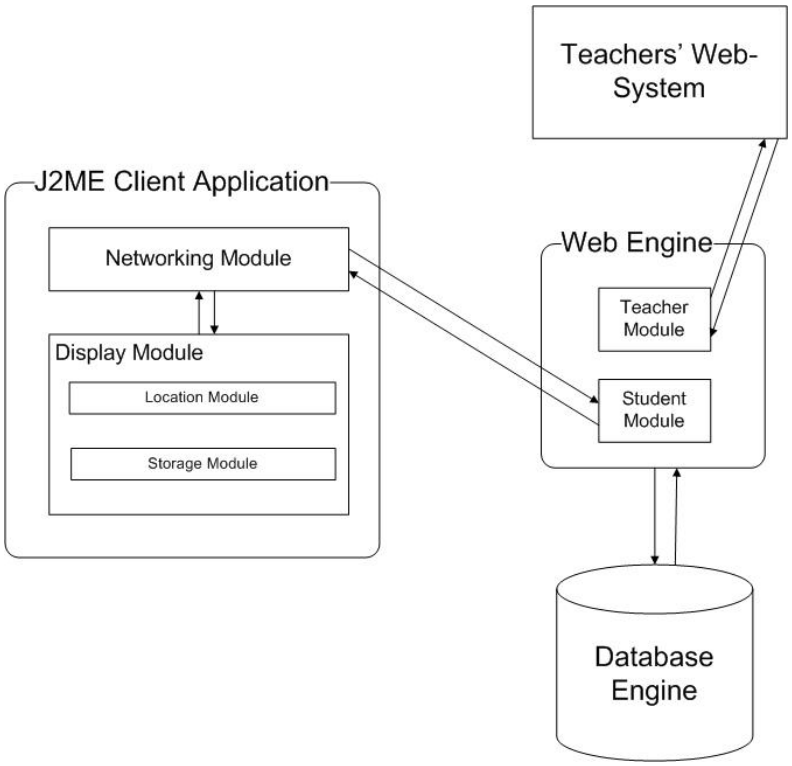


Figure 4. Main connections between the modules of mPSS

The J2ME client application is a downloadable and installable JAR (Java Archive) file. It could be downloaded from the main site of mPSS (http://m.dipseil.net/) and installed to any mobile device, which supports J2ME CLDC 1.1 and MIDP 2.0 (or higher) standards. These two standards assure that the phone has some basic and common features needed for the mPSS to correctly display the educational data (such as the J2ME MMAPI).
The J2ME client application can be divided in four modules:

- Location Module, that uses the main J2ME positioning libraries to obtain the device's coordinates, if the device has an integrated GPS module and/or has a valid connection with one.
- Networking Module that can use every possible Internet connection for delivering the educational data – 2G, 2.5G and 3G, also old WAP services and or modern Wi-Fi/WiMAX services, of course only if the phone supports them.
- The Storage Module is a simple module based on the Record Management System (RMS) of J2ME, which stores important user data for further usage.
- Display Module. It is actually the main J2ME application, which encapsulates all the other modules to build the client software. It offers the user a simple way for navigation and cares for the right displaying of the content. Upon loading of this module it checks what kind of multimedia formats the device supports, thus determining what kind of content the device can display to the learner. This module and the Networking Module are the two main criteria for determining the phone. The two possibilities are: "Advanced" (modern) device or "Unadvanced" (elder) phone. These two categories determine what kind of content will be transferred and shown to the client.

Also upon loading the J2ME client application for the first time it invokes a process, which tries to determine the device coordinates using the Global Positioning System (GPS). The built-in GPS functionalities support (for the mobile devices with GPS feature) to view tasks from specific country (in its language) or specific tasks related to the location you are.

**Current state and evaluation plan**

As part of our collaborative work within the mPSS project with other European universities, and at the moment of writing this work, our group has completed and tested two very different mPSS courses:

- "Introduction to ITIL® concepts and terminology". The objective of the course is to be a tool for reviewing the main concepts and terminology of the third version of ITIL[6] (Information Technology Infrastructure Library). It is based on the knowledge the students must have acquired after the normal process of learning in the ____'s postgraduate course of title "Curso de Experto Profesional en Gestión de Servicios TI basados en ITIL® e ISO 20000", of 6 months of duration. This course has, as an optional objective, to prepare the students for an international service management certification, developed by EXIN[7] and interesting for many different computing science jobs: "ITIL v3 Foundations".
- "Computer Architecture Simulation course. Concepts and terminology". The objective of this course is to serve as a tool for improving the capacities of students in laboratory practices time. In the course the students can learn and practice using microprocessors simulators and extract the concepts related. They will compound the structure of a

Generic Microprocessor (and practice with MC68000 concretely) understanding the principal issues. We tried to follow specially the objectives of student-centered learning acquisition of capacities and skills, one of the main ideas of the Bologna[8] process of European Space for Higher Education (ESHE).

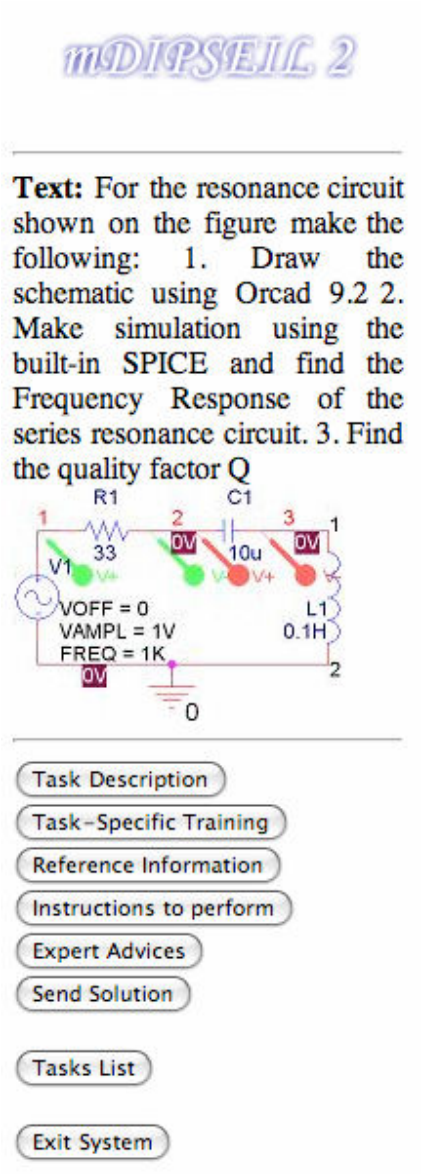


Figure 5. Output from a task in "Computer Architecture" course

Figure 5 shows the mobile format for the description of a task for the "Computer Architecture Simulation" course. The student receives the text description and the circuit and, as part of the same task, can access to the rest of the information he needs for completing the task.
Figure 6 shows the result of downloading a link with the option to see a help video to develop the task and figure 7 shows an illustration for one of the circuits for the same course.

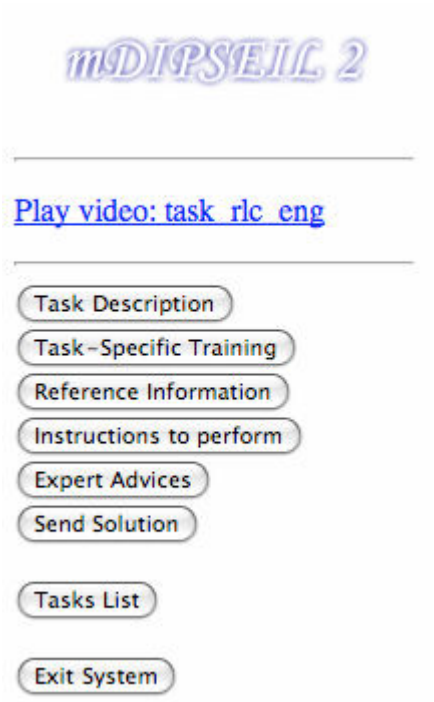


Figure 6. Result of downloading a link for a video help in "Computer Architecture" course

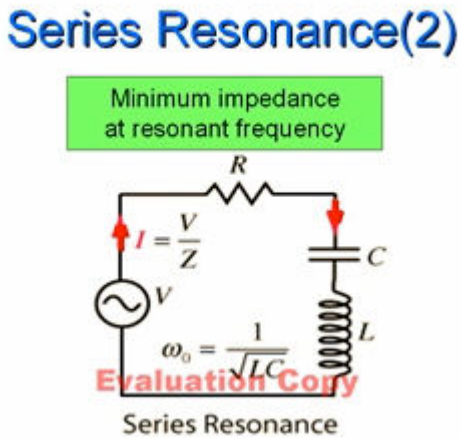


Figure 7. Real illustration for a circuit in "Computer Architecture" course

For each course, beginning on February 2010, we plan to have at least 20 students in an "experimental group" and we hope to have also a "control group" doing the same tasks but without using mPSS. For the assessment of the usability, utility and effectiveness of the system, we plan to evaluate at least two types of research questions:

1- What is the effect of mPSS on knowledge, skills and attitudes of students?
2- How do students and teachers perceive the effectiveness of mPSS?

We are interested in seeing if mPSS can lead to improvement of students' knowledge and skills. Furthermore it will be useful checking the attitudes of students toward mPSS and if mPSS

provokes significant increase in the motivation of students. Also the appreciation of teachers about the use of mPSS for their curriculum must be taken into account.

## Conclusions

With this work we try to contribute to the continuous development of mobile learning. Another objective of this project is to address the problem of the lack of education and training on the sophisticated communications devices which every student carries and uses constantly for many things, but not for education.

mPSS is a performance support system for educational and training purposes. The advantages for trainees are derived from providing learners with a job aid in the context of their work and more choice and flexibility in where and when they learn outside the non-mobile classical classroom.

We try to prove that this approach is useful, at least as a complement, and effective enough for training higher order skills, for preparing learners for self-learning, improving, adapting for changing jobs. We have built mPSS based on our previous work in the field, using performance-centred approach in different educational and training contexts, and deploying state of the art mobile technologies.

On the other hand it is essential also to consider the disadvantages of mobile learning, a combination of technical and education challenges. The technical ones are obviously related with the technical limitations of the devices, specially the small screens. Related with the pedagogical challenge, mobile learning is a fragmented learning experience, for which learning on the go is full of many different distractions. Here the challenge is also for the teachers that must try to create the smallest possible units of learning.

At the moment of the writing of this work we are ready for beginning the real experiment for our 2 complete mPSS courses, as part of a greater project in different European universities. The pilots have been tested and the results were correct.

## Acknowledgements

The authors would like to acknowledge European Union the Leonardo Project 142788-2008-BG-LEONARDO-LMP mPSS – mobile Performance Support for Vocational Education and Training Project.

And the support of the CYTED-508AC0341 “SOLITE- SOFTWARE LIBRE EN TELEFORMACIÓN” project as well as the Madrid Community support for the e-Madrid Project, S2009/TIC-1650, “Investigación y Desarrollo de tecnologías para el e-learning en la Comunidad de Madrid”.

### Bibliography

1. A. Dye, “Developing courseware for mobile devices”, in D. Keegan, (ed), “Mobile learning a practical guide”, Dun Laoghaire: Ericsson , 2007.

2. M. Castro, C. Martínez, E. López, A. Colmenar, A. Vara, G. Díaz, E. Sancristobal and J. Peire**,** "Integration of new tools and technologies in electronics teaching", 34th ASEE/IEEE Frontiers in Education Conference, Savannah (USA), 2004.
3. C. Martínez, N. Mileva, S. Tzanova, C. Alonso, N. Rioperez, G. Díaz, J. Peire and M. Castro, "Performance-Centered e-Learning in the Framework of Industry/University partnership, eChallenges. Barcelona, Spain, October, 2006. Proceeding by Paul Cunnigham & Miriam Cunnigham (Eds): *Exploiting the knowledge Economy. Issues, Applications, Cases Studies.* (2 volumes) IOS Press, Ámsterdam.
4. E. López, E. Sancristobal, S. Martín, G. Díaz, M. Castro, J. Peire, J.M. Gómez and P. López, "Internet-Based Teaching Evolution in Computer Architecture", 38th *ASEE/IEEE Frontiers in Education Conference, FIE 2008*, Saratoga Springs, NY, U.S.A., 2008.
5. G. Diaz, C. Martinez-Mediano. S. Martin, R. Gil, E. Sancristobal, M. Rodriguez-Artacho, E. Lopez, N. Mileva, A. Duran and M. Castro, "Individualized high performance and Internet-distributed courses applied to security information engineering courses in High Education", ED-MEDIA 2009--World Conference on Educational Multimedia, Hypermedia & Telecommunications, Honolulu, HI, USA, June, 2009.
6. ITIL v3. Official ITIL® Website, accessed December 2009, http://www.itilofficialsite.com/home/home.asp.
7. EXIN, the Examination Institute for Information Science, accessed December 2009, http://www.exin-exams.org/Exams/IT%20standards/ITIL.aspx.
8. European Commission, 1999, The Bologna Declaration on the European space for higher education: an explanation, see http://ec.europa.eu/education/policies/educ/bologna/bologna.pdf.