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Human Factors and Ergonomics in Engineering Curricula

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Towards the training of future engineers as intellectual leaders, skilled and well prepared professionals who are creative, know how to work in team and to communicate with other areas, is necessary a framework where the ergonomic design is the core and is surrounded by technology, human factors and market opportunities [1,2,3]. In the domain of scientific research, the IEEE Society has been developing the Human System Interaction International Conference aiming at enhancing the research activities in many areas such as electronics, robotics, computer science, education and human factors [4].

Human factors and ergonomics can be useful in the early phases of product development. How can we include human factors and ergonomic aspects in the engineering curricula of mechanic, electronics and computer science students?

The Human-Centred Design (HCD) approach can help us in this task. To achieve a usable system, the human-centred design approach is concerned with the incorporation of the user's perspective into the software development process. Following Maguire the key principles of HCD are: active involvement of users, task requirements analysis, function allocation between the user and the system, iteration of design solutions, multidisciplinary design teams [5]. In fact, the revisited analysis of the international standard ISO 13407 proposes an extended version of these principles based on relevant aspects of the user's experience when interacting with the product. For example one of the new requirements is: "Users' strengths, limitations, preferences and expectations should be taken into account when specifying which activities are carried out by the users and which functions are carried out by the technology" [6,7].

Thus, the aim is add a HCD model process approach inside the engineering subjects. For example, in Technical schools of engineering where has been developing a Design and Product development Engineering curriculum is possible the inclusion of human-centred strategies along the curriculum. For example: cognitive ergonomics, accessibility, usability, human-system interaction.

In Technical schools of human-computer interaction and computer science where has been developing a Human-computer interaction master is possible the inclusion of engineering strategies along the curriculum. For example: model process engineering of usability and accessibility, product design, Kansei engineering [8].

The author of this editorial teaches the Industrial design subject in the Masters' Degree Human-Computer Interaction (HCI) at the Lleida University (Barceloan, Spain) and adds design and engineering skills into the HCI program. In the Industrial design subject the head teacher highlights the importance of an ergonomic approach at the first step of the product design. For this reason we are developing teaching material related to product design and HCD. The theoretical chapters of this subject are:

- Introduction: connection between the industrial field (machine, flexible manufacturing system, product design) and human factors and ergonomics
- Interface design: interface design recommendations and control strategies of automation systems in order to design interfaces and facilitate the human intervention in the control of industrial machines
- Display design: use of an ergonomic display design guideline to develop displays in the industrial domain and home automation displays for smart environments
- Control room design: use of the HCD approach in the definition of the industrial human supervisory control task

One of the aims of the subject is to show that the HCI engineer not only can design web solutions and software solutions in the software engineering domain; they can design industrial and assistive technologies products. In the subject, the head teacher uses a virtual meeting room when the students discuss about good or bad design, human error and new prototype interfaces (design and use), etc. Students work in pairs and in many occasions one student has a social profile and the other one has a technical profile, therefore, students learn in this master how to develop integrated projects. In this sense we use the project based learning approach trying to develop prototype interfaces and we have special care in the specifications of the product design and the analysis requirements of the users' needs.

To obtain a set of design skills it is necessary to complement the theory with practicum activities in the laboratory. We count with three related new laboratories (the Mechanical prototyping laboratory, the Interactive Systems Design laboratory and the 4all-L@b Usability laboratory) besides traditional laboratories in Electricity, Electronics and Control. A laboratory specially focusing on evaluating human-automation interaction, ergonomic design, user's experience and usability of industrial and digital home products and services was established: the Interactive Systems Design (ISD) Laboratory at the Technical School of the Barcelona Tech University [9,10].

An effective synergy is beneficial in the teaching of the future engineers. We highlight the inclusion of human factors and ergonomics subjects into engineering degrees and the inclusion of engineering subjects into Human-computer interaction degrees aiming to bring up multidisciplinary graduates.

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