TECHNICAL CREATIVITY: knowledge for the generation of creativities technological ideas

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***Abstract*— The principal aim of this project consists in promoting the students' creativity encouraging the search of new knowledge, the self-learning and the team group. For this purpose, at the starting point the necessaries basis give them, and then, the students develop their own practical applications. In this work, the obtained results are presented related with two subjects given in the Biomedical Engineering Degree of Tecnun.**

***Keywords*—technical creativity, autonomous learning, improvement search**

I. INTRODUCTION

Looking for a definition of creativity, A. Richard says that "to create is to contribute something unexpected, something that exceeds the hoped frame" [1]. This can be understood as to give new contributions in a known context. The creativity techniques are efficient tools in the conception of ideas and in the search of more suitable solutions to a problem with several alternatives.

These techniques try to wake up people creativity, because this concept usually is not so developed due to the lack of knowledge about the technology to use in order to find new ideas.

The creativity is a good tool for the educational university innovation. It improves the efficiency of the pupils in all matters and subjects. Moreover, it reinforces the aptitudes to formulate relevant questions, to create great ideas, to use the information effectively, to come to the solutions of problems, to benefit the critical thought, the fluency of ideas, the capacity of analysis,…

In our case, over the course of the university degree, the students possess practical matters in those who apply the theoretical foundations acquired along other subjects. Habitually the accomplishment of these practices is guided so that the acquired knowledge often can remain strongly linked to the concrete context of the subject. Inside the new European frame of the university educations, it is expected that people, at the end of the formation process, have integrated the theoretical knowledge and developed the cognitive skills (use of the logical, intuitive and creative thought) and responsibilities practices (founded on the manual skill and on the use of methods, materials, tools and instruments) [2] and the autonomy. Under this premise, it considers to update the teaching in practical subjects so that the students combine the acquired knowledge during the development of the subject in order that they design their own applications beyond the given matters. In this way, the assimilation of the concepts and the creativity by means of the technology are encouraged, achieving that people generate some ideas in a short period of time.

II. FRAMEWORK

The presented work consists of the fact that the enrolled students of Biological Techniques II and Advanced Micro and Nanobiotechnology (of the third and fourth course respectively in the Biomedical Engineering Degree), will carry out an offer of the laboratory practices.

In the case of the subject of Biological Techniques II, where the pupils learn the principal techniques and technologies used in molecular biology, they have to propose some practices made by reagents and/or material of daily or domestic use. The pupils have been divided in groups of two people. Each group has to present a project of the practice where they define the objectives, the available materials, the stages of the execution and possible contingencies. The time required by students to prepare the practice has been distributed as follows: for a month the students have chosen the practice they have to make. Then, for two months, they have prepared, processed and recorded on video the procedure of the practice many times as they have needed to obtain the expected results. Finally, they have explained it to the rest of students.

These practices have been made in the biotechnological laboratory under the supervision of the teacher. In this way, the students have used the laboratory material as the erlenmeyer flask, crystal glass, precision balance,

thermostatic bath, some reactive,... The process of evaluation consists of analyzing if the video includes the main ideas of the practice, considering if the content of the work appears reflected in the presentation. Furthermore, the cleaned and appropriate language has been taken into account during the communication process. Finally, the skill of students to answer questions made by the classmates and the teachers has been evaluated to know if the students have understood the basic concepts in which the practice was based on. Each student assess to his classmates promoting the critical spirit of the students.

In the subject of Advanced Micro and Nanobiotechnology, the students acquire the necessary knowledge both of software and hardware, for the using of an Arduin platform [3]. Moreover, the pupils apply the acquired knowledge in the subject of Micro and Nanobiotechnology given the year before to carry out the new application of the Arduin platform. Along the course of this subject, the students design microdevices that later make of the clean room facilities that we have in our building. They carry out photolithography techniques, sputter deposition processes, characterization of the deposited film by means of perfilometry techniques,… With the acquired concepts in this subject and thanks to the learned matters during the degree, as electronic, a guided learning has been carried out by means of the gradual application of the necessary concepts for obtaining a miniaturized model of an incubator and his own control system in temperature.

III. RESULTS

In the Biological Techniques II, the students have carried out several practices:

· Elaboration of the plastic from the milk casein
· Alcoholic fermentation with bread
· DNA extraction of food
· Voltage generation with an aluminum and sodium battery
· Osmotic effect with an egg
· The Franklin bells
· Generation of ice immediately
· Chromatography with flowers
· A pHmeter made of purple cabbage
· Formation of soap with unsaturated and saturated fatty's acids
· …

The students have hardly edited the video of the practice with the aim to show all the details of each experiment. In some cases, they have innovated when they have recorded the practice dressing up as some elements related to it.

In the Advanced Micro and Nanobiotechnology subject, the pupils have proposed and designed a new application based on their particular daily needs.

Initially, the students have designed the masks to subsequently fabricate the temperature sensor (PT100) in our clean room facilities. Then, this sensor has tested to check that it was working perfectly. Afterwards, the control algorithm has been programmed in Arduin, and finally all the components and the incubator have been assembled. The final evaluation has consisted of a presentation of the incubator and the explanation of each component operation using the Arduin platform.

Some students have added several "extras" components as a fan, servos to control the ventilation trap door.
Others have made a new assembly: an alarm system to control the temperature rise.

The evaluation process has been made in this way: two points in the design of the masks and the temperature sensor test. One point in the programming in Arduin and the assembly of all components, and, finally, four points in the final presentation.

In figures 1 and 2 some pictures are shown about the obtained results of the design and control that the students have been made simulating an incubator. In figure 1 it can be observed the Arduin platform that students have been used with all the cables and the system control for the incubator. In figure 2 it is shown a detailed of the chip inside the incubator.

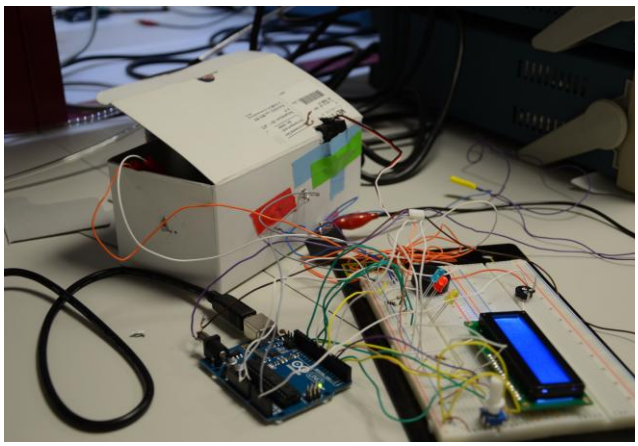

Fig. 1. The Arduin platform and the control system concerning the designed incubator

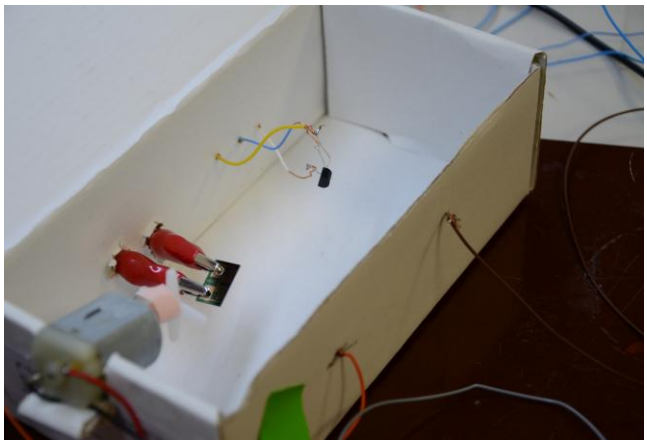

Fig. 2. A detail of the chip (sensor temperature) inside the incubator

IV. CONCLUSIONS AND FUTURE LINES

As result of this experimental experience, the pupils of Advanced Micro and Nanobiotechnology have demonstrated a major implication in their own guided practices, providing with improvements and new functionalities to the proposed practice: system of descent of temperature, loud alarms and control of mobile elements (opening door, for example). In addition, they have suggested and presented others applications of the platform, as the alarm and control access to a building by means of image acquisition.

In the case of Biological Techniques II, the students have proposed some practices made of daily material promoting the search of new knowledge, the autonomous learning and the team group. It has achieved that the students acquire an integral level of knowledge that allow them not only to understand the explained concepts in the practices given in class, but also to apply them and to use them as an alternative method to achieve the proposed aims raised by themselves in other areas.

In summary, the technical creativity has allowed us to study an idea and to analyze it, trying to find some aspects that before has not taken in account and accepting new and different points of view.

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