

Improvement proposal in the learning process of the student in the course of fundamentals of communications of the puj centered on the design and evaluation of laboratory practices

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Abstract— This article presents the development, implementation and evaluation of a series of tools such as hardware, software and documentation, which help to generate active learning dynamics in the teaching-learning process of the undergraduate course of Fundamentals of Communications, in the Department of Electronic Engineering Faculty of the Pontificia Universidad Javeriana (Colombia). For implementation of hardware and software tools was used the TMS320C6713DSK develop card designed for Spectrum Digital and the Code Composer development environment of Texas Instruments. Moreover, educational theories of learning problems, learning projects and cooperative learning are used for design the proposal. Finally, an analysis and an evaluation of these tools are presented.

Keywords-component; Learning Styles, Project based learning, Cooperative learning, Engineering education, Educational technology..

I. INTRODUCTION

In the last years has been a great number of material about active learning, the use of this type of methodology increments the flexibility of the teaching-learning process [1]. In general these kinds of methodologies try to move the learning problem from the model of teaching-learning based on lectures and the problem class, to a new model of teaching-learning more centered on the students [2]. The developed interest on this type of new methodologies changes from the quantification of the results obtained with them to the study of the methods developed for the design and implementation of courses based on them. Examples of this are presented in [2-5]. These changes of methodology implied more awareness in the way of teaching such as the contents of the course, therefore it is necessary ask about what is taught, what does these students want to learn, what does these students need to learn and how the assignments and activities must be designed in order to do that learning being meaningful [6].

The course of fundamentals of communications of the Electronics Engineering Department of the Pontificia Universidad Javeriana (PUJ) is the introductory course to the topics of communications in the undergraduate curriculum of the Electronics Engineering. It is a course of three academic credits, which are divided in three hours of class time with a

teacher and two hours weekly of laboratory. In this paper is presented the design, the implementation and evaluation of modules developed for the laboratory of this course, where some active learning methodologies were implemented as a new resource to generate more dynamic learning environments. The paper is divided in four sections: the first is a description of the theoretical and procedural constitutive elements in which the development of the modules was designed; the second is the design of the modules in relation with the course content; the third describes the results obtained on the evaluation of the modules by the students and finally the conclusions

II. CONSTITUTIVE ELEMENTS DESCRIPTION

A. *Development board DSK320C6713*. Is a development board with a high performance DSP that based on programming on C language, under power consumption, for broadband networks and digital imaging applications. It offers compatibility with fixed or floating point operations with eight separate units, two ALU for fixed point, four for floating point and two multipliers compatible for fixed and floating point [7].

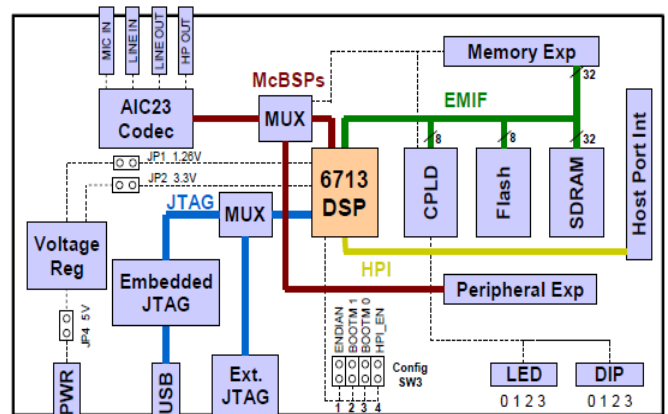


Figura 1. Diagrama en bloques de la tarjeta DSK320C6713 DSK

B. *Code Composer*. Another important element of the teaching tools is the programming environment, for the TMS320C6713DSK is called code composer, it is a program

developed by Texas Instruments, which allows programming in C and assembler. Among its main features are its versatility to support a variety of development boards families includes tools such as debugger, libraries, linkers and API (Application Programming Interface). They are parts of the program that allow programming, monitoring and correction easier on the various projects implemented in the development board [7].

C. Active Learning. Active learning is teaching-learning process based on the students; this means that requires greater participation of them. Another definition is worn out "Active learning involves students in doing things and thinking about the things they are doing" [8]. There are several active learning strategies, but in this documents only the theories in which was based the modules are presented [8]:

Cooperative Learning: This strategy involves small groups of students working together to maximize their learning. The Students should work in groups, collaborate and cooperate and employ a series of several tools that will facilitate interaction and communication, so that each student brings an individual approach to the common project.

Problem Based Learning (PBL): This strategy involves asking a question to a group of students (usually open-response), in this context, they have some resources and a facilitator, but not theory. Engineering can be given in the context of design as well-designed problems require the student to engage in both qualitative and quantitative research which will be new for students.

Project-Based Learning (PjBL): Project-based learning starts by one or more assignments to guide the production of a final product that can be a design, a model, a device or a computer simulation. The culmination of the project is generally an oral or written report summarizing the procedure used to produce the final product.

III. DESIGN AND EVALUATION OF TOOLS

The tool design was performed based on the syllabus of the Fundamentals of Communication course of the Department of Electronic Engineering of the PUJ, and the active learning strategies mentioned above. In Addition, the Bloom's taxonomy was used in order to formulate the learning objectives of the modules (a module is defined as the set of information tools, hardware and software that make up the laboratories). The modules have both active learning and conventional learning. This conventional learning refers specifically to students should read the theoretical framework of the module prior to the beginning of the laboratory.

On the other hand, the active learning is introduced in many ways. First, in the documental tools are visual spaces for

active learning, the color of the blocks identify the type of activity they try to produce in the student, where the blue blocks refer to questions that can generate reflection and discussion with peers, the green blocks are problems it seeks to generate cooperative work among students and the red blocks are projects that allow the application of the concepts seen in the modules by the students. One example of these visual spaces is shown in figure1. Second, the software tools (programs) permits that any student without knowledge in digital processors can modify easily the software tools. This software is also designed to be easy to interact with the code composer of the target, because the programs are controlling by dip switches on the card or from Code Composer with the watch window (shown in figure 2). Finally, the instructor must be an active agent of the process that must have the ability of involve the student in the process. Additionally, he should be able to answer the concerns of students and at the same time challenge the students to try to find the answers to the questions first than the instructor. All these elements will allow an ecosystem to generate active learning that helps the student to achieve appropriate learning and generate dynamic teamwork.

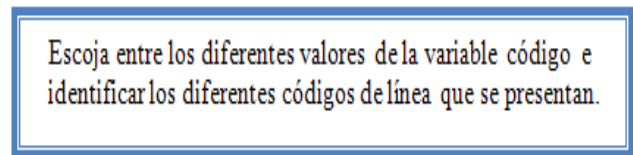


Figure 1. Example of blue visual spaces.

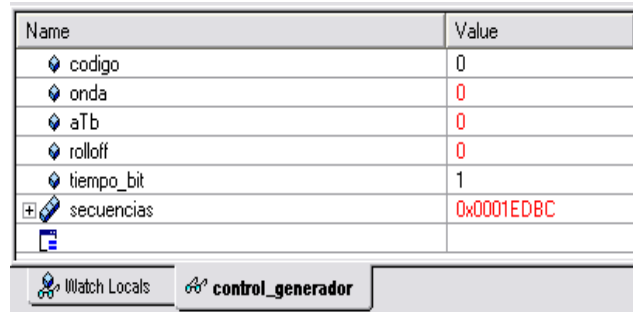


Figure 2. Watch window of code composer.

Four modules were designed, the first one familiarize students with the development board and its programming environment. The other three modules focus on the fundamentals of digital communications, which are about 40% of the content of the course. Next it is presented the objectives of these tree modules:

Module 1. Introduce of learning tools.

- a. The student is able to identify the various components of the TMS320C6713 DSK board.
- b. The student uses the program's environment code composer.
- c. The student is able to make a simple program in code composer.

d. The student uses a program that uses the CODEC and be able to make changes.

Module 2. Online code generator.

- a. The student is able to recognize and discriminate the different line codes with rectangular pulses.
- b. Compare different spectrum of line codes with rectangular pulse shape.
- c. The student describes the effects of the channel on the signal line codes.
- d. The student analyzes the line codes with different forms of wave pulse in both time and frequency.
- e. The student describes the effect of the channel on different frequency spectra with different pulse shapes with line codes.

Module 3. QAM modulator.

- a. The student knows QAM4 based modulation QAM16 modulator with a square pulse shape.
- b. Have students analyze the output of a QAM16 modulator with a square pulse shape.
- c. Have students analyze the spectrum of a QAM modulator with a square pulse shape.
- d. Students can describe a QAM modulation with a sync pulse shape.
- e. Students analyze the spectrum QAM modulator with a sync pulse shape.

The fourth module presents a project proposed to implement a modem with some of the features of the recommendation of the ITU V.22bis, where teachers may change the objectives of the project that fit what these deemed more relevant or important to be developed.

IV. MODULES EVALUATION

In order to evaluate the modules a sample of students in fundamentals of communication was selected for made the modules in a pilot group. They developed modules and assessed through a survey for each module and a general survey, intended to summarize the perception of the modules by the students. The questions were divided into three categories, the first one was the format category, this category referred to the presentation, clarity of objectives, the proposed times and clarity of procedures. The second category asks about the methodology, specifically asks about active learning spaces that were generated with the colored blocks and the last category were on the skills acquired after the module. The questions format used in the survey shown in figure 4, where the scale is as follows: where the lowest score is in total disagreement, then still disagree, then go somewhat agree, agree, and most rating is in total agreement.

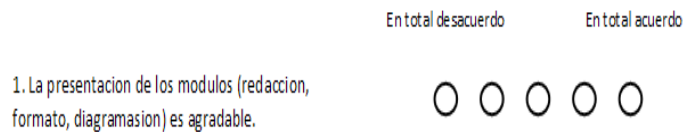


Figure 3. Example of the format in the survey.

The results presented in the figure 4 concerning to the format category of all modules. These results agree with the results of surveys of each module [9], which shows that 50% of students are completely in accordance with the format of the modules, 43% of students are in accordance with the format of the modules while watching a 8% somewhat agree and none of the respondents disagree which shows that the modules format permit to the student be aware of what have to do.

In the methodology category, the Figure 5 shows the results of the general survey questions about the methodology, in this graphic its evident that the students believe (92%) that the methodology with active and traditional mix be useful for they learning process. Specifically, they think that the blocks of color create spaces for reflection, cooperative work and application of concepts. This is evident with 30% of students who said they strongly agree and 62% said they agree. Besides the individual survey results are consistent with the results obtained in the general survey [9].

In the skills category, Figure 6 shows the results of the general survey concerning how easy are the modules for students interact and how this interaction do that they participate actively and in consequently they obtain knowledge acquisition (skills). By comparing the values obtained in the general survey and the surveys of each module [9]. In his figure is observed that most students feel that it is acquiring the skills for each module (95%), in a direct conversation whit they, some of them think that they learn more than the course syllabus; they learn how to think and resolve a problem [9] .

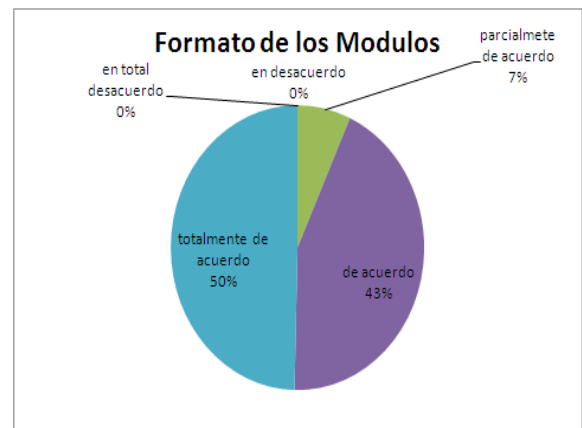


Figure 4. Outcome of the general survey for the format category.

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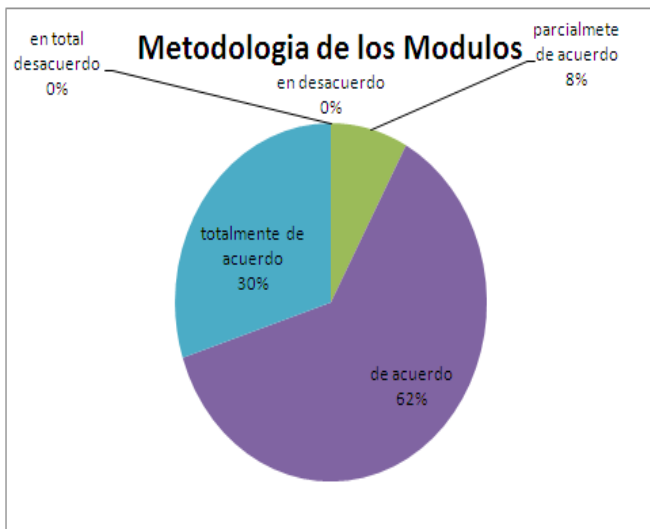


Figure 5. Outcome of the general survey for the methodology category.

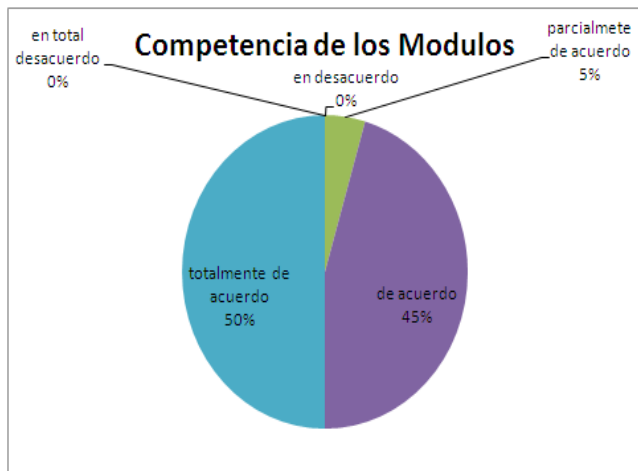


Figure 6. Outcome of the general survey for the skills category.

V. CONCLUSIONS

The results obtained allow us to have a notion of the problems that can occur and also allow us an analysis of our own method of evaluation in order to consider what improvements could be implemented in the form of evaluation of further modules. The survey was applied to a sample which is a portion of the target population of the modules. In order to improve the results of this evaluation is required to address a larger portion of the population of students. The evaluation survey showed a positive result in the different aspects that the survey assess.

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