METHODOLOGICAL INNOVATION IN ELECTRICAL ENGINEERING DEPARTMENT "CONTROL SYSTEMS" COURSE

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ABSTRACT

Pedagogic methods' implementation in the "Control Systems" course of the Engineering program are presented and stressed on Learning Object's Design, cooperative work, case study and site visits. The proposal promotes the teachers' reflection leading them to a role change within the classroom, a change in the design of curricular activities that goes from an exposition-centered teacher to a creative learning facilitator. In addition, students realize about the change and experience and express a high level of satisfaction. This contributes to increase students' attendance and participation as well as better grades.

Keywords: Learning activities, cooperative work, case study.

I. INTRODUCTION

The "Control of Systems" Course is a core course according to Universidad de Chile's Civil Electrical Engineering curriculum. It is programmed for 4th year students who have accomplished common program courses, due to the fact that it is a basic course for their development as electrical engineers.

Our interest in pedagogic methodologies for this course arise from the information provided by teaching assessment tests taken by students, which show a low satisfaction level with the course contents and commonly used teaching strategies. According to that evidence, we took the decision of using this course to test new strategies to attain learning outcomes by a change in teaching style.

Our framework to build up this proposal is a centered "educational process"; within a practical paradigm. According to it, students do not merely guide their learning processes by structured rules (techniques) but by using reasoning skills (Kemmis, 1993). The reasoning is that, not only as a mean-goal instrumental process. It implies that the resulting curricular construct puts teachers on a stage of active decision making and responsibility during the teaching process. Teachers become a main character (far from the technician's classic image) as much as they realize that education is an ethical and practical labor supporting social integration, i.e. a social dimension related to context surrounding this process.

Within this perspective L. Stenhouse (60`s) is a major author who views teachers as researchers of their own practices. He proposes a student-teacher centered curricular development, pointing out that knowledge and comprehension are elaborated by means of procedures that cannot strictly determine learning outcomes.

We seek for a pedagogic work in classroom permanently founded on reflective critics of the teacher's actions. A commitment grows necessarily to support systematic inquiry into everyday teaching as a basis to develop it (Stenhouse, 1975). In conclusion, curriculum implementation is a collective construction process, and entails opportunities to make changes.

II. METHODOLOGICAL SUGGESTIONS FOR THIS COURSE

This methodological proposal was implemented on the "Control of Systems" Course during 2006's fall term. The main objective of this course program is that students are able to "design methods and basic dynamic control systems techniques for both continuous and discrete time," considering that we are talking about a learning process~~,~~. It is clear that it must be accomplished throughout a series of activities designed for achieving a learning level. Now we detail every stage and the course's selected methodological strategies:

1st stage: Teacher-Student interaction analysis. We used Flanders's method (1977), focusing on 3-seconds' teacher-student verbal interaction intervals. Four sessions were recorded the semester before the implementation of the project. Transcripts were made by the method's indications. After coding the information, a matrix summarizes each code's percentage. According to Flanders's method, a main educative character must be identified to be held as a central reference point in analysis, i.e. the actor that leads and sets rules during the pedagogic action. From that point it was possible to prove that the teacher was the main actor with a 92.8% of entire interaction, as the students only represent a 2.0%. We observed also that the pedagogic action type in our case was that of a teacher as an information deliverer. Teachers are used most of the available time to deliver information while students are merely receptors of that speech. Once a report was prepared, a discussion session with the teacher took place based on its results, to plan more interactive strategies. Suggestions were made in relation to communication, time use in classroom (beginning – development – ending), and strengths and weaknesses.

2nd stage: we analyzed the course program to define the proper outcome level to be acquired by students. For this particular course, the strategies agreed on with the course teacher were the following:

a) Learning Objects (Bañan et al, 2000; Wiley, 2000): We outlined its didactic structure so that cultural contents are selected to be suitable for future engineers, discussing with the teacher in every activity, object and any other instance setting students into a context, taking into account that every learning object is designed to be used in a single session. Problems were planned to attain learning outcomes focusing on practice-oriented motivation, sketching control problems as real situations (Fermentators Control,

Thermopower Stations Control, etc.). Subsequently, we detailed situations to be solved taking care of strict relation between situation and session content. Each situation had to be analyzed, discussed and solved in a short time by groups formed by not more than three students.

b) Site visit: Seeking to approach students to Electrical Engineering field as an objective, we planned a site visit to Nehuenco Thermopower Station in the fifth Region, city of Quillota, as an effective element in the learning process. Each step of the visit was carefully planned, from logistic to knowledge construction processes, as also enterprise-learning outcomes relation considering how it facilitates learning for students (Aebli, 2001). Students had previously collected information on Thermopower stations, and after technical visit to Nehuenco a report had to be delivered according to the problem raised by the teacher.

c) Cooperative work: Giving importance to those subjective variables having major effect on teaching-learning processes is a key element to understand such a new dimension in higher education teaching. Life within classrooms must be interpreted as a creation, transformation and exchange of meaning network. The action of teachers in a classroom aims for designing and guiding student-knowledge interaction, so that students enrich and enforce shared meaning systems they elaborate (Sacristán et al., 1995) (see image 1). From a praxiological point of view, helping students to activate their thinking schemes using their own codes for interpreting the world and communicating is what really matters regardless how correct or inappropriate they could be. It is in this process that teachers ought to give time for exchange, due to the fact that their intervention potential is based on the ability to enforce active participation of individuals and groups to elaborate exchange and learning strategies of their own. That is called a cooperative learning (Schimt, 1986) in relation to small group's activities in class, though in our pilot project it was related both to “class development” and homework. Notice that every group member had a role assigned for each activity which had to be changed when starting a new one. In addition, an assessment strategy for cooperative work was designed, which evidenced that every student took steps and success level.

Case Study: (Narcea, 1970). This technique consists of displaying a series of cases dealing with a range of future Engineer’s real life problematic situations to be studied and solved by students. Its aim is to prepare them to get solution-generating thinking. Obviously, some minimal conditions are required as long as we deal with an active learning method. Case must not provide solutions but data to analyze, reflect and discuss suitable solutions in groups. Using case study helped diagnosing decision taking and analysis skills in students. The “Control Systems” Course teacher together with an industry experienced electrical engineer from field prepared a case study named “Electrolyte Circuit Control in a copper obtaining process. Should this be controlled by level or flow?”

III. ACADEMIC RESULTS OF THIS METHODOLOGICAL PROPOSAL.

The results of this proposal were evaluated (students' grades) and assessed (students' opinion survey).

Student's qualifications: The relation established between final grades and classroom participation, measured by cooperative work on learning objects is shown in Figure 1. A tendency to better qualifications linked to more participation can be observed. It must be mentioned that both failing students holding a high participation qualification correspond to students who did not commit enough out of the classroom to practice for graded events. It was revealed during an interview: one student asserted, "I trusted too much, I didn't solve the exercises at home. I should have dedicated more time at home."

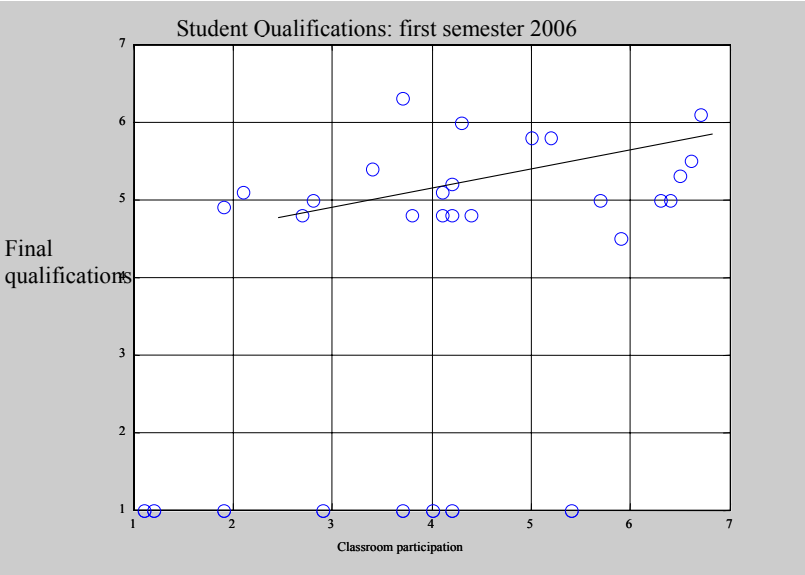

Figure 1.

Teaching Evaluation Survey: It is implemented at the end of each semester by the Engineering School and provides feedback from students to teachers about student's perception on teaching. Survey results demonstrated an increment in course value, remarked by survey comments written by students:

"In spite of the workload it implies, I think that the system tried out by teacher accomplished the objective of getting a better learning of the course contents, much better than without it"
"I liked the changes made to this course; it turned more agile and less slow than it was in former semesters. I think it was good exercising with professors to have a better practice and solve any doubts not having to wait till the end to answer questions".
"I liked the structure given to the course this semester. I think it is a very good idea that other teachers should use"
"Activities facilitate learning"

Satisfaction Survey: It was used to find out the satisfaction level in relation to the course. Results demonstrated a high rate of it. It is worth mentioning that given the question, "how much did you attend to these course sessions?" Results were in close relation with the course's failing or succeeding condition. As we can see in figure 1, the failing rate is associated with those students who attended only 20% }of the sessions.

Among students, more than 80% declare a level of "agreement" with the statement "teacher promoted knowledge transference to engineering field". By this fact, we conclude that students noticed the implementation of that particular strategy. In addition, more than 80% declare the same level with another important statement: "You consider you have successfully accomplished learning objectives defined by teacher". From this level of agreement, we can see that students were aware of the outcomes to be achieved. Furthermore, they feel they succeeded in learning.

In relation to teaching methods, 90% of students also state to agree with the assertion "Methods used by the teacher, such as site visit, case study and class sessions activities, promoted content learning". It leads us to conclude that there is a high rate of satisfaction with the range of implemented methods to get outcomes. In relation to the idea, "it was possible to raise doubts (…)", 80% of students also declare a level of "agreement" which makes evident how the teacher's role changed, for it implies that students feel they were guided and truly considered by teacher.

It is definitive that 95% of students state their agreement with the idea that "The methods used were a useful tool to develop abilities such as team work, oral and written communication and information searching".

In sum, all moves us to believe that the pilot project was satisfying at a high rate for students as also for the teacher, which can be illustrated by the opinions that "the change of the methods increased students' motivation in a meaningful way, a fact which it is noticeable in their active participation in sessions and most of the times in their grades" (Doris Sáez, "Control of System" Course).

IV CONCLUSIONS

This paper shows changes in methodological strategies implemented as a pilot project in a core course of Universidad de Chile's Civil Electrical Engineering program.

The implemented methods were a key element to succeed in the achievement of the course's planned objectives, making clear for instance, that students' cooperative work led to effective course contents learning by problem discussion.

It also constituted an opportunity to develop pedagogic skills in teachers, who realized how significant methodological support could be. A methodological change proposal is thus associated with a change in the teacher's role, from an information-delivering teacher to one that reflects on practice and is centered on tutoring, guiding, creating among other

necessary competences to manage meaningful changes in classroom.

Students are able to recognize a well-planned teaching performance, for it brings about accomplishment of defined outcomes as an increased motivation to keep on looking for information about the course topics.

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