

## **Working with Projects in Engineering Education**

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### Abstract

Presently there is a general assent that for the future the new professional has to have some extra abilities to be able to compete in the new global work market. The world has started a new era, the era of global economy where technology and scientific knowledge are moving the world development in a very fast way. Now the professional competence is measured not only by the work that a man can realize but also by the results that he gets. And so extra abilities can make a difference. Thinking about this we have conceived and developed a new kind of Engineering course. This work is the description with some details of the Engineering Course of the Engineering Faculty of Catholic University of Santos, in which the students have to develop projects since the first year of the course. In this scheme of education the students can count with a Professor/advisor to help them during the process of elaboration of the projects. Their projects are showed in a Congress that happens every year around November. This is a new kind of education that we have named Scientific Introductory Project and that added by Lab works provide the students at least five projects of experience that means more research skills, self confidence and leadership habits. The Mercosul reality has also influenced our project that takes in account the necessity of giving the students a more generalist formation viewing the South America work market.

### I. Introduction

Humanity has never passed through a period of so intense transformations as we are having now. The speed of changes has been higher than any other time in history as consequence of technology development. The scientific knowledge and technology together have improved and become possible the globalization.

The globalization is much more than the idea of a world of no borders. It is the humankind's desire of a bigger integration. It means also an information society where knowledge is the new source of power. In fact the knowledge has become the economical resource of the greatest importance for any professional.

It is not necessary to point out the importance of Engineering to the nations of this global world.

We all agree that Engineering has been playing an important part in the development of new technologies and the acquaintance of scientific knowledge that promotes the new cultural world and social order. In this New World we can detect two challenges for both the professionals and the Educational Institutions. To the professionals the challenge is to search for an Educational Institution capable to give them the adequate formation to face new global economy. To the Educational Institutions the challenge consists in developing new generations of good professionals as well as to develop good scientific research. And so the Universities are fundamental and irreplaceable.

In Brazil another data that should be taking in account is that less than 10% of students that conclude University courses belongs to the Engineering area against 50% in Japan, 60% in China and 23% in USA. This is not very good once Engineering is so important to the development of the country.

This work has the goal to show with some details, the experience that Catholic University of Santos has been developing to overcome the challenge to adequate the future Engineering Professional to the new market of the new century.

It is a way to form Engineers in which the students, since the first year of the course have to develop projects in what we call “Scientific Introductory”. It is a process of integration of Theory with the practice because since early the students have to work in projects, they have to propose, to develop and get the conclusions in according to the proposition.

## II. The University

In Brazil there are four kinds of Universities: The State Universities supported by the States; The Public Universities supported by Federation; The Private Universities supported by foundations and students payment; and Private Community Universities like all the Catholic Universities of Brazil.

The Catholic University of Santos - UNISANTOS - as University is an academic community that in a critic and rigorous way contributes to the defense and the development of human dignity, as well as to the cultural inheritance, by the research, education and services to the community. Altogether with the values in common with the whole University, the UNISANTOS devotes in a special way to the cultivation of human values and Christian ethic, for building a renewed democratic society, fairer and more equal.

It confirms the man’s primacy over the things, the spirit over substance, the ethic over the technical, so that science and technical are to men’s service.

UNISANTOS recognizes and defend the universal right to education and man’s free choice of education types. Inserted in a pluralist society it accepts all kinds of people, with no distinction of race, color or creed, since the legal demands are satisfied and the respect to the Catholic Identity of the Institution.

UNISANTOS has as one of its goals, to prepare professionals with a solid Christian formation, remarkable in knowledge, qualified to the efficient performance of their functions, with a sense of social responsibility. They are witnesses in the world of their Catholic Identity.

The members of University Teaching Staff are chosen among people of scientific merit, technical competence, professional honesty and life probity socially accept and respect to the principles of Catholic doctrine.

The entrance and the permanence in the Teaching, Student and Administrative staff is a free and individual option, what implies as an attitude of coherence to the compromise of respecting the principles that guides the Institution.

Every exercise of functions is a service to be realized with dedication to the university community.

UNISANTOS predisposes to a permanent evaluation of its performance, searching for a continuous institutional improvement and the accomplishment of its objective.

### III. The Engineering Faculty

The Engineering Faculty of Catholic University of Santos provides the students a solid professional formation allied to a humanistic formation in according to the Philosophy of the University. It has the preoccupation to make the curriculum structure adequate and suitable to assure the students a good professional performance and the ability to face the challenges of future world.

The high level of Education is a consequence of a good Teaching Staff, Researchers, Technicians as well as the high level Students who are rigorously selected. Besides the good material conditions which includes Libraries very well equipped as well as the Labs, Internet access and so on. The Professors can also count with all sort of extra equipment they eventually need for the classes.

### IV. Engineer of Conception and Engineer of Application

There are two types of Engineers that are named Engineer of Conception and Engineer of Application<sup>1,2</sup>. In developed countries there is a clear distinction between them. The first one has a university formation and the other a superior technician formation (not university).

In Brazil the difference is not so clear because there is no distinction between university Education and third degree Education (not university).

The Engineering Faculty of Santos and which is part of a University has the goal to form Engineer of conception. However, it is not possible to form Engineer of conception ready for the work market with the traditional under graduation course. There is the need of complementing with the skill of good practical work to the effective professional performance<sup>3</sup>. One solution

that we have been developed is to complement the course with the necessary enlightenment to get this. In our course the students have to develop projects, individually with the guidance of a Professor/adviser chosen by the student. They have to propose, to develop and to implement the projects and get the results. So at the end of every year they will show their projects in a Congress.

#### V. The "Scientific Introductory"

This is a process of integration of Theory with the practice because since early, in fact since the first year, the students have to concept projects. They have to propose, to develop and to get the conclusions in according to the proposition. The projects are presented in a Congress that happens every year and evaluated by some of invited Professors.

The curriculum was elaborated in a way that the experience in what we call "Scientific Introductory" is part of the course. This is in fact a subject that gives to the students the guidelines and subsidies to develop researches. The main objective is to decrease the conflicts between the academic learning and the use of knowledge.

This subject provides the students the theoretic and practical knowledge qualifying them to incorporate the knowledge of Engineering areas in the process of project creation.

#### VI. Scientific and Technological Introductory Congress

As the Engineering Faculty of UniSantos is not a Superior Course but a University Course, so it has the function of forming the Profession and not Professionals. It has the goal of forming Engineers capable to develop Science and technology, capable to innovate and so capable to compete in the changing global work market where there is no place for amateurs.

So to realize this goal we have also developed the Science Introductory which is as related before, the integration of theory with practice.

This new scheme of Education mobilizes the whole Institution and the University has created a "Science and Technological Introductory Congress" for all students of Engineering to show their projects to the Academic / Scientific and Industrial Community<sup>4,5</sup>.

It is an event that takes place in the Engineering Faculty of Catholic University of Santos, around November, that is the end of the scholar year.

The Section is presided by the Professor/coordinator and the students show their projects to a group of Professors who are specialists to evaluate the works. The approval of the works is necessary condition to the approval for next year.

The development of the project, the presentation, the score, is a lot of pressure. Anyway it has been working well, because even the students realize that after they get used to, it becomes easier to face hard situations.

With the success of the Congress, from now to the future the ideal is to open the Congress to other fields of knowledge in the University so that all the students have the opportunity to show their projects to the community. It is part of the philosophy of integration of practice/theory for all courses of Catholic University of Santos.

## VII. Project's Description

This Project consists of the union of a high academic process with a strong emphasis to the activities of "Scientific Introductory" offered to the students in University Labs. This will provide considerable benefits not only to the students but also to the University and the Enterprises that are the main clients of University.

As related before every project developed by the students during the year are presented in a public section to three Professors, specialists who evaluate the works. The section is presided by the Coordinator/Professor and the approval of the work is necessary condition to the approval of student for next year. The projects are also included in Proceedings of the Congress which are distributed to all University and some segments of the Academic Community.

The students are stimulated to assume more responsibilities and so they have to work hard to ensure the good score for their works. They pass the day in the University taking classes, in the Labs, in the Libraries and they have after six in the evening to develop their researches and to study.

Besides the project of "Scientific Introductory" the students also have other works of other subjects to do.

The Project that is the introducing of this new method was planned considering the following aspects:

- the Global Economy which has an incidence straight in Education, with the fall of the boundaries and the exchange of ideas, technologies and culture;
- the new work market that is emerging because of the advanced technological achievement;
- the technological transformations principally in transport and communications that are approaching the distances;
- the changes in the entire Producing System;
- the consequent changes in the work relations;
- as well as the consequent social transformations that have been promoting deep and strong changes in human relationship;
- the Educational Policy of the Country;
- the historical and political moment of the Country and the fact that we are a "developing country";
- the geographical situation of the region: Santos is part of what is called "Metropolitan Region of Santos". Its population is about one million in habitants and this number triple during summer time. It is also a beach resort with 7 Km of sand in full beaches. Santos is also very close to São Paulo the capital city of São Paulo State and close to Cubatão City where is one of the largest

Industrial Park of Latin America. Santos has also the biggest seaport of Brazil that is responsible for the exit of most part of the exportation of the country. In Santos there are five Universities and a large number of students come from the hinterlands of São Paulo State and from others cities of Brazil.

- the material and human resources available in the University, which includes the good Labs and a very good staff of Professors and Technicians, and of course the students.

The students are selected by the "Vestibular", a selective exam to get into the University Courses. Catholic University of Santos has the most selective one. In the Engineering Courses around 1/5 of first year students has been getting approval for second year, which shows a tendency of a rigid study to make of them besides good Engineers also good researchers. In fact Catholic University of Santos traditionally has been forming through the years leaders of the region in the several segments of Santos Community.

### VIII. The Engineering Curriculum

To implement the new Engineering Course, one of our preoccupations was to make the curriculum more dynamic, present and flexible just to accompany the quickness of the changes in the several areas of Science. So it became necessary to adopt a new organization strategy for Engineering Courses because of the growth necessity of constant reorganization of the curriculum.

To get this goal the curriculum was created so that it is possible the constant adaptation to the necessities of the economy, industry and the society. Then we have been concerned about the items listed below:

- attention to the changes of professional practices;
- the courses tend to a generalist organization so that it is possible to face the quick mutations of knowledge;
- logical coherence between the contents of basic disciplines and the specific necessities of Engineering Courses;
- and above all the radical renewal of unnecessary repetitions.

Other concerns have been the didactic adequacy of scholar practices and the conditions in which the process develops.

This adequacy was tempted by means of:

- the student has to feel himself an Engineering student since the beginning introducing technical subjects since first year of the course;
- permanent attention to the students;
- appropriate locals for studies;
- Library.

Added to this, every student has an advisor who supervises his Science/Technological Introductory project until the presentation at the Congress.

## IX. A Step Further

For 1999 for the first years of the course we have included as an extra curriculum week what we named Preliminary Course. It happens during the week before the course starts and the students have some subjects that will help them to have a better performance in the next five years.

These subjects were chosen considering the necessity that we have been feeling to emulate their critical spirit and their creativity besides some previous knowledge that need to be reminded. For this goal we have chosen the following subjects:

- Creativity;
- Engineering History;
- Calculus Introductory;
- Human Behaving;
- Scientific Methodology.

The respective specialists have elaborated the contents of the subjects in according to the proposal. The classes are as much as possible more practical than theoretical. The group makes an evaluation of the contents as well as a self-evaluation that are part of the objective of developing their critical spirit.

## X. The Profile of the Engineer of Catholic University of Santos.

The Engineer of Engineering Faculty of Catholic University of Santos will have a wide formation involving the several areas of technological knowledge.

The main focus of the study of these areas is to endow the future professional of a bunch of information and knowledge that will provide him to work in a consistent way in any activities of the Engineering area. His formation is Engineering so the professional will have a vast technological and scientific culture in a way that he can apply scientific information and knowledge, as well as the technological progress to realize his projects <sup>6,7,8</sup>.

He is a highly specialized Engineer; he is used to leadership situations with administration and management skill besides the reasonable experience in projects development achieved during the course.

They will be able to perform effectively in the new global work market <sup>9</sup>.

## XI. Results

Along the years of this new Course we have been watching a raise of projects quality that students have been presenting.

The Professors like the experience of guiding and accompanying the Projects development. It is outrageous the complex and the diversity of conceptions and creations. For them it is also the opportunity to get in touch with new technologies the students bring to their works <sup>10</sup>.

The students recognize it is a great opportunity to feel how it is to be Engineers since the beginning. By the other hand they feel pushed to get good results and the presentation is a stressing experience for many of them. Fortunately they do their best to face this situation which will provide them more confidence to face crowded meetings anytime.

## XII. Conclusion

First of all there is something that must be emphasized, which is the peculiar characteristic in Education of Engineering Faculty of Catholic University of Santos that is looking for a way to form professionals capable to innovate. The course provides the students a real integration between theory and practice. Besides the Catholic University of Santos has been stimulating in a new way the national research because it requires the students a real work as researchers.

So on the contrary of what occurs in the traditional Superior Educational Institutions the Engineering Courses of Catholic University of Santos offer the conditions to the employers to supply the necessity of good experienced professionals hiring ours.

This is the realization of a new phase to the Education in Brazil, a pioneer initiative of UniSantos that is at the moment the only one in the country, which the curriculum grating considers the elaboration and development of scientific and technological projects, individually since the first year.

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