

## A Non Orthodox Method for a Biomedical Engineering Program

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### Abstract

The new world that is emerging brings to the education institutions the challenge of forming a new kind of professional: a professional with solid formation, who is capable to think global and acting locally. In a Country like Brazil it is very important to have engineers committed with science and technology research principally in biomedical field, because despite of all problems of policy nature it has, it is a Country that medical and engineering fields are not behind any other, Country like USA and France for example. So it is possible to get good results in the proposal of university programs for these areas. With the goal to change the old orthodox pedagogy for engineering education the coordinating team of Engineering College of Lusiada University Center has conceived a different kind of engineering program. It is a five years program of Biomedical Engineering, which main characteristic is the inclusion of what has been named "Challenge Cycle". It consists in extra classes of peculiar areas of human knowledge, specially selected to make the students to develop their abilities of applying their skills in the global context with success. The courses last a period of four months each and the professionals are invited, some of them belong to the academic midst, others not and they are hired specially for this program. They are engineers with solid theoretical knowledge of management, economy and law and possessing great biomedical basis. At the end of the Biomedical Engineering Program the student will have a full formation in Electrical and Computer Engineering, which is necessary in according to the Education Law for third degree in Brazil.

### I. Introduction

Education has most of all, to promote the natural ability of the mind to set and to solve problems and by inter-relation to stimulate the full usage of general intelligence. This general intelligence is the human capability to deal with problem viewing the global aspects that surround it. So it is the global and the complexity that are now more than ever evident in our lives.

Are the Universities prepared to defeat the challenges promoted by the development of science and technology? The answer is yes, because it is a secular institution that has been adapted itself to the needs of society since its creation, even in a Country in development like Brazil, where the Universities are very young. In a country like Brazil it is very important to form professionals committed with the creation and development of science, principally in biomedical field, because Brazil despite of all problems of management it has, it is a Country, which in medical and engineering areas are not behind other developed Countries. So it is possible to get good results in the proposal of university programs for these areas.

With the objective of changing the traditional and orthodox method of engineering education in the Country, the coordinating team of Engineering College of Lusiada University Center has conceived a different kind of approach to a Biomedical Engineering Program. It is called "Challenge Cycle", which consists in the inclusion of extra classes of peculiar areas of human knowledge, specially selected to make the students to develop their abilities of applying their skills in the global context with success.

## **II. Lusiada University Center, Quality and Community Services**

Lusiada University Center is a very young one, with a history of success and involvement with society. It has merged and has been acting not only as an education institution of excellence but also as one of the most active institution, which promotes the welfare of Santos community in many fields.

Its history starts in 1967, when the Lusiada Foundation was created and it started its activities with the Medical Science College. In 1969 Management College began and after having consolidated the two Colleges, other Colleges has come. Finally in 1993 the Education Ministry of Brazil recognized the Lusiada as a University Center. The main characteristic of University Center of Lusiada is the preoccupation with the excellence of education that it offers. This characteristic is expressed in its modern and well-equipped laboratories, libraries and research centers.

Besides a high level of Faculty with 400 members, the University Center of Lusiada also maintains services to the community. By an agreement between the University and the city Hospital, the "Guilherme Alvaro Hospital" can receive around 11 thousands patients per month. It has 220 places and 22 are reserved for Aids patients. Besides it has the most modern Dental Clinic with an average of 30 people attendance per day. All its Research Centers develop a work close to the community, which has a positive result providing the students knowledge and experience <sup>1</sup>.

## **III. The Challenge**

A new paradigm of education has emerged and it preaches that the capital is the intellect and people are the most important, but by the other hand it is still difficult the total absorption of this new model of development. The education institutions are redefining its rule in present society and so it became necessary the adoption of new approaches. New programs have been conceived, new laboratories and so on. Changes have been happening and many of them are successful. Lusiada's program for engineering education is one of the successful new kind of forming good engineers prepared to face next century.

Although biomedical engineering is a young area of engineering it has been contributing to the development of medical and biological fields. In according to the definition developed by the Bioengineering Definition Committee (BDC), which was released on July 24, 1997. "Bioengineering is rooted in physics, mathematics, chemistry, biology, and the life sciences. It is the application of a systematic, quantitative, and integrative way of thinking about and approaching the solutions of problems important to biology, medical research, clinical proactive,

and population studies... It advances fundamental concepts, creates knowledge for the molecular to the organ systems levels, and develops innovative biologics, materials, processes, implants, devices and informatics approaches for the prevention, diagnosis, and treatment of disease, for patient rehabilitation, and for improving health”.

#### **IV. The Biomedical Engineering Project**

The coordinating team of Lusiada Engineering School has conceived and developed a project of an biomedical engineering program, which basic characteristics are:

- under graduation,
- five years,
- the inclusion of new courses
- the effective work in projects <sup>2</sup>.

So besides the basic science courses, basic engineering courses and specific electrical engineering courses <sup>3</sup>, other two blocs of biomedical engineering courses were added and they are:

- Bioengineering: The study of biological systems using techniques and quantitative methods.
- Medical Engineering: Essentially the development of methods, devices and equipments for diagnosis and therapeutics purposes.

The specific courses of biomedical engineering are distributed along the last two years of the program <sup>4</sup>. These courses allied with the basic science courses and the basic engineering courses can provide to the students a new kind of formation <sup>5</sup>, which is much more dynamic and general <sup>6</sup>.

#### **V. The Curriculum**

The curriculum that was proposed and which attends a minimum of the resolution 48/76 of April 27 of 1976 from CFE – Federal Council of Education about the curricula directress <sup>7</sup>. The courses follow basically the ones of traditional program plus the ones that compound the “Challenge Cycle” proposal.

In the last two years of the program the students will have the “Work Term”, which is a period of four months at the end or in the beginning of the last two years. It is a period when the students work effectively in a hospital or research center. A professor altogether the supervisor of the institution supervises the students’ work in part of a project. They have to accomplish their work so that another student that will replace him in the project performs the next step. The effective work in projects exposes the students to the real medical environment and problems, and this provides the interface of the theory and the practice. It is believed that the seeking for the right solution for such problems enlarges their academic horizons considerably.

#### **VI. The “Challenge Cycle” Proposal**

The “Challenge Cycle” consists in the inclusion of extra classes of areas related to engineering and biological fields. The main goal is to make the students to develop their abilities of applying their skills in the global context with success.

The courses last a period of four months each and the professionals are invited and hired specially for this program.. They can be a physician or mathematician or biologist or even a psychologist. There is also an evaluation of the student for each course and a minimum score to pass to next year is required. At the end of the program the student will be a professional with full formation in Electrical Engineer, with strong knowledge in bioengineering, and medicine and health, besides management, economy and law.

## **VII. Evaluation of Student Knowledge Achievement**

The main feedback to the necessary adjustments for the betterment of the curriculum and the content of every course is the evaluation, which provides the teachers the students development and knowledge achievement.

The evaluation criterion is up to the Professor responsible for each course <sup>8</sup>. It can be done by means of works, seminars and tests or any other method. This flexibility <sup>9</sup> is important because of the objective of the courses, which is to give the student an opportunity to develop their abilities of create solutions in according to the demands of medical environment, helping to decrease the impact of progress over nature and men. For sure a minimum score is required to the approval for next year <sup>10</sup>. The students can count with good faculty members, well equipped Laboratories and well served Libraries, Internet access and a staff of technicians specially trained for helping <sup>11</sup>.

## **VIII. Conclusions**

In a Country like Brazil it is very important to have qualified engineers that are also researchers because it is fundamental the development of technology to promote the development of a Country.

The Biomedical Engineering Program proposed by the coordinating team of Engineering School of Lusida University Center has got good results so far.

In according to the evaluation questionnaire applied to the students and to the teachers, both are satisfied with the program principally because of the opportunity they have to be in touch with all the activities a biomedical engineer can act during her/his professional life.

The work in hospitals and laboratories has a special effect in students’ development during the program. The teachers are equally satisfied with the program because it has been a big challenge to accomplish the goal of turning the students in autonomous engineers with research skills and entrepreneurial mind.

Such kind of education prepares the students for the effective professional practice in a more solid way, coherent with the complex demand of present world.

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