

THE HIGH SCHOOL OUTREACH PROGRAM IN THE CATHOLIC UNIVERSITY OF RIO DE JANEIRO

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ABSTRACT - The Pontifical Catholic University of Rio de Janeiro (PUC-Rio) started an outreach program (PIUES) toward the high school system of the city of Rio de Janeiro in the areas of basic sciences. This paper is a report on these activities conducted at PUC-Rio's Technical-Scientific Center (CTC) since 1997. The idea was to improve the contact between the high school structure and the university's scientific environment, through two major ways: 1. students participation in the regular "Introduction to Engineering Course" given for our freshmen, and in scientific research programs in Computing and Engineering areas; 2. refreshing courses to the K - 12 science and math teachers. The obtained results and an assessment of these activities are presented, as well as a plan for future development.

Key Words: Engineering Education, Entrepreneurship, K-12, Technical Literacy

1. THE PROBLEM: THE DECREASING INTEREST ON ENGINEERING

The interest on the career of Engineers reduced in the last few year, what can be observed by the continuously shrinking number of candidates to the School of Engineering, and the high drop-out rate on these schools^[1]. This worldwide problem is paradoxically connected with the present technological revolution.

The technical environment of classes on Mathematics, Physics, and Chemistry is dry and does not mimic the flamboyance of the last technological discoveries. Moreover, some of the negative aspect of the recent advances in technology is connected to an apparent evil face of Sciences. This connection is frequently underlined on the High School student's life.

The High School curriculum tends to be disconnected from the student's daily life; it dissociates the present concept of comfort from the technologies and generates abstract disciplines. The culture developed by the media (TV, Internet or newspaper) shows the present advances in a quasi magical way, far from the possibilities and utterly

independent of the normal professional.

The School of Engineering usually preserves the same approach during the first two years (Freshman and Sophomore periods), underlining the negative stereotype already set by the High School about the career of Engineer.

The lack of a large number of candidates to the School of Engineering and the high drop-out rate add to the formation of a large bottleneck on the number of professional Engineers available in a period when the profound changes in the productive processes ask for a larger number of professionals

The decreasing interest on engineering parallels a decreasing interest on the knowledge of sciences and technology that constitutes the basis to the technical literacy that nowadays defines the minimum mechanisms of defense that our society offers to the normal citizen.

The technological changes in the productive processes have changed the meaning of the new professionals, particularly the engineer. The high unemployment rate of these professionals has been associated to a reduction of importance of this professional instead of to a dramatic need of change on the scope of this profession.

2. WHY THE DECREASING INTEREST ON ENGINEERING NEEDS TO BE REVERSED ?

The world is living its third industrial revolution wave^[2]. This third wave is characterized by an increased use of computer sciences and information technology in a

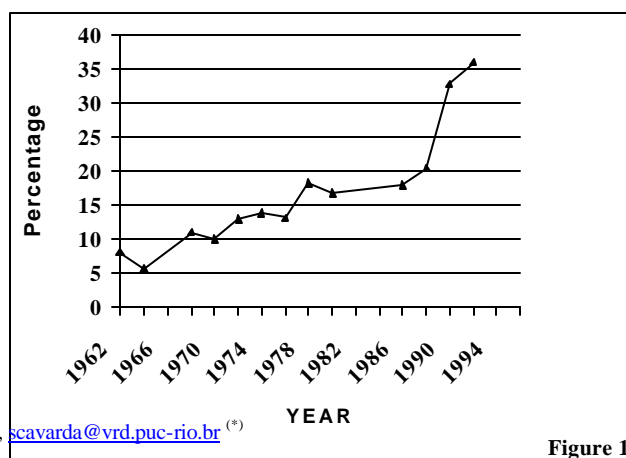


Figure 1

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capillary mechanism in the whole society; this fact gave birth to a rapid increase of a service society with a large majority of its labor force involved on small and medium size business.

Figure 1 Shows the relative increase of engineers in small firms^[3]. The process, that became much faster in the 90's of the past century, changes the vision on the mission of the engineer in the society from a completely technical professional with a s **YEAR** c basis to a professional that added to these **abilities a full** command on managerial skills, and also a solid cultural basis and market vision^[4].

The social consequences on the dramatic changes in the productive process can be understood from the data in figure 2 on the American workforce on a 150-year period^[5].

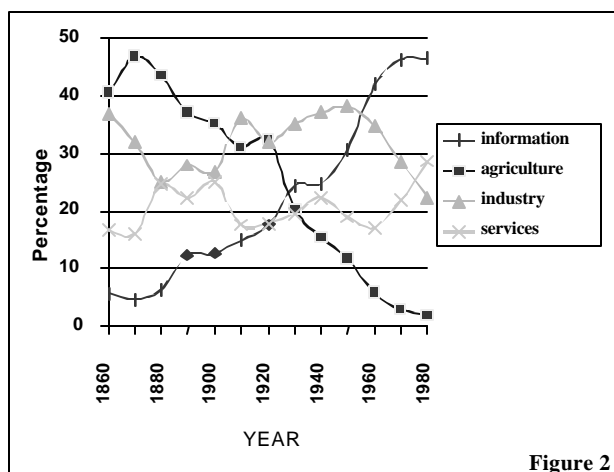


Figure 2

As an example, in this period the workforce shifted from agricultural to urban and, specifically from the end of the second world war to the early 80's, the workforce on the manufacture industry started to shift to the service sector.

The role of the engineer, as much as the daily life of every citizen, changed with that new technology driven process depicted in figure 2. The secondary school and the School of Engineering responded slowly to these processes, becoming a reactionary element in a chain of institutions. In the knowledge society, where knowledge is an obvious economic asset, the high school and the school of Engineering became central institutions in the betterment of the social conditions.

The importance of these institutions is more deeply felt in the developing world, where the third industrial wave cohabits with aspects of the previous two waves that were not yet fully absorbed neither by the local industry nor by the whole society.

The lack of perception of the high school and the school of engineering may be observed by:

- the slowness in changing objectives
- the conservative organizational and administrative mechanisms
- the difficulty in implementing new didactic techniques

based on the already abundant and widespread information technology

The lack of social perception created the typical "school environment" where the "academic" view contrasts with the "real" view. Moreover, in the Secondary level of education, many schools post an anti technological view of the development and teach values that simply are not connected whit the daily life.

The changing role of the engineer in our society needs to be understood by the students either in the high school as in the first two years of the school of Engineering.

3. HOW TO START THE REVERSAL OF THE DECREASING INTEREST

Measures to increase the interest for the career of Engineering and for Sciences and Technology must take into consideration that the University and the High School share the problem. The PUC-Rio outreach program receives high school students and helps schoolteachers with refreshing courses and, at the some time the discipline of the Introduction of Engineering is offered for high school students.

The efforts are now centered on the high school and in the freshman period, allowing students of practically the some age to work together in teams. These efforts involve the schoolteacher, the high school student, the freshman and the University Professor, all them part of the problem and part of the problem's solution^[6].

4. THE EXPERIENCE OF PUC-RIO

4.1 PIUES - UNIVERSITY, HIGH SCHOOL AND SOCIETY INTEGRATION PROGRAM

PIUES is an acronym in Portuguese to the University, High School and Social Integration Program. This program is an effort to respond to the present need to develop the interface between the University and the "outside world", particularly the High School.

The main objectives of PIUES are to improve the K-12 Sciences Education, mostly in the High School period, and to built a bridge between the University and High School activities.

The more important joint activities were developing in the Department of Physics, Department of Mathematics, and Department of Chemistry.

DEPARTMENT OF PHYSICS

The activities on the Department of Physics gave birth to PIUES. The main activities are :

- Visits to the PIUES laboratories by high school students. The three-hour sessions cover the areas of Physics that are common to the High School curriculum and the Freshman years. This activity must be part of the discipline of Physics in the High School

and tends to cover the traditional lack of laboratorial work on the high school.

- Partnership with institutions that diffuse scientific information.
- Live transmission of laboratories showing a typical research unit, starting with the Laboratory of Superconductivity and cryogenics.
- Internet interactive questions and answers chats with the program professor.
- Mini courses for high school teachers.

DEPARTMENT OF MATHEMATICS

This Department develops an important program to refresh high school teachers on modern aspects of Mathematics; computers could solve mostly tackling on questions that.

DEPARTMENT OF CHEMISTRY

- Visits to the teaching laboratories of the Department of Chemistry by high school students trying to fill the gap created by the lack of laboratorial practices on Chemistry in the high school.
- Mini courses for high school teaching.
- A graduate program on Chemistry teaching on the High School.

4.2 SCIENTIFIC INITIATION AND INTRODUCTION TO ENGINEERING : PROGRAMS TO HIGH SCHOOL STUDENTS

Some activities were recently designed to strengthen the interface between the University and the High School System.

The first activity deals with Scientific Initiation in Basic and Technological areas, which is a traditional program in Brazil, devised to help undergraduate students to understand the mechanisms of research, and is usually an activity restricted to graduate students. This program has been an important bridge between undergraduate and graduate activities. In our outreach activities we are extending the "Scientific Initiation" program to high school students, trying to instill in their spirit the habits of research. During the past two years we received about 50 students (from 10 public high schools) which were located inside 20 different research groups, in physics, engineering and computation projects.

The second activity is the extension of the discipline of "Introduction of Engineering" to the high school. This discipline was conceived in 1997^[7] for Freshman students as a mechanism to give students a hands-on experience on design just in their first contact with the School of Engineering. The objectives of this extension are two-fold: to show a more realistic environment of the career of engineering to high school students and also to attract talents to the school of engineering.

For both activities we defined a strategic plan:

- We chose 12 well known high schools in Rio de Janeiro

- We chose a small number of students per High School (around five).
- Each group from each school had a project assigned to them with a tutor in the high school and a tutor in the University. Both organized on agenda of meetings.
- The final presentation of the high school students was done at the same time as that of the freshman.

4.3 RESULTS AND ASSESSMENT

All this programs were devised to attract talents to the University, to reduce the dropout rate in the University^[8] and to stimulate high school students to interest themselves to sciences and technology. These three goals can not be easily measured in the short run. Nevertheless, related to the PIUES program it is important to point out that the student's interest grew to the physical limit to the laboratory and a growing number of university students recall their time as a participant in the PIUES program.

A set of questionnaires filled by high school students was used to identify the positive and negative aspects of the cited programs. We list the more important entries:

- POSITIVE ASPECTS:
 - Freedom to access the Internet
 - Facility to contact the tutors
 - Better knowledge of the university realities
 - Discovery of the real meaning of "doing research"
 - Importance of team work
 - Perception of the meaning of being an Engineering
 - Contact with highly qualified professionals
- NEGATIVE ASPECTS
 - Very few computers were continuously available
 - Reports with very general information without a real individual evaluation
 - Contact with tutors were easy but the communication was difficult
 - Inflexible schedules for laboratory use
 - Difficulties on the used of what were considered a huge library.

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