

Engineering Education Program Promoting the Profession

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Abstract—Many Engineering colleges have been facing the retention issue because of difficulties and lack of knowledge about what really means being an engineer. The first 3 years are particularly intense and hard. A possible way to overcome this period is to implement a new kind of course, more enticing and dynamic, which is the idea of COPEC's engineering education research team, to embed a course with a more interesting activity for students in the first year. Current students have access to multiple ways of learning. They make use of a range of learning sites, both physical and virtual. Currently, students are very smart users of modern technology and are well connected with the online world. They are already international. However, an international experience adds a lot to their reality. It also promotes an early picture of the profession in their minds. So, this program provides students the possibility to perform as engineers in an international environment. It is a project developed for a private university in order to foster the retention rate in their engineering courses.

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1. Introduction

In the 21st. Century, new paradigms of business, work and education have brought a greater need for workers with higher levels of education and specific skills to perform in advanced economies. It is a fact that under-skilled workers are disappearing, due to automation and low-cost labor markets abroad. Nations worldwide recognize (particularly in the western part of the globe) that it is urgent to train a larger number of engineers with technical knowledge, as well as with soft skills.

Engineering courses are full of important core subjects, however it is necessary to innovate and find ways to embed the curricula with important topics to attend the current global trends. Once engineering skills are internationally portable, leading to international mobility, which engineering can easily provide, and it is, in fact, an increasing trend. Intercultural skills, knowledge of languages and cultural prejudice management are very important, because opportunities are broad less and it is important to be able to adapt to any different cultural environment.

Another fact, which is not new, is that many engineering colleges have been facing the retention issue, due to the difficulties and lack of knowledge about what being an engineer really means. The first 3 years are particularly intense and hard. A possible way to overcome this period is to implement a new kind of course, more enticing and dynamic. This is one of the proposals of COPEC's engineering education research team: - to embed a course with more interesting activities for students, sooner in the first year. It is a short-term workshop to show students the possibilities of performing as engineers in a global environment – a project developed for a private university in order to reduce retention rate among students of engineering courses.

It is a 3 months' period, in the second semester of the 1st. year, when the students have different classes, which are more dynamic, due to the mix of site visits, lectures, project proposals, travel period and project presentation. It is a very dynamic experience that provides students a clear view of what it is to be an engineer and what their possibilities for the future are.

The final goal of this project is to provide a sophisticated period to implement integrated environments for teaching/learning systems. It is in fact a way to reduce the evasion of engineering courses, showing a glimpse of what it is to be an engineer and the wide varieties of opportunities worldwide.

2. COPEC: Science and Education Research Council

COPEC – Science and Education Research Council is a multi-disciplinary organization, leader on advance science and its application to the development of technology serving society. It started its activity sixteen years ago and since then this organization has made a major contribution to the development of science and education, working to increase the best practices in several research fields.

Integration activities promoted by COPEC provide a qualified coordination and building partnerships, because COPEC is an organization that brings together scientists who share the mission of promoting and developing science, technology and education.

The objectives of COPEC are to promote professionalism, integrity, competency, and education; foster research, improve practice and encourage collaboration in different fields of sciences.

Contents, tools and services provided by COPEC, through courses, publications and consultations, with national and international experts, contribute to the promotion of the professional who wants to be privy of new achievements and service of men to technology.

COPEC enjoys respect and recognition internationally, characterized by the open discussion, the free exchange of ideas, respectful debate and a commitment to rigorous inquiry. Its IIE – International Institute of Education – is a bold and resilient source of innovation in higher education [1].

3. Contemporary Aspects of Education

Work environment worldwide has changed drastically, and today millions of professionals are also unemployed, even in advanced economies. On the other hand, businesses in economically advanced countries claim that they are often not able to find workers with the required skills. It is a fact that, this is a symptomatic dysfunction due to the structural changes that are transforming the nature of work and reshaping employment opportunities. This shows that organizations and policies are not keeping up with the changes in business practices and new technologies are defining what kind of jobs will be created and where they will be located. So there is a need for companies to redefine how and where different tasks have to be carried out, requiring new skills and new employer and employee relationships [2].

It is also important to attempt that globalization has been expanding access to low-cost talented professionals and creating a greater need for workers with higher levels of education and specific skills in order to perform in advanced economies. Under-skilled workers are disappearing, due to automation and low-cost labor markets abroad. In this world scenario, education and training should be seen as vital economic priorities by governments. However, it is still possible to observe some nations neglecting this, perhaps due to the lack of political interest other than electoral.

Although governments need to invest in the entire system, which builds workforce skills, in some places it is up to private initiatives to offer opportunities for young ambitious talented professionals, who can cooperate for a better future of generations to come. There is no better place than universities to offer these opportunities, pushed by the enterprises. It is important for nations to train highly skilled native-born citizens, as well as to attract highly skilled immigrants, in order to be competitive in a global scale and assure a future for the people [3].

Finally, government agents should be aware of the fact that, if there is no production system, there will be no financial resources to maintain the social assistance sys-

tem. This idea of an innovative office will help to generate more quality services to improve industry service, as well as the production system, generating opportunities and jobs, which is a need everywhere in the world today [4].

4. The Course

Engineering is a challenging and dynamic profession, however, unknown mainly among the younger population. Some very bright students are advised to pursue medicine or Engineering. For those who choose engineering, however, the first three years are not charming and do not show what it is to be an engineer. It does not show students the very important work that they might accomplish in their lives. How much they will help human beings in daily life and how much engineering is important for the world and mainly the world people live today.

The proposed course promotes and allows students to get to know what it is to be an engineer. It is a short-term workshop which shows students the possibilities of performing as engineers in a global environment with the goal to reduce the retention rate in engineering courses.

It is a 3 months' period, during the second semester of the 1st. year, when students have different classes, which are more dynamic due to the mix of site visits, lectures, project proposal, travel period and project presentation.

Besides the proposal of a project, which students have to develop, the course includes a short study abroad period, preferably in Europe. It happens in between the project proposal and the presentation of it after the trip, ending in October before the tests period.

The period abroad includes Technical, Academic, Social and Cultural activities, all very important to have a real experience, however, brief, and to understand a little about the lifestyle, history and culture of a country, elected by COPEC's education team.

All activities are performed within two weeks of intense work, generally in September. During this period, students also have lectures, visits to companies, universities, as well as social and cultural activities, which will provide students with a great experience and discover a different world.

It is a very dynamic experience that provides students a clearer view of what it is to be an engineer and what their possibilities for the future are. Students acquire inputs and ideas that instigate their imagination.

The period abroad can be done in more or less days, according to the needs of the course proposal for the period. Activities can be changed to fit the availability of organizations and people involved, as well.

Besides this period other activities are programed such as enterprises visits, as well as keynote speakers during the "Engineering Week". The idea is to invite successful engineers to speak about their path to where they are now. The speakers are invited to show mainly what the positive and negative points of the way are, what they had to change, give tips and hints etc. The idea is to provide more information to motivate

students even more to keep going, finish the program and later to pursue success in their career.

5. Method

The team has chosen to design the course abroad in three phases:

Phase 1 – when students have preferably Industry lectures and are challenged to develop a project proposal in a specific engineering theme.

Phase 2 – when students go abroad for a short period.

Phase 3 – when students present their project proposal to a group of invited professionals who evaluate them.

The course is designed to introduce the world of engineering to the students and also to present them a bit of another culture, touring through several academic and business environments, developing cultural activities, exploring the history, experience local public services, where engineering plays an important role. The proposed course consists of an opportunity to improve the training of engineering students, providing them with an excellent experience, by meeting the practice of engineering in many sectors as well as providing them an experience abroad.

The students are graded and the best project group is invited to have an internship in one of the enterprises of the region, which are interested in having some of these students for a training period.

It is intended to enlarge the experience and send the students who have designed the best project abroad again for a short period to a university to work close to a group of researchers in their field of interest.

6. Details of the Period Abroad

The period abroad includes lectures, visits to companies, universities, as well as social and cultural activities, which will provide students with a great experience and allow them to discover a different world (see Figure 1).

The course can be done in more or less days according to the availability of the group of students. Activities can also be changed to fit the goals of the course. It is, in fact, a very flexible part of the course.

Within the academic activities, students have classes and participate in activities in different universities.

Technical activities include visits to some companies of the visited country. The lecturers are generally very technical in content, being some of them about administration aspects of projects and businesses generated from them.

Visits to laboratories and research centers are the main activities, developed in a pre-established framework, in accordance with the objectives of the program. In general, they follow the main theme developed by the students' groups in their project proposal. For example, "the development of sensors for data collection in subway fluxes in rush hours", one of the main themes developed by the groups in 2015.

During social activities, students have the opportunity to visit some local meetings with other students in a friendly environment.

Cultural activities provide students with concepts of history and art, as well as the way of life, including guided tours, visits to museums, and other related activities.

All proposed activities take place in a way that students can experience the educational environment, business, culture and lifestyle of the country.

September 2016						
Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
				1	2	1 st Day 3
						Evening: ✓ Leave for Abroad
2 nd Day 4	3 rd Day 5	4 th Day 6	5 th Day 7	6 th Day 8	7 th Day 9	8 th Day 10
Morning: ✓ Arrival ✓ Trip to main city ✓ Check in Hotel ✓ Rest time, unpack Afternoon: ✓ Walking tour to acknowledge the surroundings of hotel Evening: ✓ Dinner with typical food	Morning: ✓ Visit to University ✓ Lunch Afternoon: ✓ Lecture Evening: ✓ Free	Morning: ✓ Visit to enterprise ✓ Lunch Afternoon: ✓ Lecture Evening: ✓ Free	Morning: ✓ Trip to city 1 ✓ Visit to University ✓ Lunch Afternoon: ✓ Lecture ✓ Ride back to main city Evening: ✓ Free	Morning: ✓ Trip to city 2 ✓ Cultural walk ✓ Lunch Afternoon: ✓ Lecture Evening: ✓ Trip back to main city	Morning: ✓ Cultural Trip ✓ Lunch Afternoon: ✓ Visit to Churches ✓ Visit to small business Evening: ✓ Trip back to main city	Morning: ✓ Lecture ✓ Lunch Afternoon: ✓ City Tour in city 4 ✓ Trip back to main city Evening: ✓ Free
9 th Day 11	10 th Day 12	13	14	15	16	17
Morning: ✓ Free Afternoon: ✓ Free Evening:	Morning: ✓ Leave to Airport ✓ Get into airplane					

Fig. 1. Schedule for 2016/2017

The proposed course consists of an opportunity to improve the training of engineering students, providing them with an excellent experience abroad and to acknowledge the international career that an engineer can develop. Besides the technical knowledge they acquire in site.

The course has the reputation of being demanding, rewarding and intense, providing a challenging educational environment by following high quality standards. The course is also developed to provide to the participants some free time to relax and enjoy the city and all it can offer.

Accommodations could not be better; students stay in comfortable hotels, with all the necessary facilities, in downtown areas of the cities [5].

7. Specific Objectives, Goals And Expected Results

The primary goal of the course is to foster curiosity and passion for the engineering profession and to provide engineering students an opportunity to experience different environments in the chosen profession. They will have a very impacting Engineering experience.

Furthermore, the course aims to:

- Improve the academic skills and leadership;
- Offer the opportunity to live in different cultures;
- Strengthen their career goals;
- Develop researching skills;
- Provide Travel experience;
- Provide a Global experience;
- Explore new opportunities;
- Enrich their life [6].

The project goals are:

- Providing an international academic experience;
- Make the students feel what it is to be an engineer;
- Assist in the development of critical analysis;
- Provide an overall experience.

The expected outcomes of the extra academic classes are:

- Dynamism for undergraduate careers;
- Long-term friendships;
- Technical skills and knowledge;
- Experience different cultures and histories;
- Enrichment of life;
- Valuing the profession [7].

It is important to provide students the core of any profession development, which are the values and sense of identity and about creating a culture of commitment and performance.

8. Partial Results

2016 is the third year of this 1st year effort program and the results are as follows:

Table 1. 1st year effort program and the results.

YEAR	1 st . year students number enrollment in Engineering	*students number enrollment in the special course	% of enrollment rate
2014	213	68 students	31.92%
2015	225	77 students	34.22%
2016	236	95 students	40.25%

The College conducted a survey among the students participating in this program and the results are the following:

Table 2. Survey among the students participating in the Program (2014-2016)

Questions	2014	2015	2016
Satisfaction with knowledge acquisition	56%	64%	72%
Satisfaction with international experience	62%	68%	69%
Satisfaction with acquired skills	65%	79%	81%

For the year 2017 (by the presentation of this work) the proposal is to have a complete chart with statistics about the retention rates acquired with this program so far. The decision relies in the fact that it is necessary at least three years of program to have significant data.

9. Conclusion

In the 21st Century, Universities are becoming the key actor in local development. It is clear that, along history, universities have become international organizations, not only receiving students from all parts of the world, but also through international research partnerships and providing opportunities to students. There is no doubt that this role has become imperative for countries which wish to keep up with a challenging and global educational and research environment. The best universities attract the best students and the best students make the university better.

The enhancement and promotion of students' quality training, as well as employability, brings financial resources, increases teacher's quality and promotes regional development, along with the future professional, no matter the field, but mainly in engineering.

And finally, in the global competitive environment that nations live, no matter the political scenario of the country, governments must invest in Science and Technology for the sake of national economy and development.

This course, in particular, promotes engineering courses, fighting the retention issue, providing the students a glimpse of what it is to be an engineer and increases their possibilities of developing an international career.

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11. References

1. COPEC. Science and Education Research Council, 2017. Available at www.copec.eu
2. Heick, Terry. 10 characteristics of a highly effective learning environment, 2014. Available at <http://www.teachthought.com/learning/10-characteristics-of-a-highly-effective-learning-environment/>
3. Smith, Aaron. Us Views of Technology and the Future. 4 (17), 2014. Available at <http://www.pewinternet.org/2014/04/17/us-views-of-technology-and-the-future/>.
4. Ciampi, M. M., Brito, C. da R., Vasconcelos, R. M. C. F., Amaral, L. A. M.; Barros, V. F. A. Science, Engineering and Technology Innovation for Global Human Challenges. In: American Society for Engineering Education Annual Conference, 123, New Orleans, 2016. Jazzed about Engineering Education. New Orleans: ASEE, 2016. <https://peer.asee.org/26146>
5. Ciampi, M. M., Vasconcelos, R. M. C. F., Brito, C. da R., Amaral, L. A. M., Barros, V. F. A. Engineering for Humanity in the 21st Century: Challenges and Opportunities. In: IEEE Frontiers in Education Annual Conference, 46, Erie, 2016. The Crossroads of Engineering and Business. Erie: FIE, 2016.
6. Ciampi, M. M., Brito, C. da R., Vasconcelos, R. M. C. F., Amaral, L. A. M., Barros, V. F. A. Shift For Engineering Horizons. In: European Society of Engineering Education Annual Conference, 44, Tampere, 2016. Engineering Education on Top of the World: Industry University Cooperation. Tampere: SEFI, 2016. http://www.sefi.be/?page_id=7081
7. Ciampi, M. M., Brito, C. da R., Amaral, L., Vasconcelos, R., Barros, V. F. A. Engineering Challenging Entrepreneurship Practice. In M. E. Auer, D. Guralnick, & J. Uhomiohbi (Eds.), Interactive Collaborative Learning: Proceedings of the 19th ICL Conference - Volume 2 (pp. 444–452). Cham: Springer International Publishing, 2017. https://doi.org/10.1007/978-3-319-50340-0_39.