Promoting STEM studies among young students

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UNIVERSITAT



ECOMUNICACION

What do I really mean with "Promoting STEM studies among young students"?

- What?
- Why?
- How?
- Who?
- Where?
- When?
- A real example



What?: The objective

- Innosoc Case Study 3 2016, Case Study 8 2017
- Promoting STEM Studies among Young Students
- STEM: Science, Technology, Engineering, Mathematics
- H2020 challenge: *Europe in a changing world inclusive, innovative and reflective societies*

The Team

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But...are you alone?

- NOP
- It is a priority for Europe and USA.
 - European Schoolnet: <u>http://www.eun.org/focus-areas/stem</u>
 - eSkills for jobs: <u>http://eskills4jobs.ec.europa.eu/</u>
 - STEM Education Coalition <u>http://www.stemedcoalition.org/</u>
 - US Department of Education http://www.ed.gov/stem

Our effort ...



Why?: The reason we want to do this

- The study of Science, Technology, Engineering and Mathematics (STEM) has suffered a strong decrease during the last decade in Western Countries.
- Is this really true?
 Let´s see some examples



France



Slovakia

 In 2005, there were 27 000 students of secondary school and in 2015 there were 33 000 (it is +8 000 students), but when we see on universities, in 2005 there were 30 000 students, but in 2015 there were only 20 000 students on STEM studies. This is -10 000 students

Croatia



Spain



Bulgaria

Almost 60,000 students graduate every year



Germany

- Germany has a shortage of 210,000 workers in the mathematics, computer science, natural science and technology disciplines.
- Germany has the third-highest average annual raw number of STEM graduates at about 10,000, right behind the US and China –despite those countries' much larger populations.
- The numbers have doubled between 2000 and 2010, which corresponds to 168,000 people cumulatively.
- This will increase Germany's long-term growth rate by 0,35%.

Other countries



Which are the causes of this?

- Two main factors contribute to maintain this situation, even to worse it
 - The own setup of the high school studies
 - The perception that the pupils have regarding technological studies.

The setup of the high school studies

- The balance among Arts, Humanities and Social Sciences, and Science and Technology in secondary studies and Baccalaureate is not uniform neither agreed in all the European Countries.
 - In some high schools the Science and Technology Baccalaureate is not fully completed due to a lack of material resources (a science laboratory is far more expensive than a conventional classroom).
 - Syllabus as Technology and Computing are sometimes optional and the programs of Mathematics and Physics are less extensive than during the 90's and 2000's decades.

France



Slovakia



automatically

Croatia



Spain



Educación de personas adultas





Germany

GRADE A										Ε
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Bulgaria



The perception of STEM studies

- The students have a negative perception of technological studies: difficult and poorly paid.
- Society perceives that ICT professionals are nerds; the media show them as funny strange people without glamour:
 - The Big Bang Theory vs CSI characters, and both are supposedly scientists,
 - STEM professionals vs lawyers, doctors or brokers.



It is true: we are nerds. But...

With whom would you rather go party?



The gender issue

STEM studies are less attractive to girls, only a 10\% to a 20\% of ICT students are women, and those data are not increasing throughout the time.



Is time running backwards?



LEGO in 1970

LEGO in 2015

But is there a real need for all of this?

- Steve Wozniak from Apple asks: Which are the skills that are required to face the future?
- Tony Wagner from Harvard answers:



And what about jobs?

- Despite that the number of ICT jobs decreased a 10\% in Europe during the period 2006/10, it is expected that Europe will require one million of ICT professionals in a short future.
- Moreover it is a fact that a good development in ICT is crucial to face an economic or social crisis situation.

And about the incomes?



DEMOGRAPHIC AND SOCIO-ECONOMIC



Drivers of change

New business models

Impact felt already

2015-2017

- » Rising geopolitical volatility
- » Mobile internet and cloud technology
- » Advances in computing power and Big Data
- » Crowdsourcing, the sharing economy and peer-to-peer platforms
- » Rise of the middle class in emerging markets
- » Young demographics in emerging markets
- » Rapid urbanization
- » Changing work environments and flexible working arrangements
- » Climate change, natural resource constraints and the transition to a greener economy

- » New energy supplies and technologies
- » The Internet of Things
- » Advanced manufacturing and 3D printing
- » Longevity and ageing societies
- » New consumer concerns about ethical and privacy issues
- » Women's rising aspirations and economic power

2018–2020

- » Advanced robotics and autonomous transport
- » Artificial intelligence and machine learning
- » Advanced materials, biotechnology and genomics

The Future of Jobs Report. World Economic Forum: January 2016.

Demanded Skills



The future of Jobs Report. World Economic Forum: January 2016.

How?: The way

- Involvement of Innosoc students: closer in age and culture to the target future students.
- 8 different activities proposed.

We love diversity....

Innosoc Porposed Activities

- Croatia: organize visits from the Faculty of Electrical Engineering and Computing, design a web page and promotional material.
- France: creation of a Youtube channel.
- Slovakia: organize "Science Day with EFRI".
- Spain: promoting the use at schools of Zowi robot.
- Bulgaria: physical+virtual promotion.
- Germany: The Junior Science event at School.
- Hungary: self-developed and gamified application.

Who.... The target

- Society
- Teachers
- Orienters
- Parents

Young students
 Boys and girls
 Girls



Why gender gap is so important?

-Maybe because I am a woman and I work in STEM?
- Because women are:
 - 49,6% of total world population
 - Only 12% of those women that study at the university study STEM.
- Because the income gap between men and women is actually reduced when women access to STEM.



Nobody wins with gender gap

- Because the different cosmovision, skills and values that women have can enrich scientific and technological advances.
- Because it is a lie, coming from a discriminatory prejudice, that women are not naturally interested neither equiped for STEM disciplines.



But prejudies biass the situation

- The paradox of education in equality based on a non equal situation:
 - Different activities, specific and only for girls are required.



Who.... The stakeholders



Where?

- Schools
- High schools
- University premises
- On street fairs
- Science Museums
- On the web:
 - Social networks
 - Blogs and webs

Animations Videos Text Podcasts Chats



When.... The age

- The age is linked to the type of action.
- Actions to primary school students:
 - At school
 - Entertainment actions are preferred: robotics, experiments, interaction with machines...

• Actions to secondary school students:

- At the University
- Scientific or technological level can be higher: visits to labs, science fairs, talks...
- Support webs for teachers with audiovisual contents must be different depending of the audience.

Telecochips: a real experience

• The origins:

- 2007-2010
- Electronic Music in Telecommunication: talk+concert.
- Is workshops more than 600 students atending.

• Telecochips: 2011-2012

- Lectures and workshops
- Offered to high school students (16-17 years old).
- In Faculty premises.
- Involvement of students, researchers and professors of Faculty.
- Support of: Faculty, University and Local Government. EC E-Skills Programme.

Telecochips

• Planning of sessions:

- Time: 9:00-14:00
- Content: 1 lecture (45 min) plenary+ 1 workshop (3 h 30 min) two groups.
- Group size: 20-25 students.
- Dates: agreed with high school teachers, when the evaluation of the semester is completed.
- Number of sessions: 7
- Attendants: 14 high schools, 480 students, aged between 16 and 18, and 36 high school teachers (Technology, Physics, Mathematics and Music)
- Material: workbook and web.

Application Design

Workshops

- Birth of Radiocommunication.
- Insecurity in Wireless Networks.
- Use of Electronic Technology in Music.
- "Do It Yourself" Philosophy.
- Applications of Computer Vision.
- Lectures
 - Will it Work in Space?
 - Understanding the Language of Cetaceans.
 - ICT and Sustainable Human Development.



TELECO

Charlas, talleres y actividades Para alumnos de secundaria ^{Curso 2011-2012}

Cuadernillo de trabajo



DELINE FICIER SUFFICIER DE INSCHERCES DE TELECOMUNICACIÓN



Non scholae, sed vitae discimus (Seneca)

- <u>http://museotelecomvlc.</u> <u>etsit.upv.es/telecochips/</u>
- Multimedia content:
 - Videos
 - Slides
 - Texts:
 - Presentation
 - Development of activity
 - Homework
 - Lecturer



RADIOCOMUNICACIÓN

🆻 Descarga este Telecochip en pdf



El nacimiento de la radiocomunicación

Este telecochip propone un recorrido por la historia de la ciencia que desembocó en el nacimiento de la Radiocomunicación. Tres grandes facetas del intelecto humano, como son la científico-teórica, la científico-experimental y la ingeniería, nos conducen hasta la concepción del primer sistema de radiocomunicación que fue la Radiotelegrafía.

DESARROLLO

Cuando se descubre el fenómeno de la radiación electromagnética, el telégrafo era un sistema de comunicación eléctrica a

larga distancia que se encontraba en una fase consolidada, al igual que sucedía con el teléfono. El nacimiento de la radiocomunicación consistió en integrar un sistema de comunicación ya existente junto con la recién descubierta capacidad de generar radiaciones electromagnéticas y poderlas detectar, para constatar su evidencia y su medición. Como se puede suponer, el sistema de comunicación que se integró en primer lugar fue, por su mayor sencillez, el telégrafo, constituyéndose así la Radiotelegrafía o también la Telegrafía sin hilos. Luego al poco tiempo vendría la sofisticación de incorporar la voz.

Marconi fue el ingeniero que tuvo la genial idea de integrar sistemas, utilizó el experimento de Hertz para generar oscilaciones de radiofrecuencia, el sensible cohesor de Branly para detectar las radiaciones a larga distancia y el telégrafo de Morse para concebir la radio como sistema de comunicación. A Marconi se le atribuye la

invención de la antena, desde el punto de vista puramente experimental, una estructura de hilos conductores que optimizaba el alcance del sistema, así como la incorporación de circuitos resonadores, con el fin de compatibilizar el uso múltiple de los sistemas de radiocomunicaciones con frecuencias diversas.



- To increase the **interest and motivation** in STEM-related degrees, in particular in Telecommunications and Electronic Engineering.
 - Students assessed as more positive the practical part of the workshops over theoretical explanations, as well as the capacity of the speakers and the facilities of the University.
 - **96** % of students would recommend this type of activities to their peers.
 - 78% of students would be willing to participate in such these initiatives in the future, nevertheless, they do not explain why they would do so.
 - 21 % of teachers considered the contents very appropriate, 43 % considered them appropriate, only 14 % considered them less appropriate and nobody considered them inappropriate.
 - 22 % of teachers considered the activity highly motivating, 64 % considered it motivating, nobody considered it less motivating or dismotivating.

- To **change the perception** of secondary education and high school students concerning STEM studies and professionals.
 - 13 % of the students considered the day very positively, 63 % considered it positively, while only 4% and 1% considered it negatively or very negatively respectively.
 - The average assessment of the lectures was **3.55** points over 5.
 - The average assessment of the workshops has been **4.1** points over 5.
 - Professors/lecturers have been rated with 4.1 points over 5.
 - 29 % of teachers considered the day very positive, 50 % considered it positive, only 7 % considered it negative and nobody considered it very negative.
 - The lectures were rated with an average of **3.7** points over 5.
 - The workshops had an average rating of **4.3** points over 5.
 - The lecturers were rated with **4.2** points over 5.

- To **promote** Telecommunications and Electronic Engineering studies, the Telecommunications College and the University among secondary and high school students.
 - 480 students in Telecochips:
 - **Type A**: 158 of high school(16-17 years old). First course in University 2013-14. Massive into University system. 67 accessed the Polytechnic University of Valencia (42.4 %), 16 of them (**23.8** %) opted for the ICT branch.
 - **Type B**: 322 of secondary education(15-16 years old). First course in University 2014-15. Some can not follow studies. 60 (18.6 %) are currently studying at the UPV, and of these, 22 (**36.7 %**) opted for the ICT branch
 - The UPV annually offers 4500 places for new students, of which 14 % belong to the ICT branch.

- To offer **academic guidance** concerning the professional opportunities that are linked to these degrees with the aim of impacting on the students' professional future.
 - 26 % of attendants think that these days can have a very high impact on their academic future, 33 % think that the impact can be high, while 10 % and 6 % think that the impact can be low or very low respectively.
- To **work more closely** with teachers of secondary and high school providing them with tools for further study and discussion at classrooms.
 - 72 % of theachers considered the duration suitable, while 14 % considered it brief and 14 % extense.
 - The organization was rated as very good by 7 % of teachers, good by 50 %, only 7 % considered it bad and nobody considered it very bad.
 - Teachers suggestions: increasing student participation, possibility of attending the two workshops on the same day, shorter talks, prior availability of the material, lower technical level, more practice and interaction and showing more material.
 - All would participate again and found the experience interesting and motivating.

Follow up

• In 2015

- Telecochips as part of Exhibition
 "Comunicando" about
 - the History of Telecommunications
- Valencia Science Museum.
- 5 workshops
- Primary school and secondary school students.





Follow up

- In 2016
 - Telecochips as part of Innosoc
 Multiplier Event.
- 3 workshops
- 130 Secondary school students.



Major drawbacks

- Some place is required for conducting the activities.
- They have to be announced in advance.
- Secondary schools need to be contacted to manage the attendance
- The materials for the activities must be chosen carefully in order to be really interesting...
- In short, these activities require a dedicated group of people and a minimum budget.

But Don't stop me know cause we're having a great time...

- Exploiting synergies school-high school-University
- SoundCool Project www.soundcool.org



Thank you for your attention!!!!