Promoting STEM studies among young students

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UNIVERSITAT
POLITÈCNICA
DE VALÈNCIA

_TELECOM ESCUELA
TÉCNICA VLC SUPERIOR
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TELECOMUNICACIÓN

InnoSoc
Innovative ICT Solutions
for the Societal Challenges

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
- 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

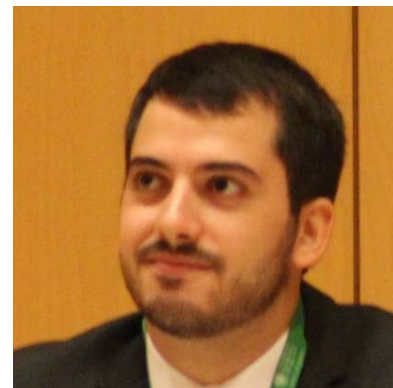**Supervisor**

Carmen Bachiller
Spain

InnoSoc Students

| Miroslav Dočár | Martina Majcen | Alex Gascón | Florian Boyrivent |
| *Slovakia* | *Croatia* | *Spain* | *France* |

But...are you alone?

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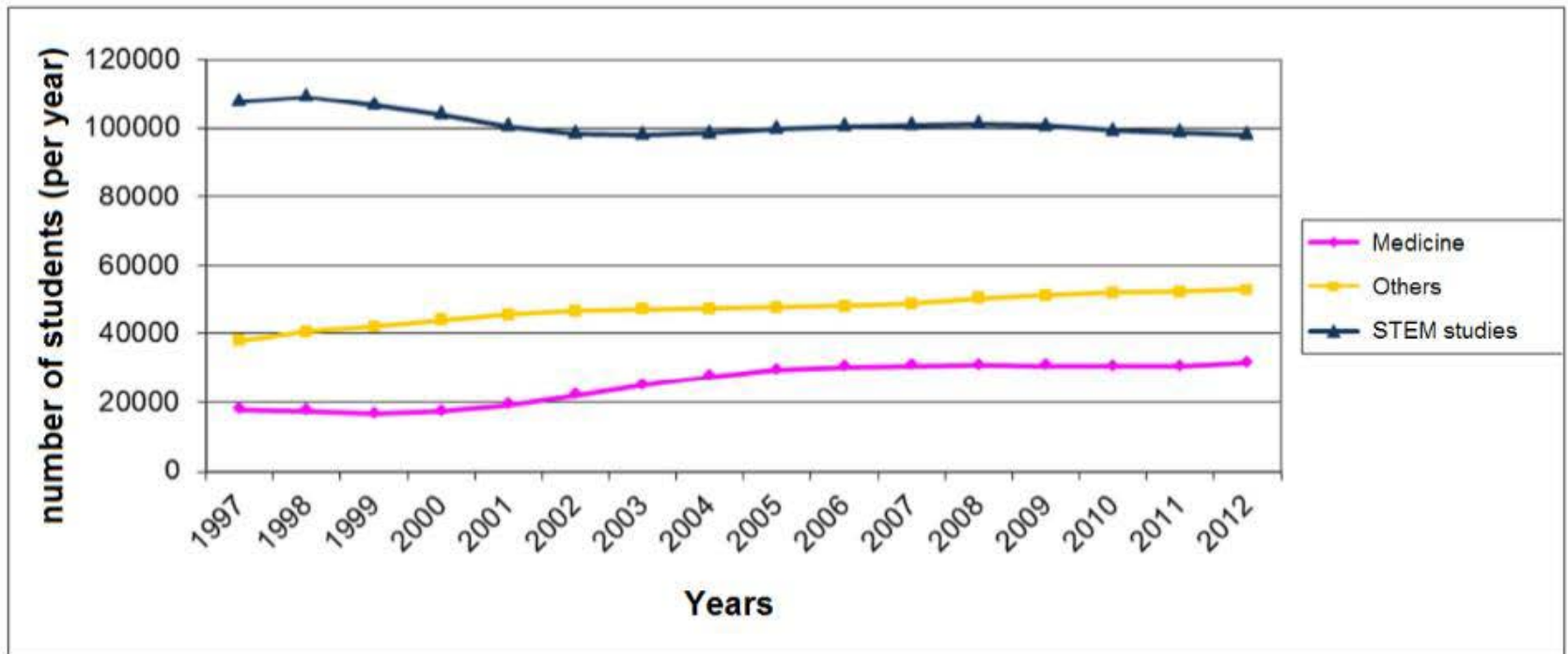
Our effort …

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.**
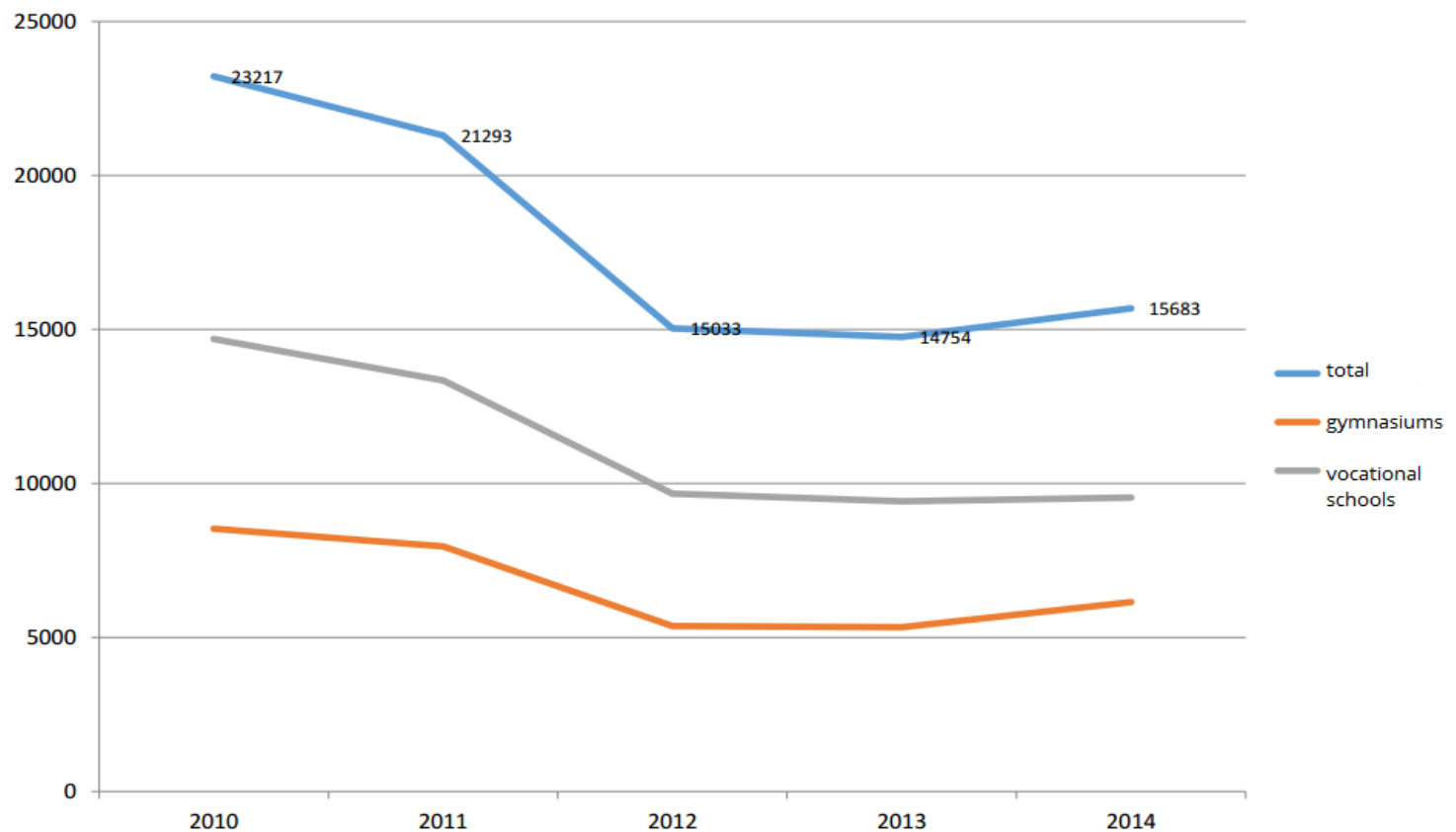- **Is this really true?**

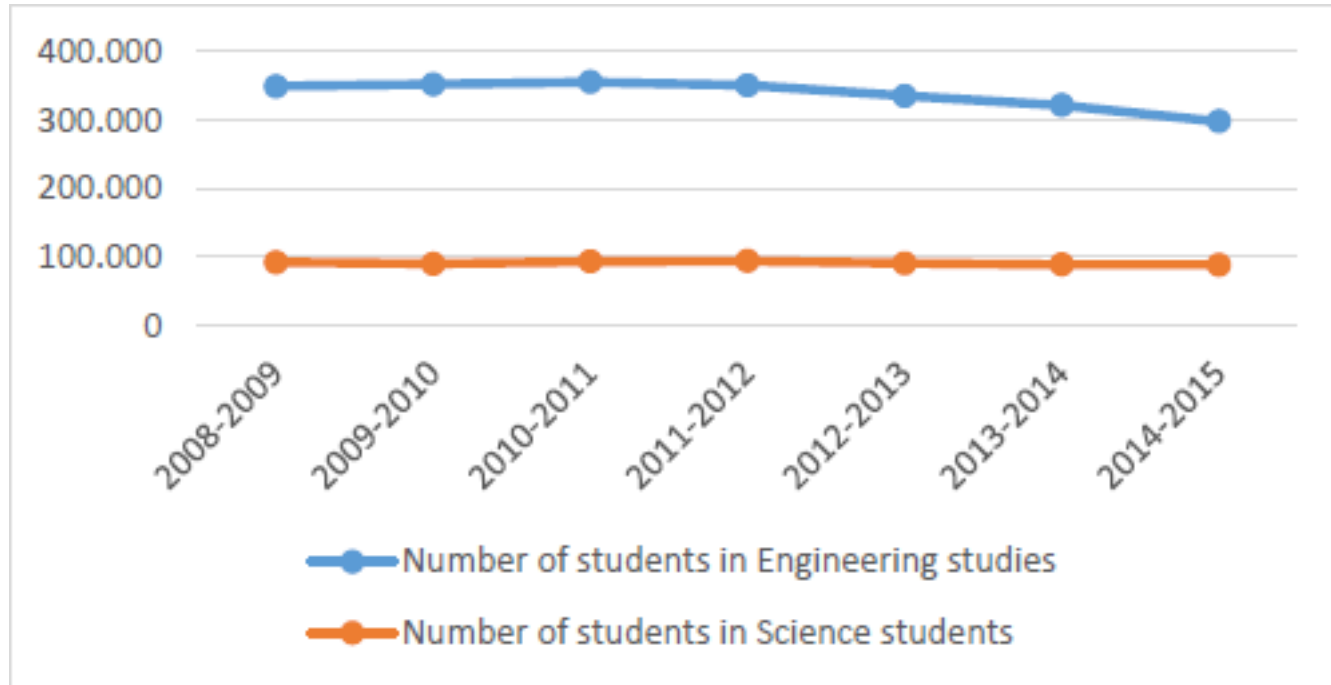**Let´s see some examples**

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
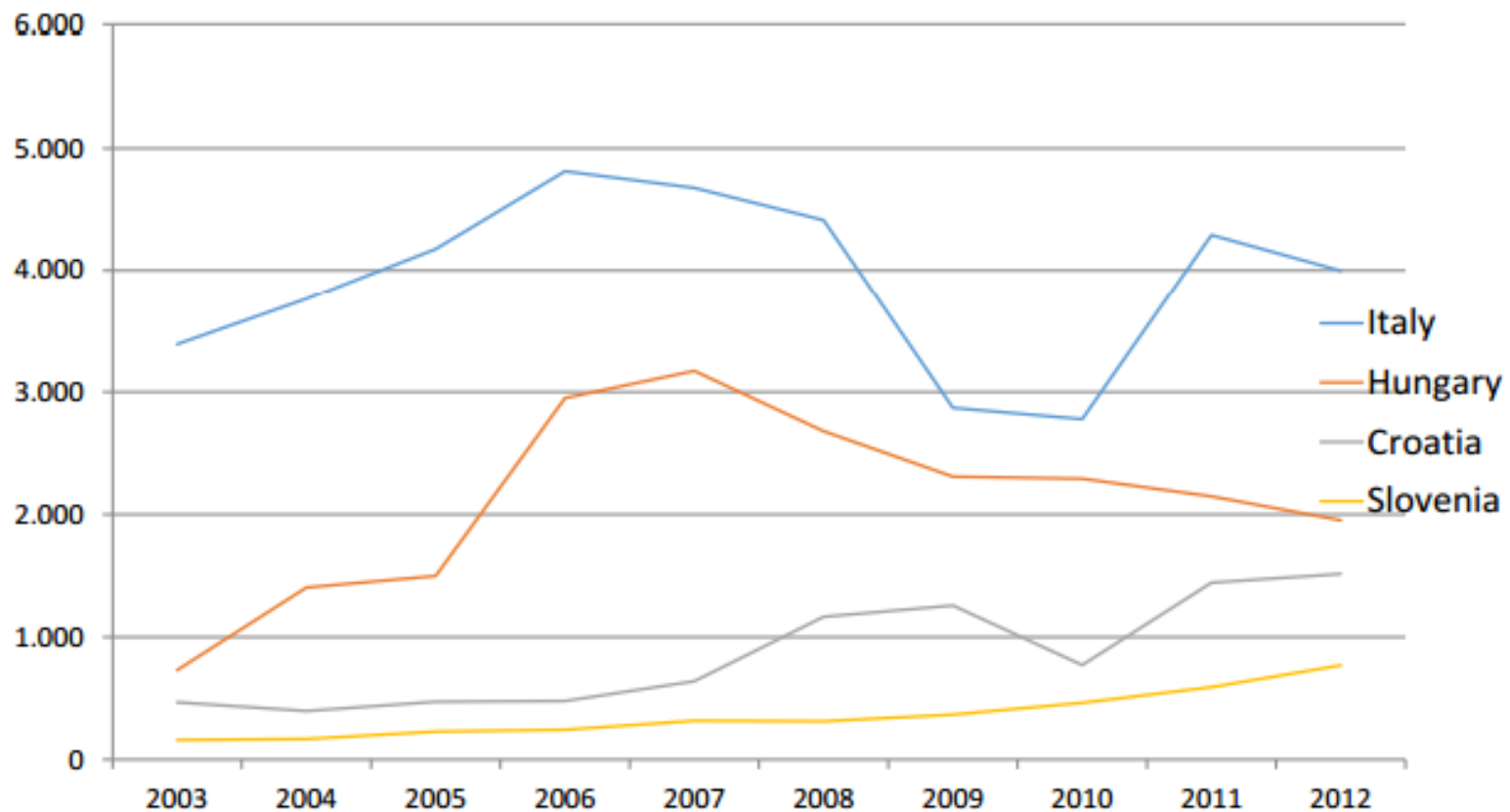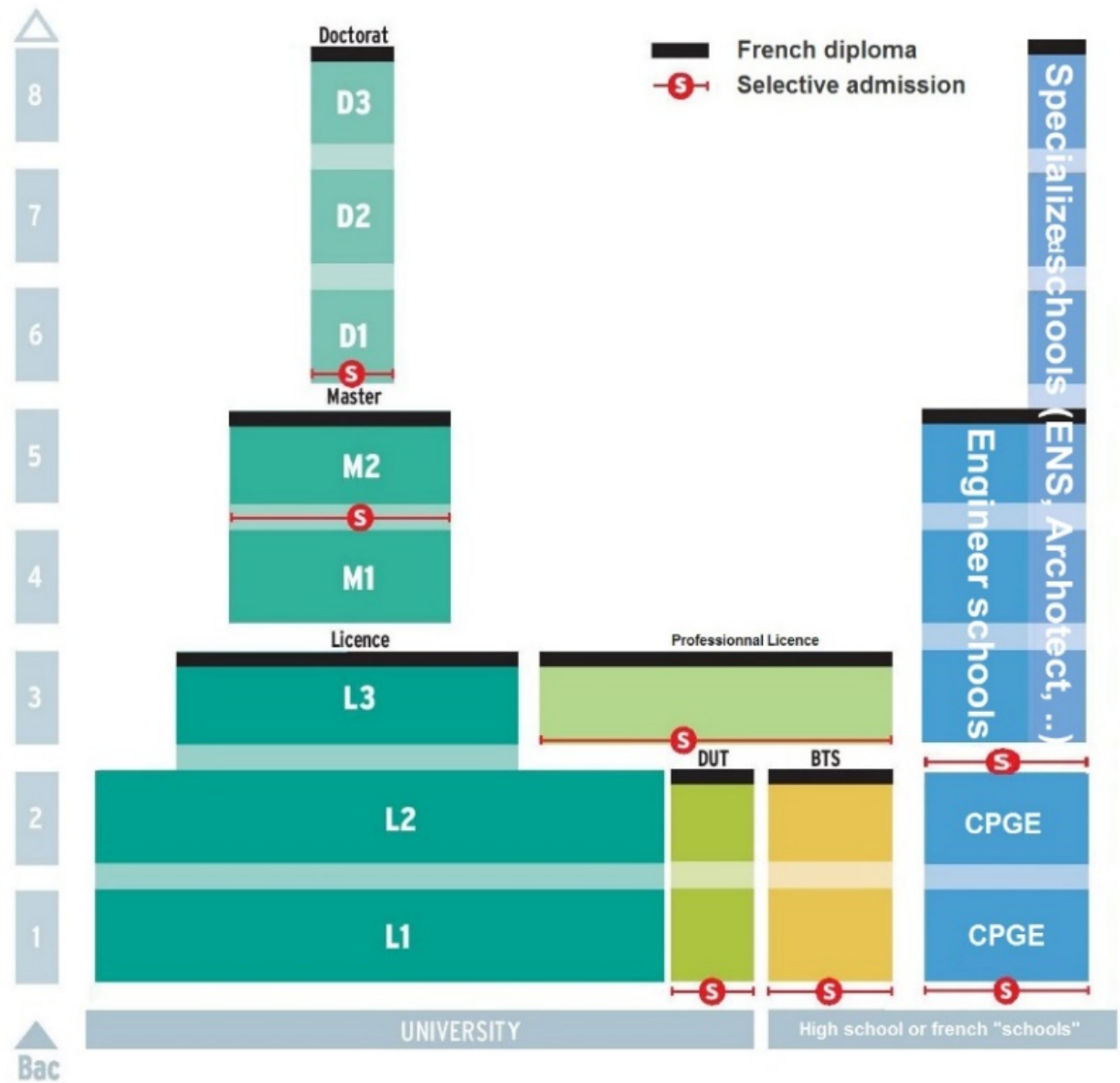
Croatia

Spain

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.
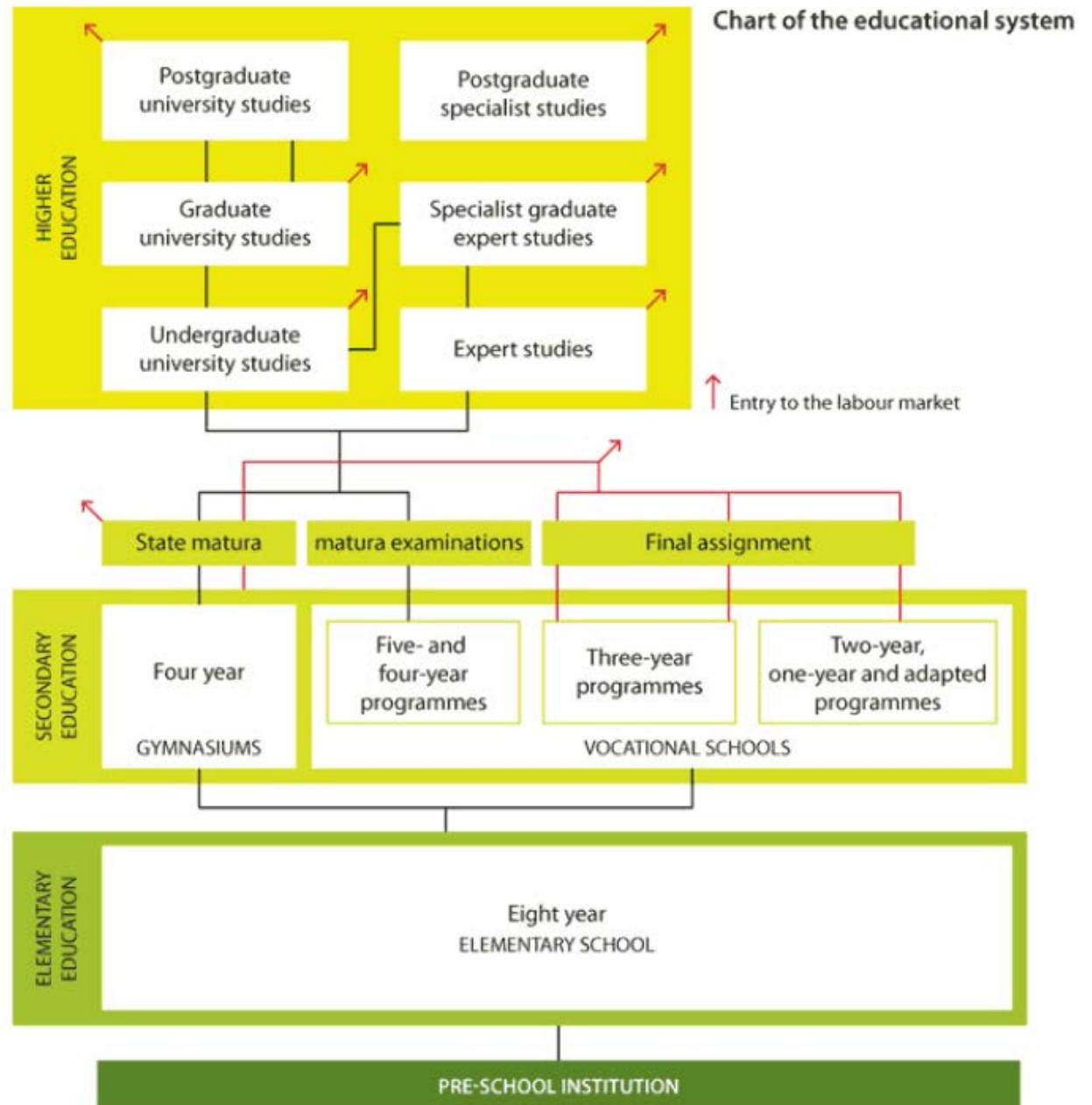
France

Slovakia

Croatia

Chart of the educational system

Spain
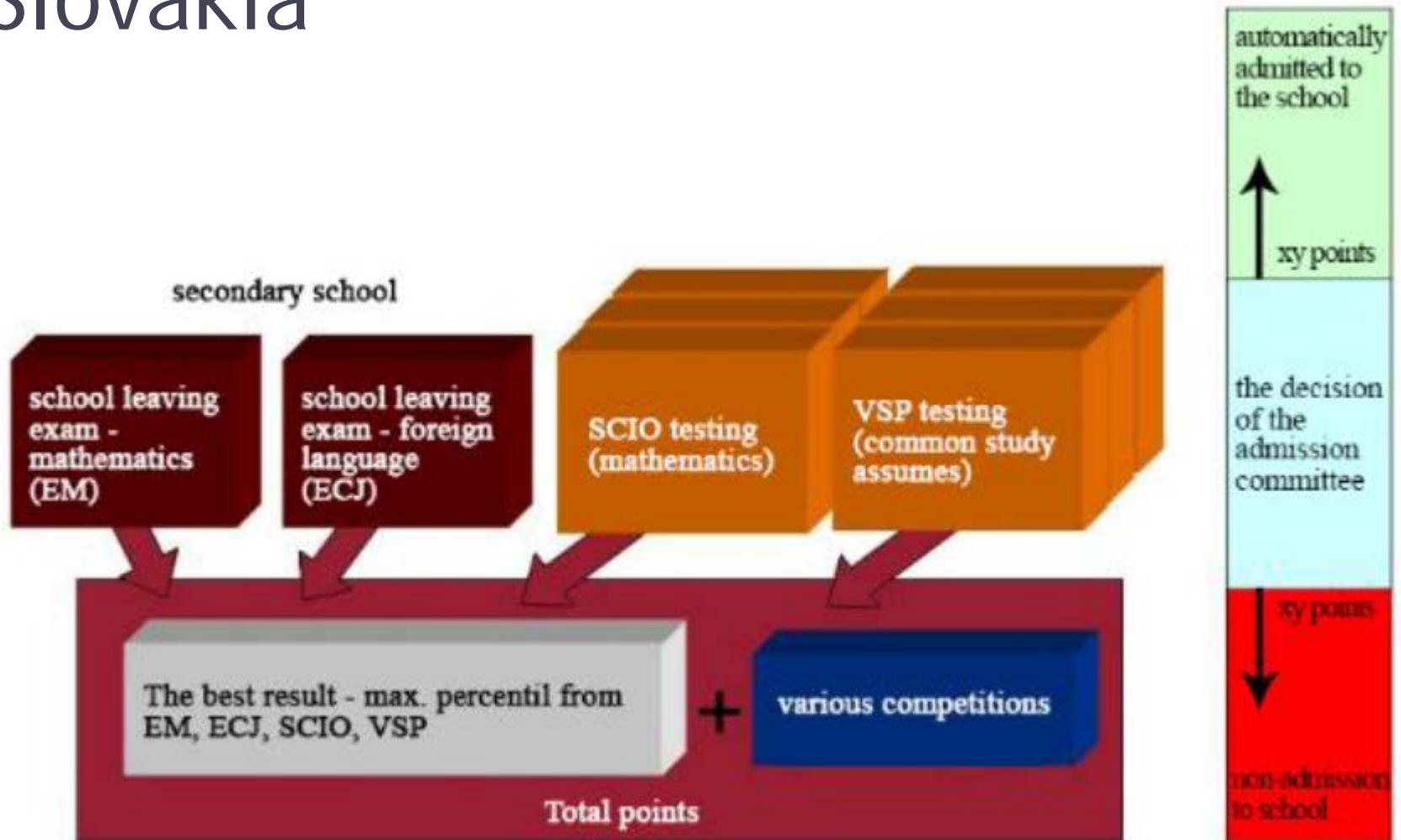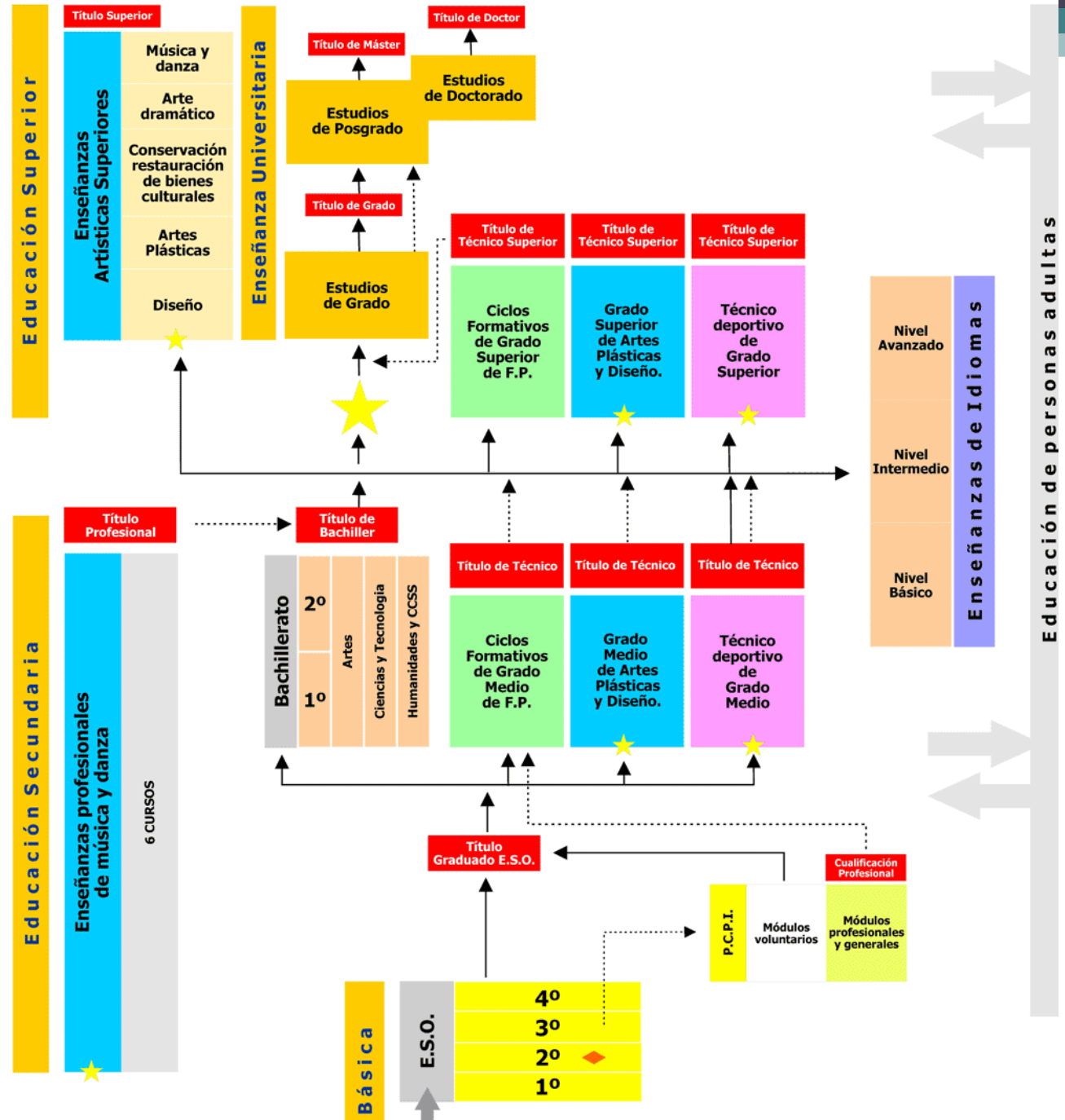
The perception of STEM studies

- **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.

100 — Women who enter college and obtain a BA

12 — Women who graduate with a BA in a STEM major

5 — Women STEM BA graduates working in STEM (after 2 years)

3 — Women STEM BA graduates working in STEM (after 10 years)
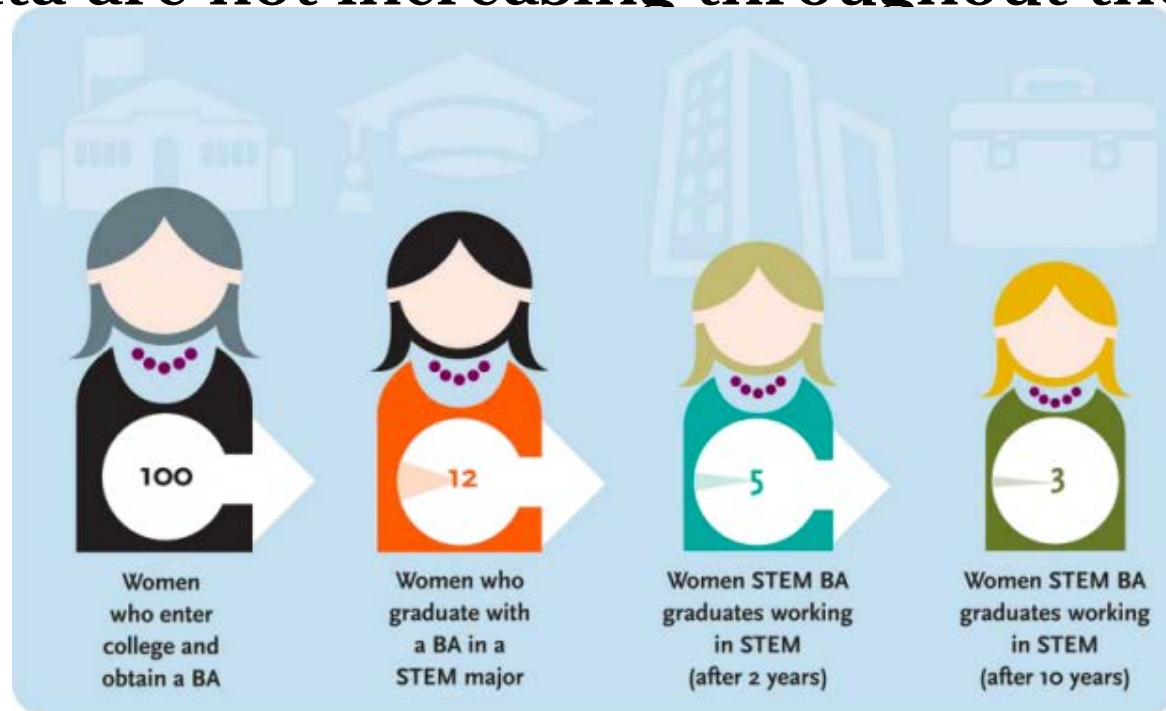
Is time running backwards?

LEGO in 1970   **LEGO in 2015**

But is there a real need for all of this?

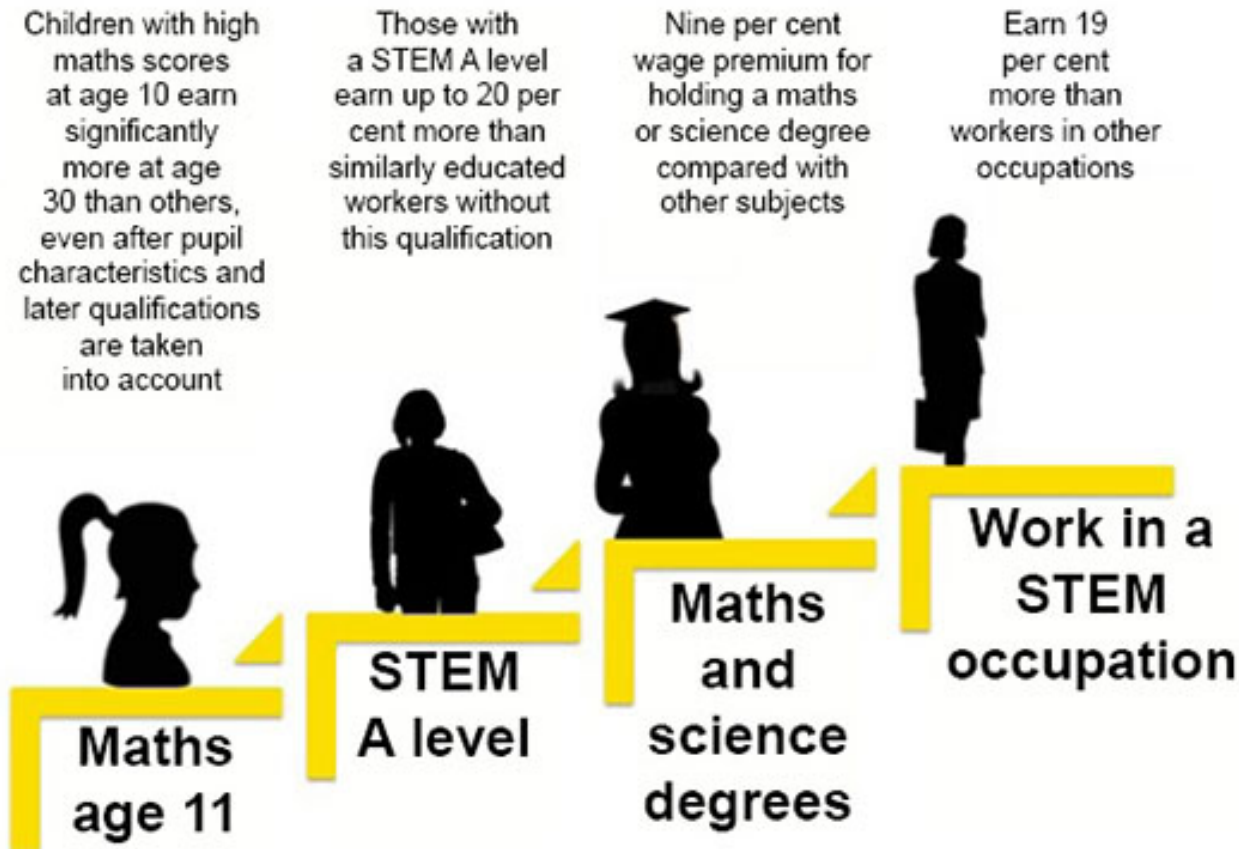- **Steve Wozniak from Apple asks: Which are the skills that are required to face the future?**
- **Tony Wagner from Harvard answers:**
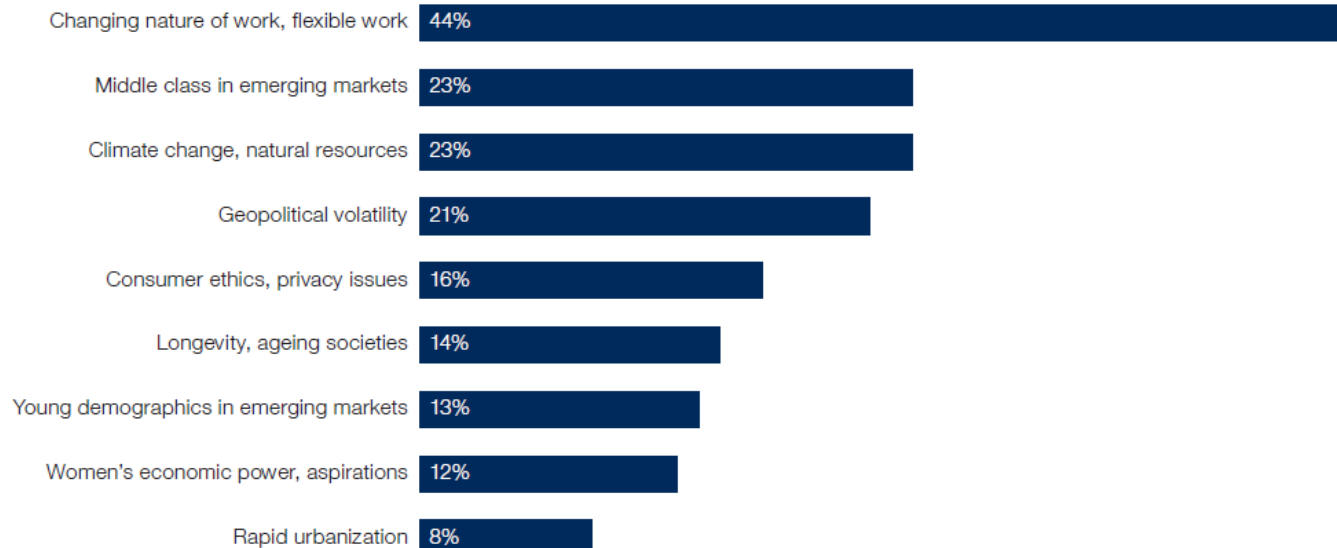
And what about jobs?

- 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?

Children with high maths scores at age 10 earn significantly more at age 30 than others, even after pupil characteristics and later qualifications are taken into account

Those with a STEM A level earn up to 20 per cent more than similarly educated workers without this qualification

Nine per cent wage premium for holding a maths or science degree compared with other subjects

Earn 19 per cent more than workers in other occupations

Maths age 11

STEM A level

Maths and science degrees

Work in a STEM occupation

Drivers of change

DEMOGRAPHIC AND SOCIO-ECONOMIC

Driver	%
Changing nature of work, flexible work	44%
Middle class in emerging markets	23%
Climate change, natural resources	23%
Geopolitical volatility	21%
Consumer ethics, privacy issues	16%
Longevity, ageing societies	14%
Young demographics in emerging markets	13%
Women's economic power, aspirations	12%
Rapid urbanization	8%

TECHNOLOGICAL

Driver	%
Mobile internet, cloud technology	34%
Processing power, Big Data	26%
New energy supplies and technologies	22%
Internet of Things	14%
Sharing economy, crowdsourcing	12%
Robotics, autonomous transport	9%
Artificial intelligence	7%
Adv. manufacturing, 3D printing	6%
Adv. materials, biotechnology	6%

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

New business models

Impact felt already	2015–2017	2018–2020
» 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	» 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.**
- **Four activities proposed:**
  - 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.

Organizing visits from Faculty

- **Students and assistants of Faculty of Electrical Engineering and Computing to visit high schools**
- **Web page, Facebook and Twitter with information about the visits.**
- **Topics:**
  - Number of students, subjects and professors,
  - Structure of study programs,
  - Grade point average,
  - Number of students who give up / falling the year,
  - Interesting projects at universities,
  - Description of working day of an engineer.
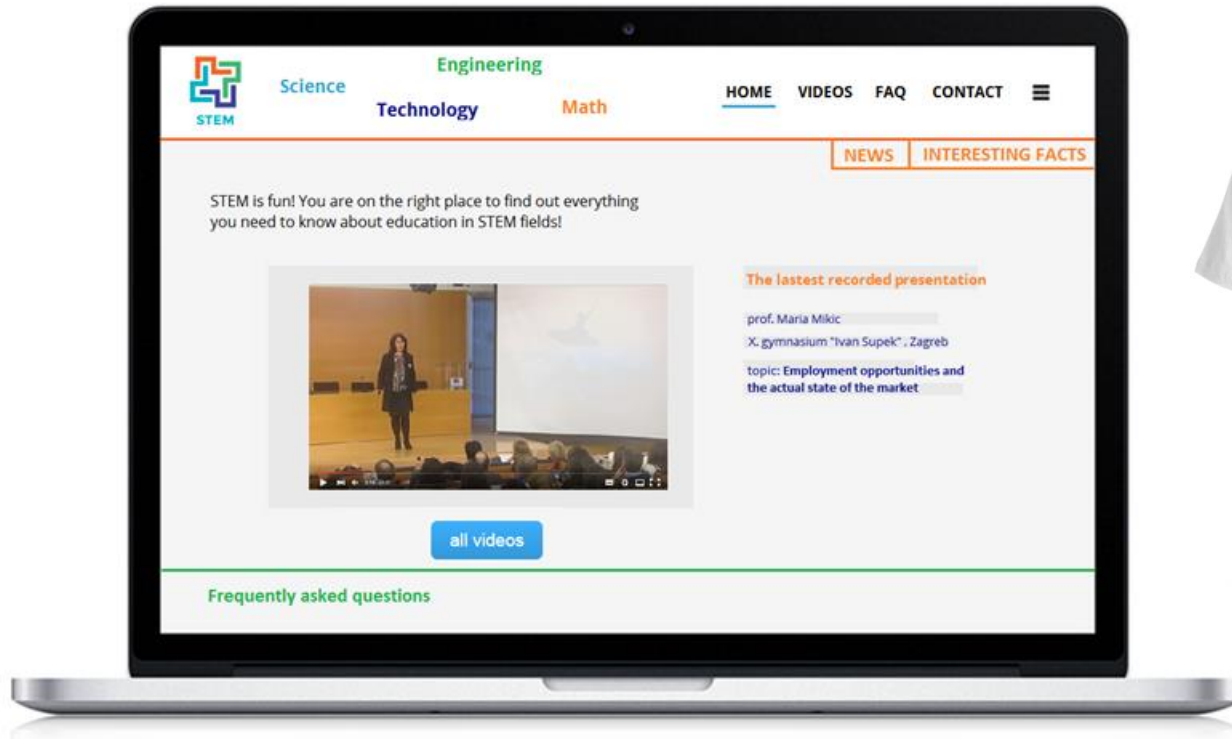
- **How can benefits be measured?**
  - ▫ Coments from the visits
  - ▫ Coments in the web page

Creation of Youtube Channel

- **Contents**
  - **Vulgarized scientific facts** to popularize science and awaken scientific curiosity among students.
  - **Some scientific contents explaining new discovery and research fields**.
  - **Some career overview of scientists working in the industry** (engineer, technicians, etc.). In order to cover the lack of information about industry careers after STEM studies, it is important to add some feedbacks about people working as engineer or technicians (and other possible careers after STEM studies).
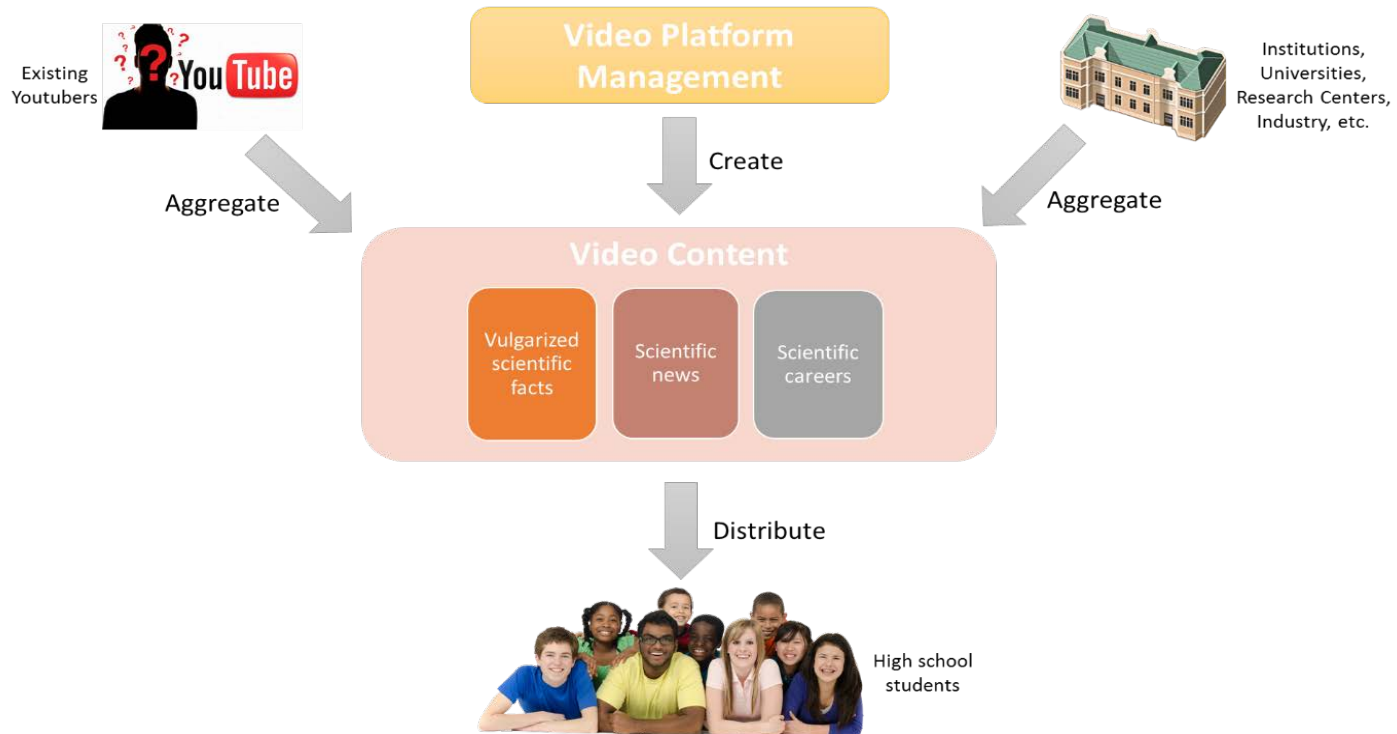
- Strategy: aggregate existing videos and only create the platform
- How can benefits be measured?
  - Number of views
  - Coments in the platform

Science Day with EFRI

- **Open day in: Faculty of Management Science and Informatics**
- **FRI Club:**
    - **Section for pupils** of elementary school.
        - Moving robots by remote control,
        - Simple games programmed by our students,
        - Experiments with electricity
        - Competitions with the possibility to win IT prize.
    - **Section for students** of secondary school.
        - Robots and games
        - DIY: programming.
        - A working single LAN network with basic configuration and more.
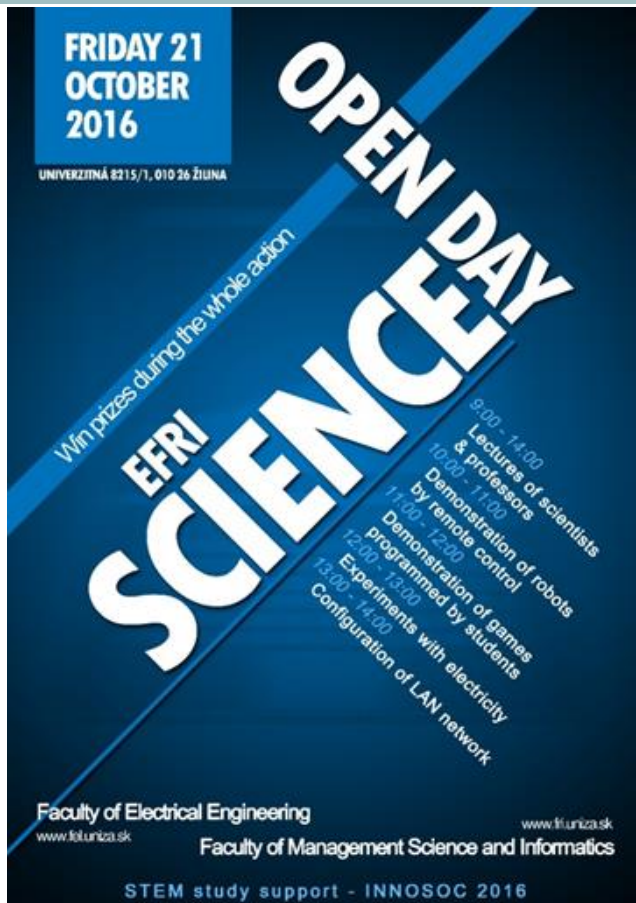
- **How can benefits be measured?**
  - ▫ Short term: increase the interest of pupils and students in this faculty.
  - ▫ Long term: increase of students studying STEM

Use of Zowi Robot in schools

- **Zowi is a robot of Spanish company BQ.**
  - Interaction thought smartphone or tablet.
  - Programmed by the children using Bitbloq graphical language.
- **At school:**
  - Syllabus content
  - Zowi lab shared by different syllabus and children.
  - Teachers formation
    - Courses
    - Generating pedagogical material
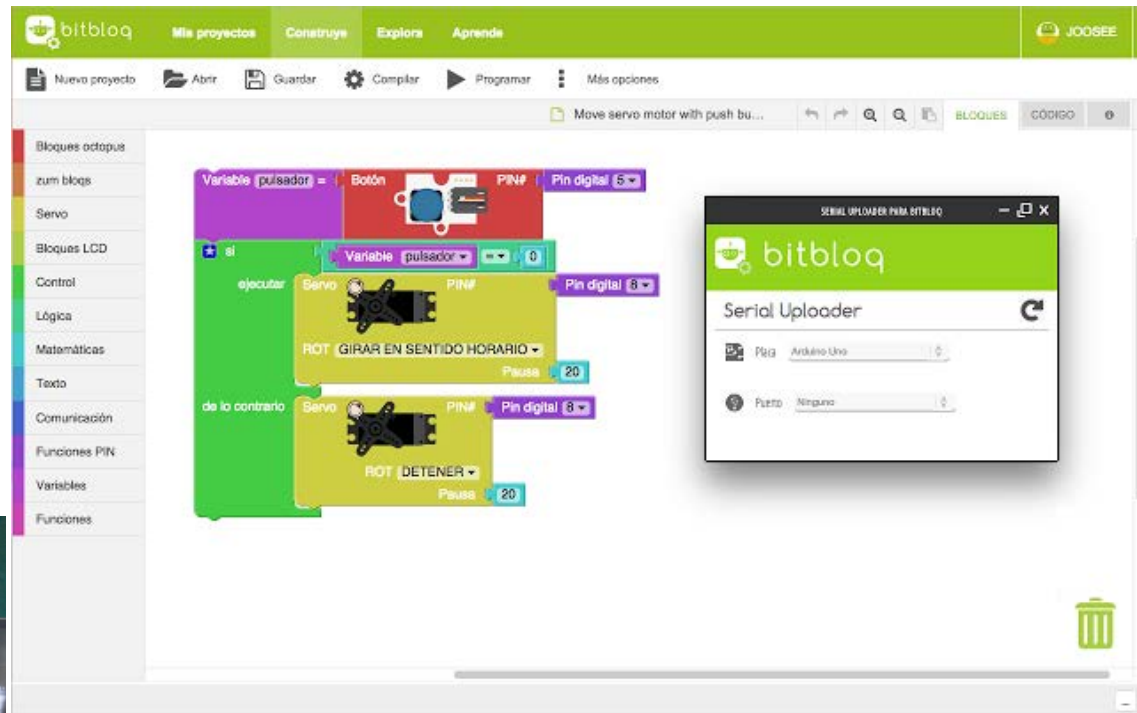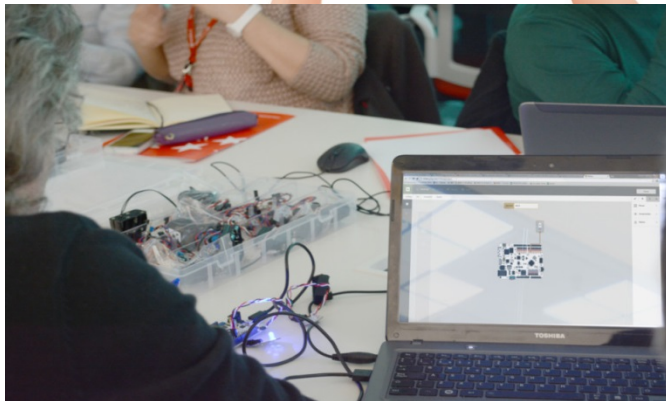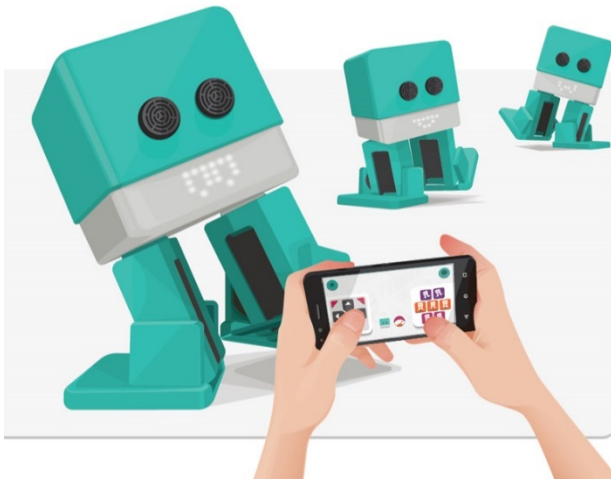
- **How can benefits be measured?**
  - ▫ Long term action. Survey after 10 years.
  - ▫ Survey with kids about their intention about studying in the future.

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.
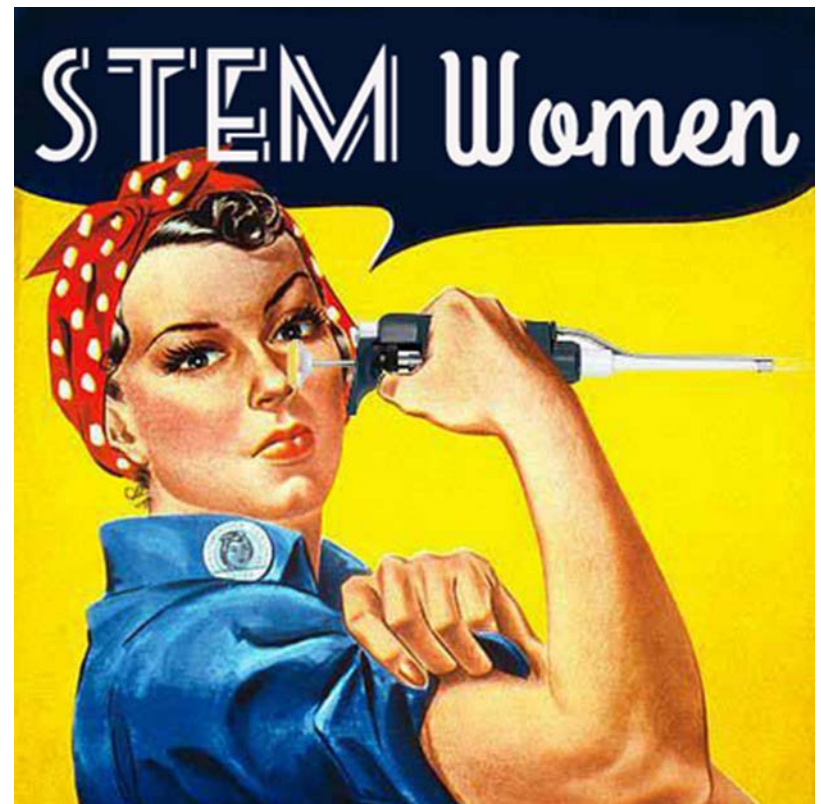
Nobody wins with gender gap

- 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.
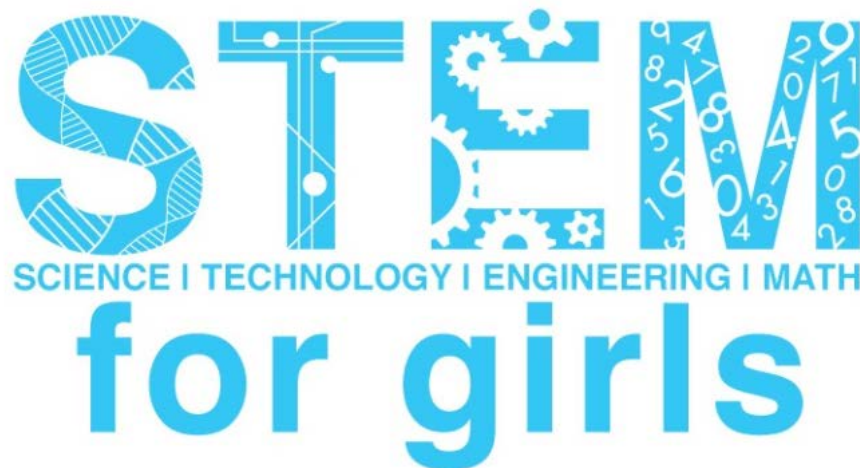
Who…. The stakeholders
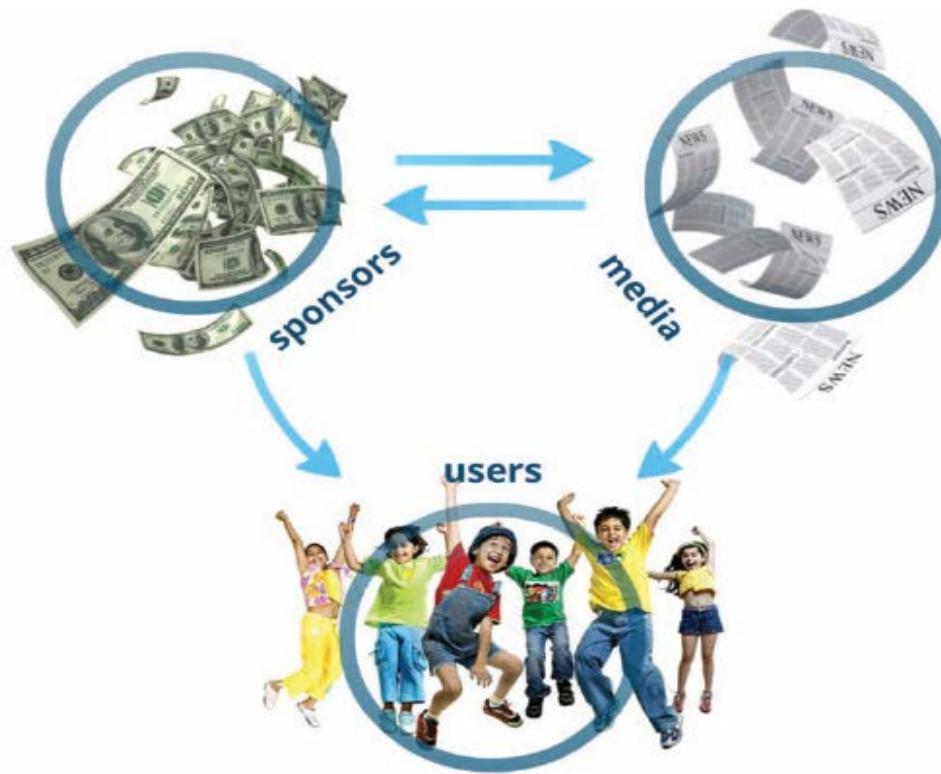
Where?

- Schools
- High schools
- University premises
- On street fairs
- Science Museums
- On the web:
  - Social networks
  - Blogs and webs
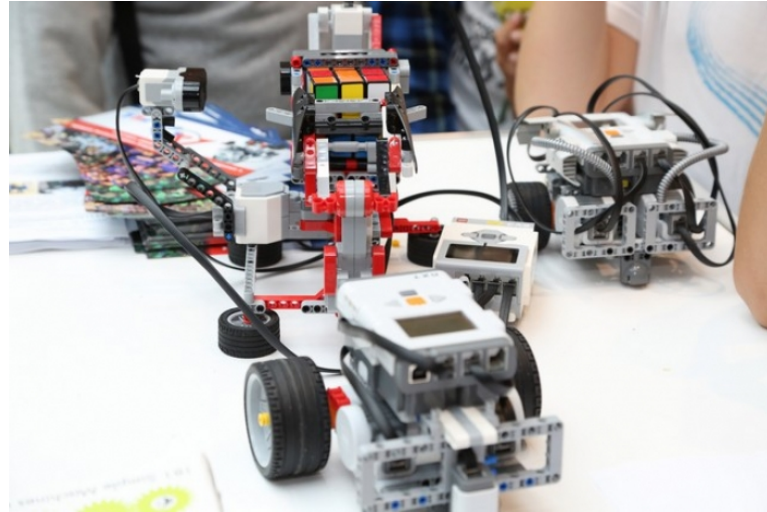
Animations
Videos
Text
Podcasts
Chats

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.
  - 15 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.

Non scholae, sed vitae discimus
(Seneca)

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

Intended Outcomes and Findings

- 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.

Intended Outcomes and Findings

- **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.

Intended Outcomes and Findings

- **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.

Intended Outcomes and Findings

- 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.

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!!!!