

STEM: Engineers of future

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STEM teaching and learning: critical issues

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Introduction: what we know... - 1

- Most of our students will forget most of the content that they "learn" in school.
- Most of our students are bored and disengaged in school.
- Deep, lasting learning requires conditions that schools and classrooms simply were not built for.
- We are not assessing many of the things that really matter for future success.
- Grades, not learning, are the outcomes that students and parents are most interested in.

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Introduction: what we know... - 2

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- Curriculum is just a guess.
- Separating learning into discrete subjects and time blocks is not the best way to prepare kids for the real world.
- The system of education as currently constructed is not adequately preparing kids for what follows if and when they graduate.
- Learning that sticks is usually learned informally, that explicit knowledge accounts for very little of our success in most professions.

[from HUFFPOST EDUCATION, Wednesday, April 13, 2016]

Introduction

- What contents to teach? [*Curriculum*]
- How? [*Methodology*]
- Why to teach a given piece of content? [*Motivation*]
- What for? [*Aims*]

Critical issues about mathematics teaching

School textbooks or popularizing books are primarily engaged in the "what" to teach; literature on mathematics education mainly devotes the attention to the "how". Rather scarce are publications which aim to reflect on the big and little "why" of mathematics teaching (translated from Villani, 2003)

Maths contents vs. Maths activities

Maths made of... vs. Maths made for...

- ***Content categories*** (*Overarching ideas*) [OECD/OCSE-PISA 2012]
Space and Shape – Change and relationships – Quantity – Uncertainty and data
- ***Content domains*** [TIMSS 2011]
Number – Algebra – Geometry – Data and chance
- ***Strands of content*** [NCTM Standards 2000]
Number and Operations – Algebra – Geometry – Measurement – Data Analysis and Probability
- ***Nuclei Fondanti*** [Italian MIUR: National Guidelines 2012]
Numbers – Space and Figures – Relations and Functions – Data and Predictions
 - ***Categories of mathematical activities*** (*Bishop*)
Counting – Locating – Measuring – Designing – Playing – Explaining

New curricula

- In the present globalized world everything is soaked in cultural products from diverse areas and societies.
- Inclusive education asks for integration of knowledge.
- New curricula are to be designed and implemented, rooted on the pillars of the education for the XXI century:

Learning to know, Learning to do, Learning to be, Learning to live with others

- What is a curriculum?
 - The set of experiences that a school intentionally designs and implements for the pupil in order to achieve the set educational goals.
 - The design of a curriculum is the process through which the educational research and innovation develop and organize.

STEM Education

■ I. Curricula

- The Technology Field

■ II. Pedagogic and Teachers

- The low achieving pupils
- Gender imbalance
- The role of Teachers

■ III. Beyond curricula

- Partnerships

[based on the 2004 Draft Conclusions and Recommendations by the Working Group D 'Mathematics, Science and Technology' of the European Commission, I was the member of]

STEM Edu – I. Curricula

The Technology Field

- Curricula should clearly take into account the important role of Technology education which should be addressed as a field in its own right within STEM. Technology education should be seen as different but complimentary to science education.

STEM Edu – II. Pedagogic and Teachers

The low achieving pupils

- The needs of low achieving pupils in STEM should be addressed specifically through providing more opportunities for practical activities and a range of initiatives such as special classes, individual tuition, inclusion measures, etc.

STEM Edu – II. Pedagogic and Teachers

Gender imbalance

- It is essential that policies tackle the problem of gender imbalance in STEM either through general policies designed to address equal opportunities and/or through specific measures (at teacher training level, through revision of didactical materials, special programmes to appeal specifically to girls, etc.)

STEM Edu – II. Pedagogic and Teachers

The role of Teachers - 1

- Pedagogy is a crucial area for decision makers to address if STEM subjects are to improve in effectiveness and attractiveness. Measure should therefore be taken to connect more systematically STEM teaching to real-life contexts and experiences. Teachers should be provided with the means (in time and resources) to do so, especially through extra-curricular activities.

STEM Edu – II. Pedagogic and Teachers

The role of Teachers - 2

- The most effective pedagogies being time consuming, time devoted to practical activities should be re-organised to improve the effectiveness of teaching and learning. One possibility would consist of moving from ‘content’ to ‘activity’ based teaching and nourish pupils’ curiosity while avoiding the overcrowded curriculum.

STEM Edu – II. Pedagogic and Teachers

The role of Teachers - 3

- Policies should address the perceived reluctance of teachers to adopt new didactics in the field of STEM and find ways and means, in particular through the dissemination of good practices, to change the situation. Teachers should also have access to resources centres supporting the development of new innovative pedagogical methods.

STEM Edu – II. Pedagogic and Teachers

The role of Teachers - 4

- Pupils' assessment procedures should give equal importance to theoretical and practical work and promote new teaching methodology.

STEM Edu – III. Beyond curricula

Partnerships - 1

- Any measure taken (at policy level or through the development of specific initiatives/partnerships) to increase interest and participation of pupils in STEM, and in particular girls, should foster the participation of parents in order to help them overcome their prejudice vis-à-vis these fields.

STEM Edu – III. Beyond curricula

Partnerships - 2

- Partnerships/initiatives aiming at providing “second chance” opportunities for those who did not opt for STEM subjects should be developed.

STEM Edu – III. Beyond curricula

Partnerships - 3

- Partnerships between schools and universities to increase interest and participation in STEM should be made more frequent. Universities in particular should have the adequate means (at human resources and financial levels) to face the potentially large demand that might arise from schools.

**THANK YOU FOR
THE ATTENTION!**

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