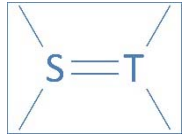




**POLITECNICO**  
MILANO 1863



Lab. di sperimentazione  
didattica ST2

 con.Scienze

**"Learning is an experience, not a download":**

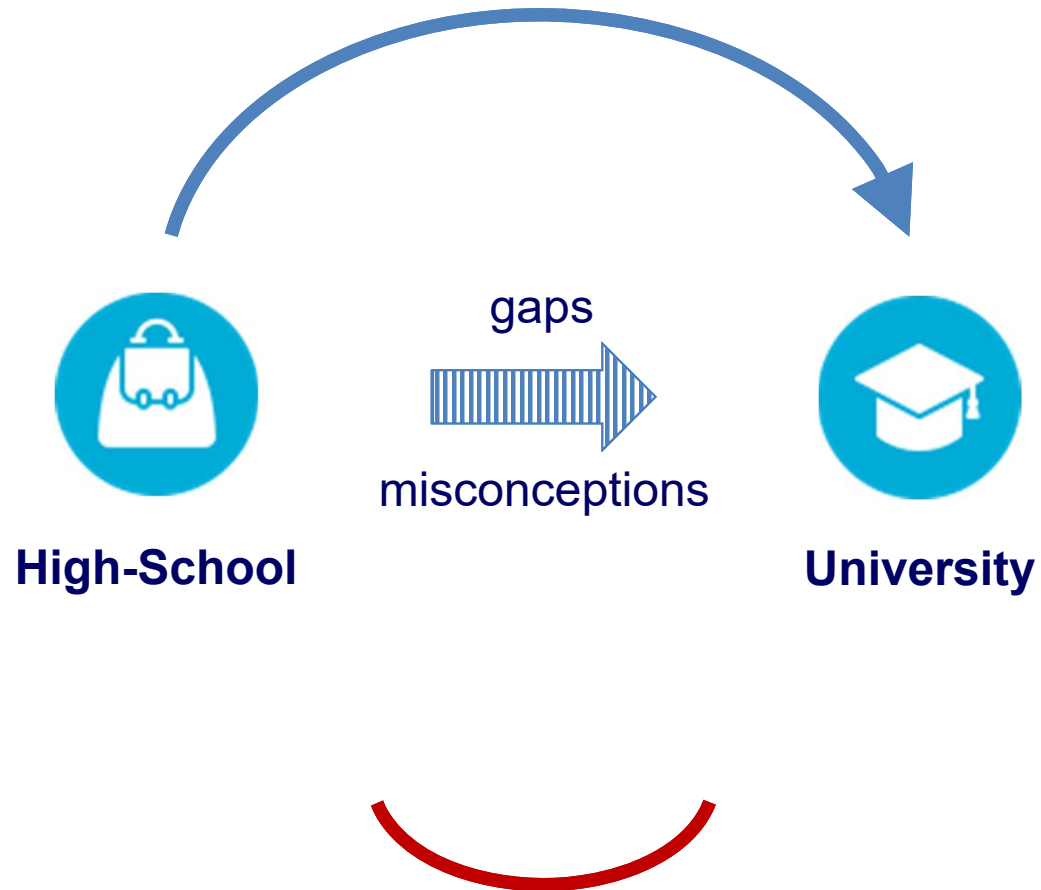
**LabST2@Polimi**

Maurizio Zani

con.Scienze, Firenze 13/12/2019

# Physics from High-School to University

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# How to bridge gaps/misconceptions?



**Project**

Jade Belt Bridge (Beijing, China)



**Design**



**Team**



# How to bridge gaps/misconceptions?

---



**Project**

Learning (everywhere)

## The 3 rules of learning

- 1. Learning is an experience, not a download
  - Involve the students in the learning approach; they must be engaged in the experience
- 2. Learning happens everywhere & everytime
  - Open your fantasy, evaluating what may be the best way to reach the learning goals
- 3. Learning takes care of materials & methods
  - Choice the appropriate combination, in order to make learning achievements more effective

[http://www.st2.fisi.polimi.it/?page\\_id=159](http://www.st2.fisi.polimi.it/?page_id=159)  
credits female voice: Lucia Ganzer



## Promo video lab. ST2

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<https://www.youtube.com/watch?v=sn0bqxpvuNc>

credits female voice: Lucia Ganzer



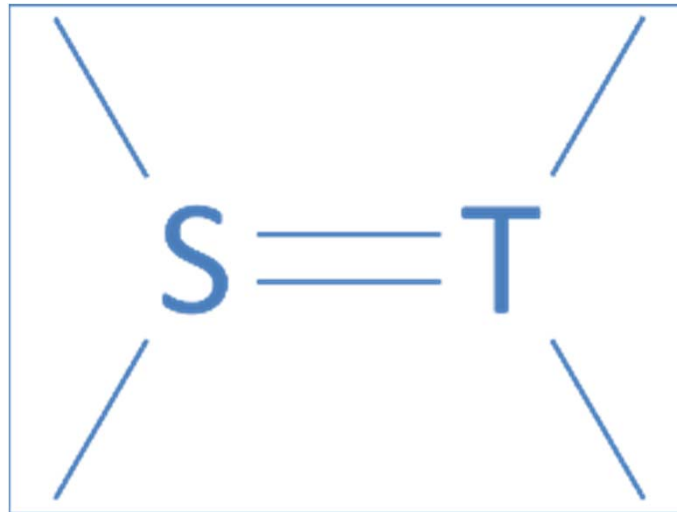
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## Experimental teaching lab. ST2

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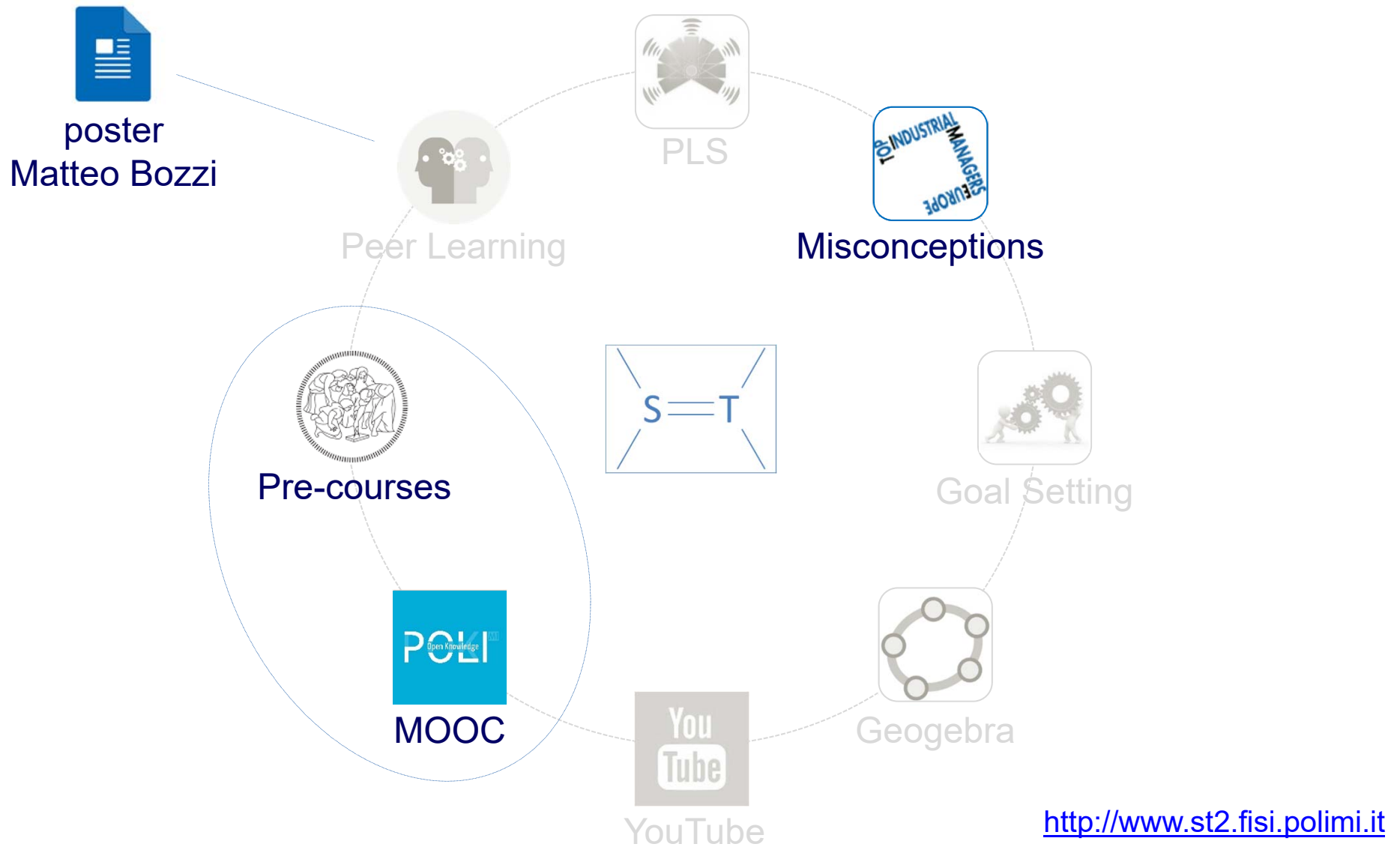
Il laboratorio si propone di studiare e sperimentare nuove metodologie e tecnologie didattiche in ambito universitario (ma non solo) nell'insegnamento della fisica (ma non solo), valorizzando la molteplicità di interazioni possibili tra lo studente (**S**tudent) e il docente (**T**eacher).



<http://www.st2.fisi.polimi.it>



# Experimental teaching lab. ST2



# Blended learning

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## Pre-courses in Physics

Politecnico di Milano

At the beginning of the academic year, the Politecnico di Milano organizes refresher courses in Mathematics and Physics opened to all students interested in strengthening their basic knowledge. The courses are free, and their content is based on that of the entrance test: for Physics it regards Mechanics, Thermodynamics, Fluid dynamics, Electromagnetism and Optics. These courses are complementary and supplementary of the MOOCs, so students are required to follow the video lessons and play the online exercises available before the start of the courses themselves.

---

**Target:** Freshmen students enrolled for engineering

**Topics:** Basic knowledge of classical Physics

Mechanics (MC)

Thermodynamics (TD)

Electromagnetism (EM)


**Goal:** Bridge the gaps between High School and University

[http://www.st2.fisi.polimi.it/?page\\_id=281](http://www.st2.fisi.polimi.it/?page_id=281)





## Pre-courses in Physics: students@polimi

Schools	Students	Freshmen (bachelor)	Pre-courses
<b>Architecture</b>	9 409 (20%)	1 167 (15%)	30 (3%)
<b>Design</b>	4 321 (10%)	861 (11%)	6 (1%)
<b>Engineering</b>	31 574 (70%)	5 630 (74%)	 827 (96%)
<i>total</i>	<i>45 304</i>	<i>7 658</i>	<i>863</i>

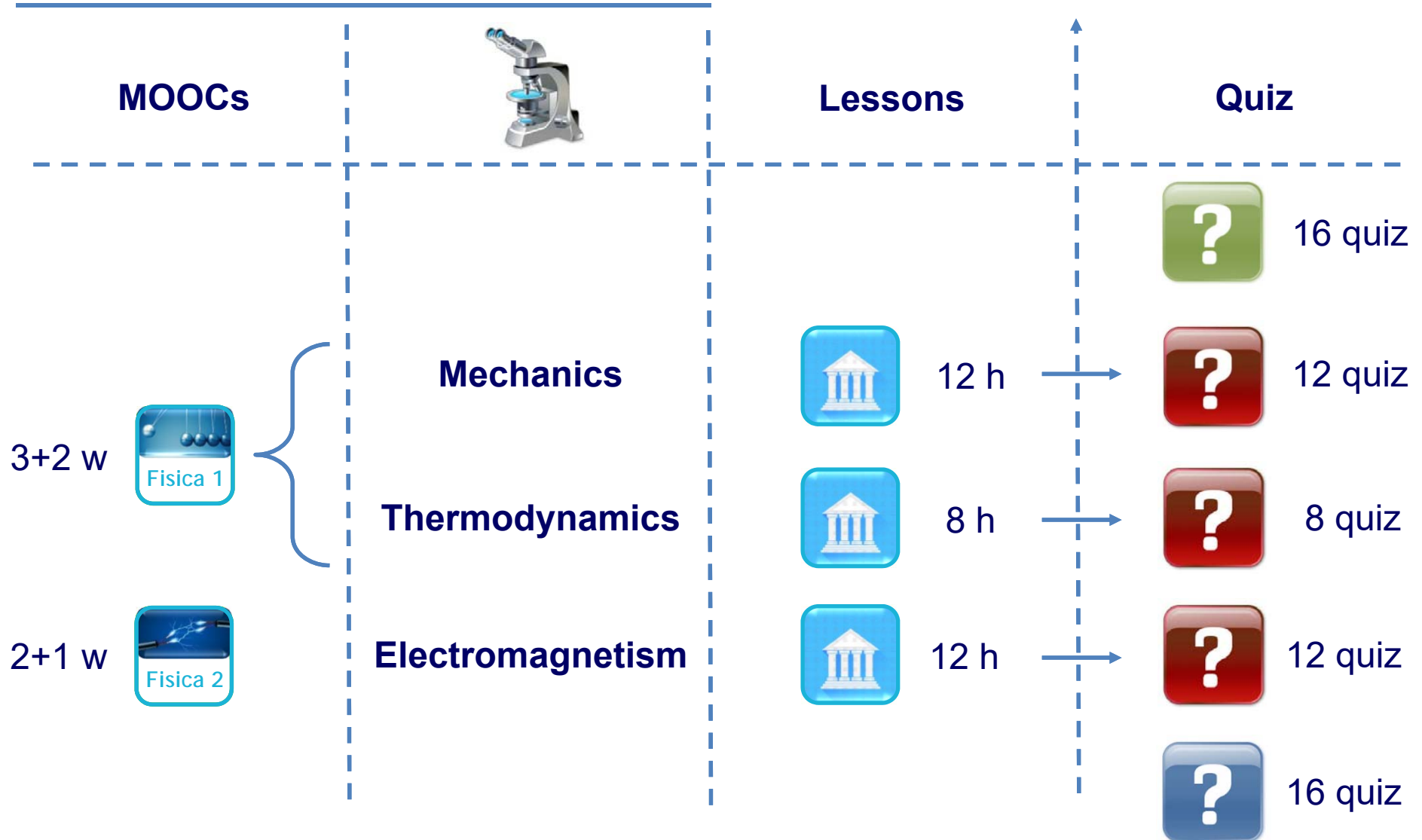
15%  
freshmen (bachelor)  
in engineering

2019-2020: 6 teams in Milan + 1 in Lecco + 1 in Piacenza

credits data: Paola Bertoli



# Pre-courses in Physics: structure



## MOOCs of experimental Physics: tools

---

quiz

cards

lessons

comics

keywords



subtitles

role games

forum

insights

exercise

simulations

interviews

case studies

forms



# MOOCs of experimental Physics: ciak... ~~action~~ start to work!



- team
- topics
- structure
- storyboard
- shooting
- post-editing
- validation
- quiz

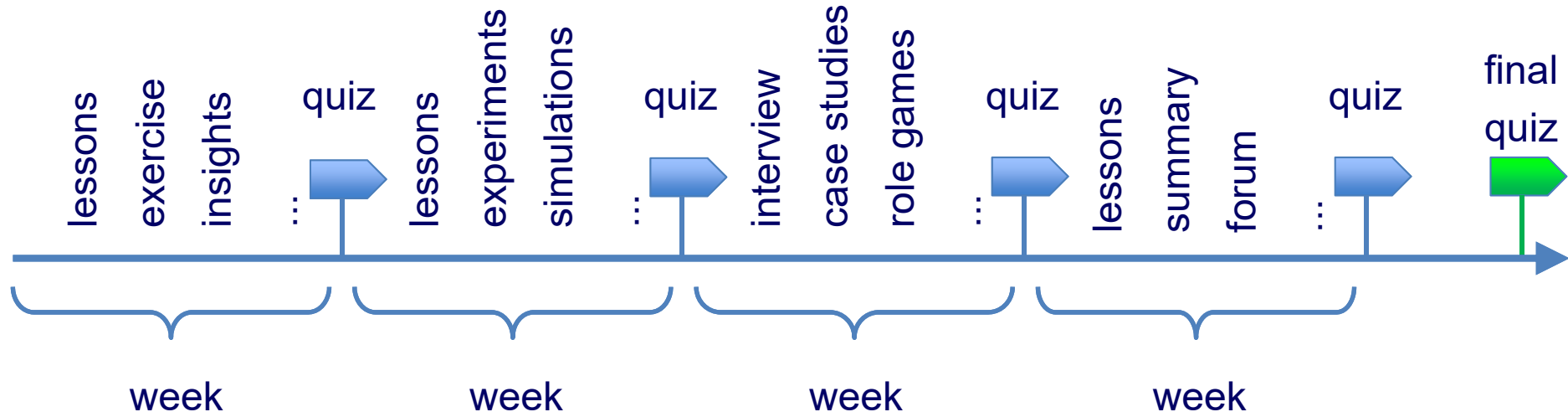
team {  
1 director  
8 teacher/tutor  
7 staff

result {  
450 h  
170 video  
150 quiz

[http://www.st2.fisi.polimi.it/?page\\_id=241](http://www.st2.fisi.polimi.it/?page_id=241)



# MOOCs of experimental Physics: structure and certificate



quiz score > 60%



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# MOOCs of experimental Physics: topics

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 { 2 courses   
≈ 26 000 enrolled  
≈ 1 000 on Coursera)



## Mechanics (3 weeks)

- kinematics of the material point and examples of motions
- dynamics of the material point and examples of motions
- work, energy, bumps and universal gravitation

## Thermodynamics (2 weeks)

- kinematics and dynamics of ideal liquids
- temperature, ideal gas, heat, thermal machines and entropy

## Electromagnetism (2 weeks)

- electric field, conductors, capacitors and dielectric materials
- electrical current, magnetic field and magnetic materials

## Optics (1 week)

- electromagnetic waves, geometrical optics and wave optics

## Hints of modern physics (1 week)

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<http://www.pok.polimi.it>

based on 



(52 MOOC, ≈ 140 000 enrolled)



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## Quiz on-line in real-time

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### Goal

- for teacher: check of the classroom status
- for student: check of the comprehension (more than knowledge)
- “stimulus” to study the topics

### Method

- on-line (suitable for a large number of students)
- real-time (using smartphone as a clicker, BYOD philosophy)

### Implementation

- fast (max. 90"), with no particular calculus
- anonymous (but logging in with the personal code)
- without credits (but self-assessment, score on smartphone)

different from  
MOOC's quiz (150)

---

<http://www.socrative.com>



(≈ 120 quiz)



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## T.I.M.E. project

---

### Highlight misconceptions in Physics

Politecnico di Milano, Università degli Studi di Trento, Doshisha University, Bauman Moscow State Technical University

This project aims at identifying and overcoming the most significant and widespread misconceptions shown by first-year university students enrolled for engineering, in relation to their basic knowledge of Physics, with specific reference to Mechanics, Thermodynamics, Electromagnetism and Optics. It will be developed by Politecnico di Milano along with two foreign universities that offer physics and engineering courses as well as with another Italian institution, Università di Trento, which provides pedagogic support.

---

**Target:** Freshmen students enrolled for engineering

**Topics:** Basic knowledge of classical Physics

Mechanics (MC)

Thermodynamics (TD)

Electromagnetism (EM)




**Goal:** "Highlight misconceptions in Physics"

[http://www.st2.fisi.polimi.it/?page\\_id=233](http://www.st2.fisi.polimi.it/?page_id=233)

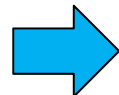




# T.I.M.E. project: structure

	Info	MC				TD					EM					
<b>Politecnico</b> 	...	X		X	X							X	X	X	X	X
	...	X		X	X		X	X	X	X	X	X	X	X	X	X
	...	X		X	X		X	X	X	X	X	X	X	X	X	
<b>Doshisha</b> 	...	X		X	X	X										
	...	X		X	X	X						X	X	X		X
	...	X		X	X	X		X	X			X	X	X		X
<b>Bauman</b> 	...	X	X	X	X			X	X	X	X					
	...	X	X	X	X			X	X	X	X					
	...											X	X	X	X	X

teacher  
study course  
term  
# students

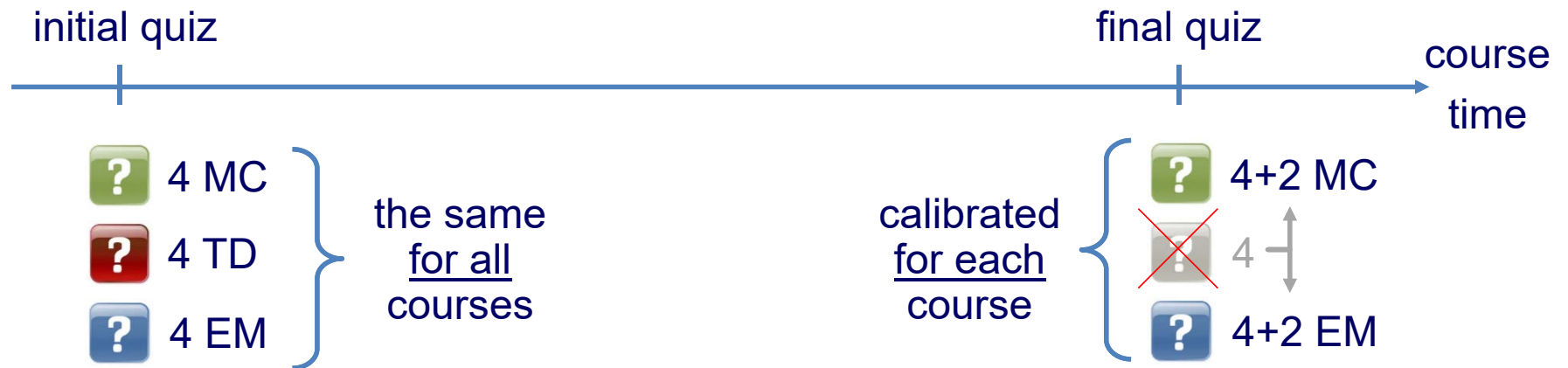


16 courses, 2500 students

"x" reported in the table are just an example

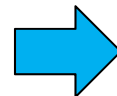


# T.I.M.E. project: structure



	Course	MC					TD					EM				
All university		x	x	x								x	x	x	x	x
		x	x	x		x	x	x	x	x	x	x	x	x	x	x
		x	x	x		x	x	x	x	x	x	x	x	x	x	

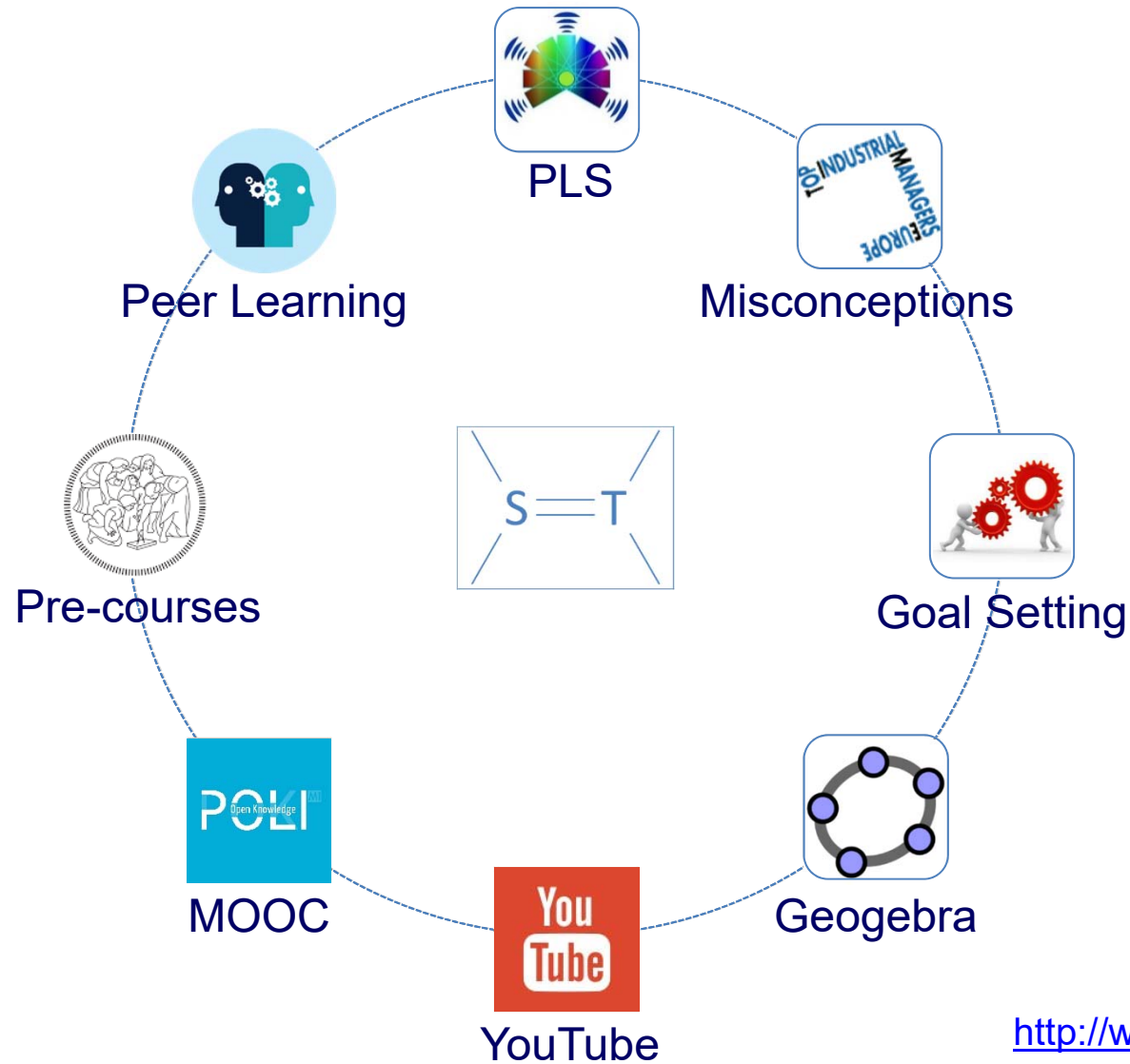
- Quiz with
- 12 multiple choice questions
  - 90 seconds for each question
  - 1 correct answer out of 4 alt.



"x" reported in the table are just an example



# Experimental teaching lab. ST2



<http://www.st2.fisi.polimi.it>



# Thanks for your attention!

MOOCs



Pre-courses



Tech.  
Pedagogy



## Thanks to teachers, tutors, staff:

Daniele Albricci, Barbara Balossi, Federico Bottegoni, Matteo Bozzi, Federica Brambilla, Gianlorenzo Bussetti, Davide Contini, Maurizio Contran, Laura Di Sieno, Gianfranco Elia, Lucia Ganzer, Immacolata Genco, Patrizia Ghislandi\*, Paolo Gondoni, Cristian Manzoni, Andrea Parisi, Andrea Pini, Dario Polli, Juliana Raffaghelli\*\*, Marco Re, Rebecca Re, Filippo Rezoagli, Susanna Sancassani, Cristina Varisco, Caterina Vozzi, Marta Zanoletti

Politecnico di Milano

Università di Trento\*

Universitat Oberta de Catalunya, Spagna\*\*



**Team  
makes the  
difference!**

