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Science and Mathematics Advanced Research for good Teaching

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MULTIPLIER EVENT – Salone del Libro Torino – 12 Maggio 2016

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# THE PROJECT RESULTS IN MATHEMATICS



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DEGLI STUDI  
DI TORINO



RADNOOTI





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M A R T I N A M A R C H I S I O

# I RISULTATI DI SMART IN MATEMATICA

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ERASMUS PLUS - KA2 - VET

SMART - Science and Mathematics Advanced Research for good Teaching

The SMART Project is coordinated by the "Carlo Anti" School in cooperation with an international partnership composed of schools, universities and representatives of the industrial world: this is strictly in line with the idea of a Transnational Strategy to develop initiatives addressing different fields of education and training and to promote innovation, exchange of experience between different types of organizations.

The countries represented in the partnership are: Italy, Germany, Hungary, the Netherlands and Sweden.

**Aims of the Project**

- to improve professional competences and to support innovation in the teachers' system of training through pedagogical and innovative practices based on the new computer and multimedia technologies
- to provide tools and methodologies to facilitate the acquisition of STEM (Science, Technology, Engineering, Mathematics) competence and basic competences in Science and Technology - through discussion and sharing with European partners and advanced technological tools in the teaching of Mathematics and Science to support learning
- to develop skills which can be used in order to contribute to a cohesive society, in particular to increase opportunities for through strengthened cooperation between the world of education and training and the world of work, formulating and solving problems autonomously, consciously and constructively

**Expected results**

- Definition of common educational models
- Development of a European database on training needs
- Development of a European database containing Best Practices
- Implementation of a dedicated international website
- Report on the results of the experimentation of laboratory modules
- Two open online courses for teachers: one called "Mathematical Modelling" for teachers of Mathematics, and one called "Observing, Measuring and Modelling in Science"

ABOUT THE PROJECT  
Learn more about SMART

Other linked Projects:  
PPoS  
LS OSA lab

NEWSLETTER  
Newsletter 1  
Newsletter 2  
Newsletter 3  
Newsletter 4  
Newsletter 5

NAVIGATION  
Home  
My home  
Site pages

<http://smart.miurprogettopps.unito.it>

Project Activities

Open Online Courses

- Mathematical Modelling
- Observing, Measuring and Modelling in Science

Courses of Mathematics 2015/2016

Courses for teachers attending the training

- 3 ala - ISS C.Anti - Liceo Scientifico S.A.
- 2 al4 - ISS C.Anti - Liceo Scientifico S.A.
- 11Q2-11Q3 St. Thomas Gymnasium
- I.S. "Carlo Anti"



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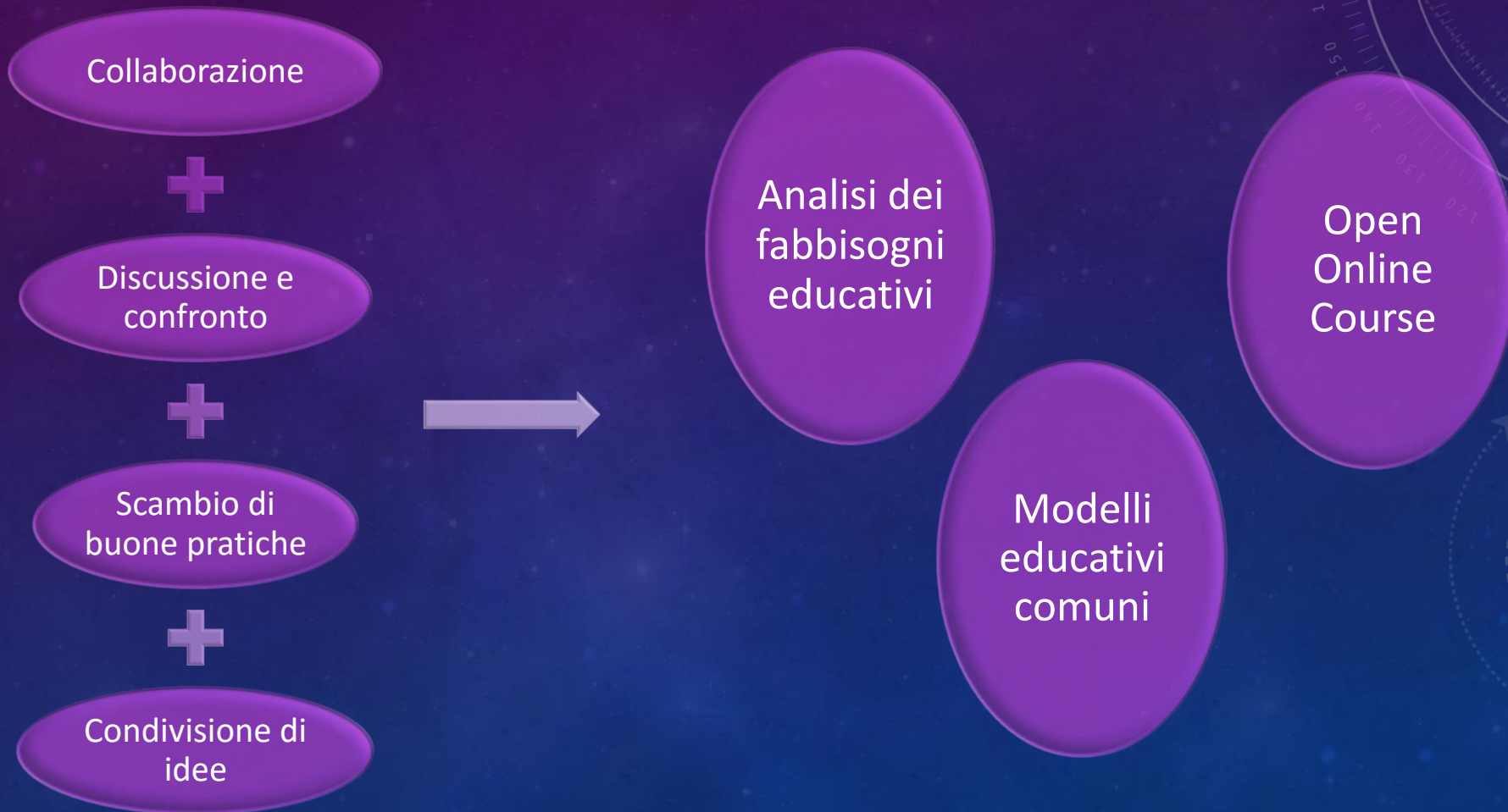
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# I RISULTATI DI SMART IN MATEMATICA







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M A R I N A M A R C H I S I O

# OOC MATHEMATICAL MODELLING

- Per insegnanti
- Formazione e aggiornamento metodologico

**Mathematical Modelling**

- News Forum
- Forum for comments and feedback on materials
- Instructions SMART - Import content from Mathematical Modelling course to the course of your class

<p>Introduction</p>	<p>PPS Methodology</p> <p>Problem Posing &amp; Solving</p>	<p>Self-training</p> <p>Advanced Computing Environment</p>	<p>Self-training</p> <p>Automatic Assessment System</p>
<p>Self-training</p> <p>Virtual Learning Environment</p>	<p>Topic</p> <p>Quantity</p>	<p>Topic</p> <p>Space and Shape</p>	<p>Topic</p> <p>Change and Relations</p>
<p>Topic</p> <p>Uncertainty</p>	<p>Problems and Assignments</p> <p>PROBLEMS and ASSIGNMENTS</p>	<p>Course Evaluation</p> <p>Course Evaluation</p>	



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M A R C H I O

# OOC MATHEMATICAL MODELLING

PPS Methodology ▶

## Introduction

The course is organised in different modules that a teacher can attend independently: the *PPS methodology* module describes the problem solving methodology, the *Self-training* modules are aimed to train teacher on the use of the Advanced Computing Environment Maple and the Automatic Assessment System Maple T.A. and the e-learning platform Moodle; four *Topics* modules contain problems and assignments conceived for classroom use. The *Learning materials* module contains the complete list of problems and assignments from all the areas (topics). The *Course evaluation* module will contain a Questionnaire for teachers rating of this course.

Currently you may request a Moodle courses for your students and teachers. Please follow the instructions written below in order to accredit classes on the Moodle Platform: they will be created in the **Courses of Mathematics 2015/2016** category.

PPS Methodology ▶

## Uncertainty

**Uncertainty Topic:**

- Production of data (valid methods for measuring certain features; statistic survey)
- Data analysis, their visualisation and graphic representation; concept of mean and median
- Probability

Problem	Worksheet & Assignment	Required in advance	Contents	Abilities	Competences	Key ideas
Who's right?		basics of statistics	Bivariate analysis	Conducting a statistic survey, organising data and representing it in tables, computing frequency and contingency indexes	Distinguishing and organising collected data, choosing a strategy for the analysis and drawing conclusion from the results	data analysis, production of data
Conducting a survey		basics of statistics	Statistic analysis	Conducting a statistic survey, collecting, organising and analysing data	Understanding what data are required and their characters, choosing the best statistic indexes for describing data	production of data, data analysis





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# OOC MATHEMATICAL MODELLING

◀ VLE Self-training

**ACE Self-training**

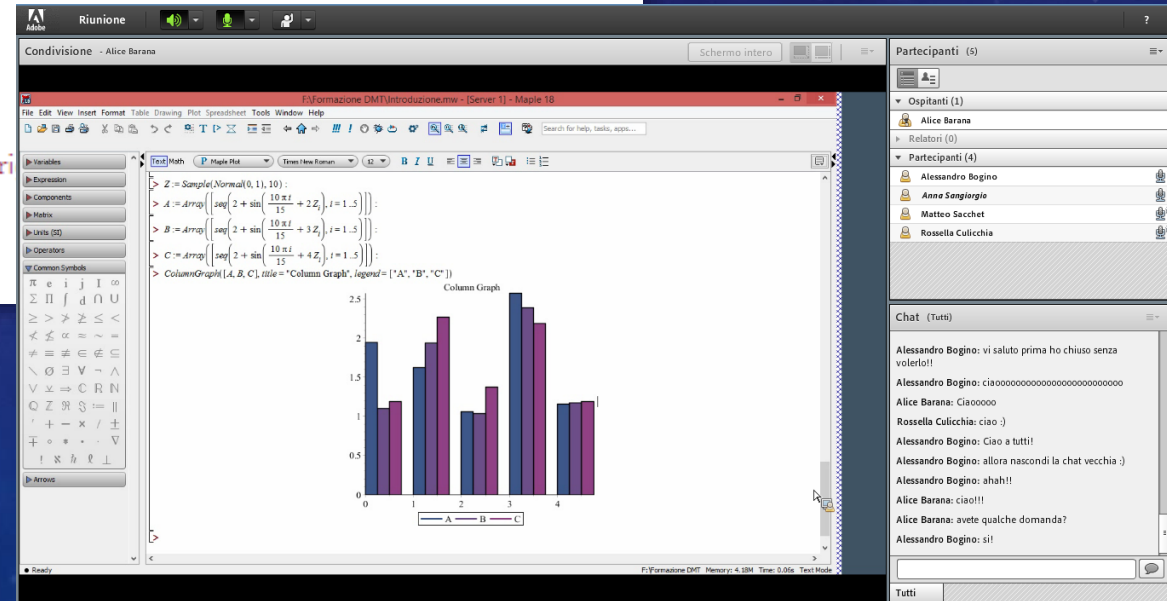
AAS Self-training ▶

**Self-training on Advanced Computing Environment**

-  Resource and video records: FUNDAMENTAL MAPLE COMMANDS
-  Resource and video records: A TOUR ABOUT MAPLE
-  MAPLE QUICKSTART GUIDE FOR BEGINNERS (from Maplesoft site)
-  Maple file integrated in Moodle, an example: Geometric Transformations of Triangles

Click to download:

Maple's template for SMART problem creation



The screenshot shows a Moodle meeting room interface. The main window displays a Maple software interface with a 'Column Graph' plot. The plot shows three data series: A (blue), B (purple), and C (red). The x-axis ranges from 0 to 4, and the y-axis ranges from 0 to 2.5. The chat window on the right shows a list of participants and a chat history.

Category	A	B	C
1	2.0	1.2	1.1
2	1.6	1.9	1.0
3	2.4	2.2	1.4
4	2.3	2.1	1.2





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# OOC MATHEMATICAL MODELLING

## Topic: Uncertainty

- Production of data (valid methods for measuring certain features; statistic survey)
- Data analysis, their visualisation and graphic representation; concept of mean and median
- Probability

Who is right?

Who is right?

Birthdays paradox

Birthdays paradox

Bivariate statistic - contingency table

The Bayes Theorem

Conducting a survey

Conducting a survey

Risiko

Probability

Probability

Combinatorics

Descriptive statistics - interpolating

Metodologia del  
problem posing and  
solving

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## ► Learning objectives

### CAPTURE THE DRUG TRADERS

## ▼ Problem

An area of open sea is monitored by a radar device whose radius of action is 30 miles long.

A motorboat driven by some dangerous drug traders has been signaled, located 50 miles West and 40 miles South with respect to the radar. The criminals are going to transfer a load of illicit trade; they follow a straight path in order to reach a secret destination.

Are there any chances of intercepting them for the radar?

What regions of sea is convenient to patrol in order to increase the probability to intercept the criminals?

## ► Resolution

## ► The Mathematics behind the problem

## ► Bibliography

## ► Maple Commands-Packages





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# OOC MATHEMATICAL MODELLING

## CHOOSING THE RIGHT ACCOMODATION

### ▼ Problem

Elizabeth and Sara are sisters coming from Florence; they are both unnyrgratuates in Milan. Elizabeth passed the test of Bocconi University; Sara, instead, attends the Polytechnic. In order to save money, the family decides to rent the same flat for both the sisters; They look for a position that requires the minimum time for daily travelling.

In the morning Sara goes to the University; she comes back home and she goes again to the University.

In the evening, before dinner she goes to volley training without coming home before. She has dinner at home and later she goes to Clara's house to study.

Elizabeth, instead, will go to Polytechnic twice a day and in the morning before having breakfast at home, she will go jogging in the park.

**Which is the best position for the flat to choose?**

### ▼ Resolution

► Creating the Basic Model

► Creating an Advanced Model

► Creating an Open Model

► The Mathematics behind the problem

## Resolution

### ▼ Creating the Basic Model

First of all, we should see the city map in order have an idea about the position of:

- Bocconi Univerity;
- Polytechnic;
- Clara's house;
- The Park;
- Volley gym.

We immediately discover that they are all lined and they are set along the main street.



Therefore we decide to look for a flat lined up with the other itemized buildings.

With the help of a ruler we measure distances on the map , represented in scale 1:18000 (1 cm = 180 m).

We choose the position of the Polytechnic as a reference point, and we measure any distance with respect to this structure.

We organize the measurements in the following table :

Route	Distance (Km)
Polytechnic - Clara's house	1.5
Polytechnic - Park	2.4
Polytechnic - Gym	3.6
Polytechnic - University	5





# OOC MATHEMATICAL MODELLING

## Utilizzo delle ICT

- ambiente virtuale di apprendimento
- materiali interattivi preparati con un ambiente di calcolo evoluto
- un sistema di valutazione automatica

### ▼ Pencil of lines passing through a point

The equation of the pencil of lines which passes through the point M is

$$F = y + 40 = m \cdot (x + 50)$$

$$y + 40 = m(x + 50)$$

(16)

Paths

```
:= animate(implicitplot, [F, x = - 50 ..50, y = - 50 ..50, scaling = constrained, gridlines = true, color = gray],
:
display(Paths, Map1, Map2)
```

m = 1.3384





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MARRINAMARCHISIO

# OOC MATHEMATICAL MODELLING

## Utilizzo delle ICT

- ambiente virtuale di apprendimento
- materiali interattivi preparati con un ambiente di calcolo evoluto
- un sistema di valutazione automatica

**Question 3: Score 1/1**  
Question type: Mathematical Formula

Quali sono i vertici dell'ellisse di equazione  $\frac{x^2}{9} + \frac{y^2}{16} = 1$  ? ✔ Correct

Elenca tutti i punti separati da ;  
Esempio: (0,1); (1,0); (1,1)

Your Answer: (0,4);(0,-4);(3,0);(-3,0)  
Correct Answer: (3,0); (-3,0); (0,4); (0,-4)  
Comment:

---

**Question 4: Score 0/1**

Your response	Correct response
Trova lo zero della funzione	Trova lo zero della funzione
$f(x) = \frac{\ln(x-1)}{x}$	$f(x) = \frac{\ln(x-1)}{x}$
X = 0 (0%)	X = 2
Total grade: 0.0×1/1 = 0%	
Comment:	✘ Incorrect

---

**Question 5: Score 1/1**  
Question type: Maple-Graded

Scrivi l'equazione della circonferenza di centro (0, 0) e raggio 3. ✔ Correct

Your Answer:  $x^2+y^2-9=0$   
Correct Answer:  $x^2+y^2 = 9$   
Comment:

Osserva il grafico.

Scrivi le componenti del vettore di traslazione nella forma (a,b)  
(4,-3)

Scrivi l'equazione della funzione traslata rispetto alla funzione base  $y = x^2$   
 $y = -3+(x-4)^2$



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# OOC MATHEMATICAL MODELLING

## Motivazioni:

- insegnamento della matematica come **processo costruttivo** e non come processo trasmissivo
- **facilitare l'apprendimento** dei concetti matematici
- rafforzare le **competenze logiche-matematiche-informatiche** utili per interpretare la realtà e prendere decisioni
- **materiali interattivi** di tipologie differenti che consentono percorsi e **feedback individuali**



**forte impatto cognitivo sull'apprendimento della matematica**





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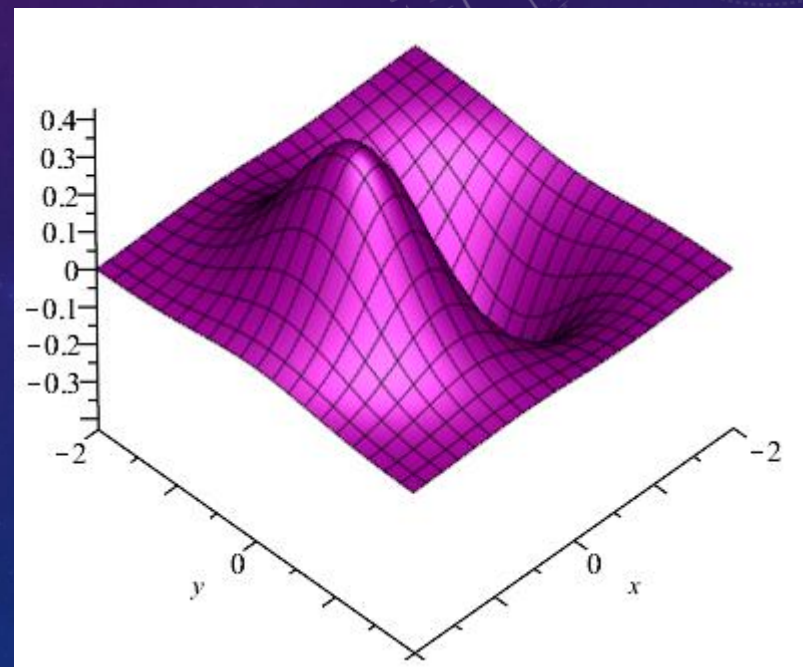


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# OOC MATHEMATICAL MODELLING

- ruolo attivo dello studente che apprende
- la paura di sbagliare si attenua
- massima attenzione al linguaggio matematico perché il software possa interpretare correttamente i comandi
- grafici e animazioni in 2 e 3 dimensioni rendono la matematica dinamica, concreta e interessante e le applicazioni alle altre discipline appaiono naturali





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# OOC MATHEMATICAL MODELLING

- Gli insegnanti partecipanti al progetto hanno contribuito attivamente alla preparazione dei materiali interattivi attraverso la sperimentazione in classe
- Gli studenti hanno mostrato entusiasmo e curiosità di fronte alle nuove risorse digitali e grande facilità nell'utilizzo



Contenuto calibrato meglio, moduli e unità in base articolati in maniera più conveniente

2 al4 - ISS C.Anti - Liceo Scientifico S.A.

Teacher: Paolo Marconi

11Q2-11Q3 St. Thomas Gymnasium

Teacher: Ulrike Kempfle

I.S. "Carlo Anti"

Teacher: Valeria Silvestri

St. Thomas Gymnasium

Teacher: Stephan Markthaler

11A Radnóti Miklós Secondary Vocational School

Teacher: Attila Háhn

Teacher: Márta Zsbánné Hámary

11BCm Radnóti Miklós Secondary Vocational School

Teacher: Éva Szabó

Teacher: Márta Zsbánné Hámary



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# OOC MATHEMATICAL MODELLING

- **insegnanti formati** mediante mini corsi erogati attraverso un sistema di webconference integrato con la piattaforma Moodle di Smart e un tutoring a distanza tramite forum
- **prodotti multimediali raccolti e organizzati** in modo tale da poter esser fruibili in maniera autonoma
- risorse e attività proposte scritte in **EasyReading** (font ad alta leggibilità )