2015

Identification of pedagogical and disciplinary topics

[Report by Accademia delle Scienze di Torino]

Improving teachers' professional competences and supporting innovation in the initial and in-service training system of Mathematics, Physics and Science teachers, but also developing competences, awareness and a constructive attitude in students so that they can improve their motivation in the study of Mathematics and Science, are the objectives of the SMART project.

One of the main aims is to support innovation in the teachers' system of training through pedagogical solutions and innovative practices based on the new computer and multimedia technologies.

In order to support this aim the SMART project is developing the construction of two open online courses for Science and Mathematics teachers'. These courses contain different **modules** based on the adoption of innovative technologies like Maple and Maple T.A. They are aimed to a teaching which supports the students' learning with a **constant formative assessment**, but also projected to **verify the acquisition of mathematical and scientific competences**.

The first step in order to develop the open on line courses was the identification of pedagogical and disciplinary topics. This was based on the analysis of training and educational needs of Italian Mathematics and Science teachers compared with training needs in the other countries (Germany and Hungary) involved in the project and according to the specification of the OECD.

SCIENCE

The work group has chosen four disciplinary topics:

1. **Methods in Science**
   - Laboratory teaching
   - Scientific reasoning
   - Measuring and uncertainty
   - Modelling and data fitting in sciences

2. **Practical optics**
   - From reflection to refraction
   - Diffraction

3. **Earth Sciences**
   - Earthquakes
   - Water in sands

4. **Energy in sciences**
   - Mechanics
   - Biochemistry

The Mathematics topics were chosen according to the four main areas indicated in the **PISA 2012 Assessment and Analytical Framework**, within a number of subtopics:

1. **Quantity (quantitative reasoning)**
   - Concept of number
   - Use of numbers to represent quantities and qualifier attributes of the real world's objects (evaluations and measurement)
   - Comprehension of the meaning of computations
   - Idea of the order of magnitude of numbers
   - Mental computation/elegant computation

2. **Space and shape**
   - Recognition of shapes and patterns
   - Comprehension of dynamical changes in shapes
   - Two- and three-dimensional representations and their interrelations
   - Capability of recognising similarities and differences between objects
   - Relative position and movements in the space

3. **Change and relations**
   - Representation of mathematical relations in several ways (symbolic, algebraic, graphic, tabular)
   - Ability in passing from one type of representation to another
   - Capability to think in functional terms (meaning of rate of change, slope..)
   - Link to aspects of other key ideas (Space and shape and Uncertainty)

4. **Uncertainty**
   - Production of Data (valid methods for measuring certain features; statistical survey)
   - Data analysis, their visualization and graphic representation
   - Concepts of mean and median
   - Probability.

Working on these topics the work group is now developing the **Modules and Didactic units** to be used in the **open online courses.**