2015

The standard competences

Report by Accademia delle Scienze di Torino

SMART
Science and Mathematics Advanced Research for good Teaching
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Acting on the professional competences of teachers leads to the direct consequence of improving the students' competences and therefore to a general positive effect on the school system.

In order to be effective, the Mathematics and Science teachers need to have good knowledge of their subject, good competence on how to teach it and the necessary flexibility to adapt their methods to all students' training needs. However, it is very difficult and expensive to reach a great number of teachers to refresh their competences.

An effective method is to improve the cooperation between them and the sharing of their best practices through web platforms, social networking sites and other online resources.

The work group is working on the definition of educational models to be shared at a European level for the training of teachers through the development of a database containing best practices and innovative didactic materials. These materials will help supporting teachers' professional competences and innovation in the initial and in-service training system but also developing competences, awareness and a constructive attitude in students.

Following the identification of disciplinary topics agreed at the partnership level, two pilot Open On line Courses (*OOCs*) will be prepared, one for Sciences and one for Mathematics.

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 teachers' teaching and students' learning with a constant formative assessment, but also projected to verify the acquisition of mathematical and scientific competences. The modules are based on *learning objects, LOs,* freely accessible resources like simple text documents, 2D or 3D images, video clips, Java applets or other objects which can be used for the online learning. A lot of lessons or didactic units can be implemented starting from the object itself; more didactic units make up the course modules.

The didactic materials, problems with self-evaluation test and experiments accompanying the modules will have a standard format, using advanced computing environments and being learning objects themselves.

Organization of Moodle Platform of SMART

PILOT OOC SCIENCE only FOR TEACHERS

Measurement and Modelling in Science

Methodology

The methodology used in the planning of the Science OOC is that of the P&PBL (Project & Problem-based Learning), in the belief that the traditional Science's teaching/learning doesn't stimulate curiosity towards natural events and everything related to the phenomenology observed in the reality.

Structure

The main objective is to give teachers the necessary support to organize, manage and improve experimental activities by using in particular materials and instrumentation available in daily life (*day-life laboratory*).

The OOC will be organized in four modules (M): each module, described in terms of prerequisites and output competences, will contain didactic units (DUs) or lessons about one or more of the topics defined by the work group (Method in Science, Chemical and Physical Systems, Living organism, Earth Science).

Each module will propose a didactic path, sometimes also interdisciplinary, in order to guide the learner through the different features of the involved subjects.

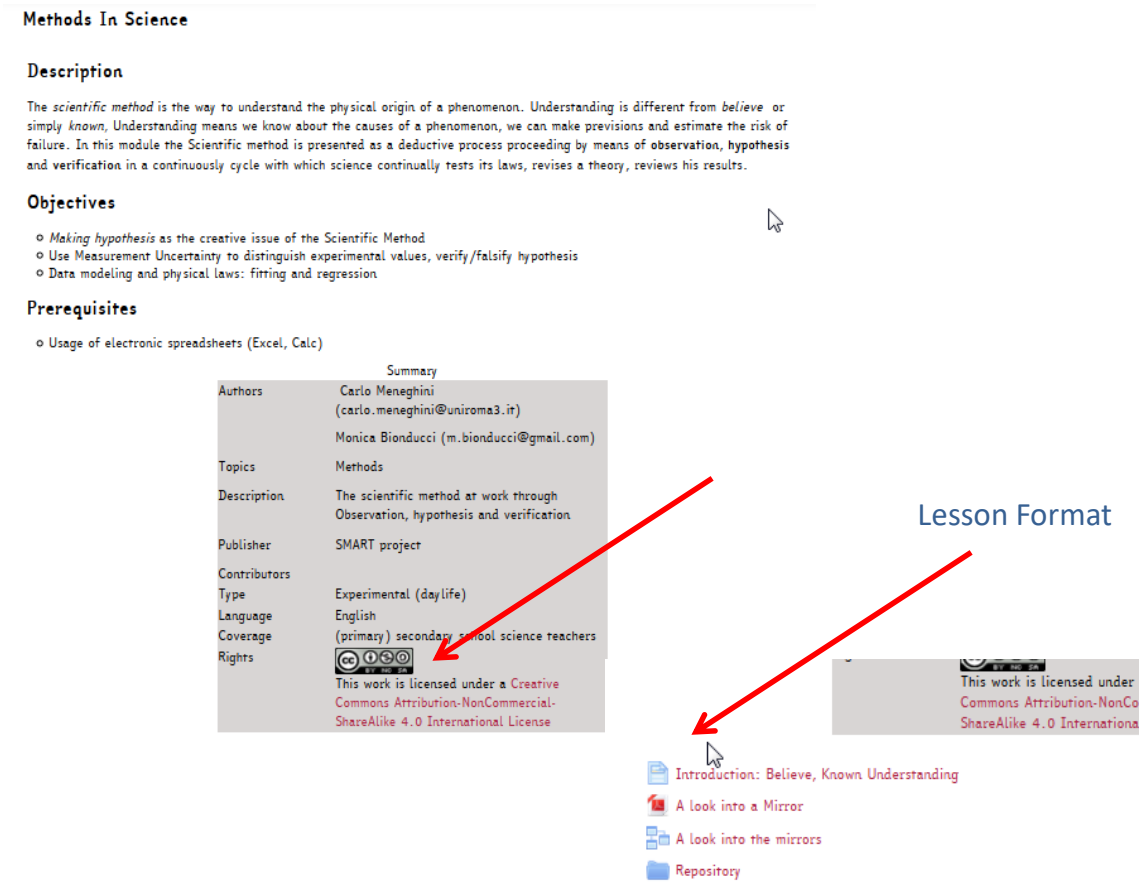
The DUs will be implemented so that they can also be used singularly and, if necessary, exploited by the teachers who want to create their own original didactic path.

Each didactic unit will be accompanied by some activity sheets, which will be the guide to carry out the experimental activities. The proposed activities are based on the quantitative observation of phenomena, mainly taken from daily life, and on their interpretation following the logic of the experimental method: observation, hypothesis and experimental testing. For this reason, experiments, achievable with easily accessible materials and instruments, and simulation applets for the virtual laboratory will be proposed.
Each sheet will contain the implementation technical details, rigorous interpretation models of the studied phenomenon, several examples of experimental data analysis and a guide to discussion and testing.

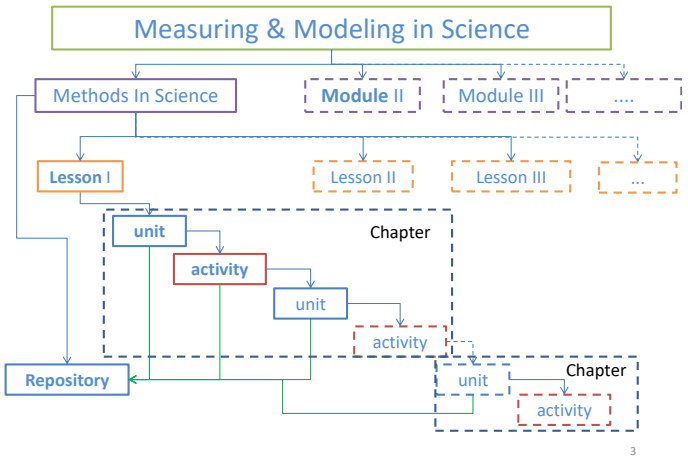
Moreover, for each sheet the teacher community who is going to use the OOC will have a dedicated forum available for the discussion in order to highlight the experiment critical and positive aspects, suggest alternative solutions, updates, improvements and propose discussions on the experiment contents and thematic analysis.

Finally, an anonymous assessment section will allow to get a rating of the proposed activities in terms of clarity, feasibility and effectiveness in order to select and update topics and contents of the didactic modules.

Topic 1: Methods in science



OOC Measuring and Modeling in Science: structure



PILOT OOC MATHEMATICS FOR STUDENTS AND TEACHERS

Mathematical Modelling

Methodology

The methodology used in the planning of the Mathematics OOC is that of the PP&S (Problem & Posing Solving), in the belief that the traditional teaching/learning of Mathematics doesn't allow to understand its pervasiveness, its depth and its important applications in everyday life.

The methodology consists in starting from a real situation in order to stimulate the capacity of solving a problem after having paid attention to its posing: the students will not simply mechanically apply learnt formulas or "prepackaged recipes", but they are put in front of a problem which can't be attributed to something they know and they don't have the method that leads them to the correct result. This method can be found at the end of a research path in various stages, from the reduction of the problem in simpler and more easily resolvable parts to the assumption of new points of view and of different possible directions.

The teacher guides the students to the research of a problem solution in four stages: understanding the problem, devising a plan, executing the plan, checking the results. Through this methodology, each student will develop independent judgment, creative thinking, awareness of his capacities, ductility and flexibility in the research of solutions. The topics on which the course will be implemented were defined by the work group and are the following: Quantity, Space and Shape, Change and relations, Uncertainty.

In the solution research the students will learn how to use an Advanced Computing Environment, ACE, which allows them to concentrate on the solution, visualize the problem, hypothesize strategy solutions and above all get rid of the calculation technical rigidity. The competence acquisition in the use of ACE will also allow the students to be better prepared for the world of work in which these environments are used in an essential way above all for the simulation.

Structure

The OOC contains interactive material to organize, manage and improve the learning of Mathematics through more stimulating lessons in which the student is more active and willing to participate. A part of these materials should be used when the student has a PC with ACE available.

The OOC will be organized in four modules (Ms): each module, described in terms of prerequisites and output competences, will contain didactic units (DUs) or lessons about one or more of the choosen topics. As with the Science OOC, each module will propose a didactic path, sometimes also interdisciplinary and the DUs will be implemented so that they can also be used singularly and, if necessary, exploited by the teachers who want to create their own original didactic path.

Each didactic unit will contain one or more problems to be proposed to the students who, individually or in groups, will look for original solutions by using an ACE.

Finally, each didactic unit will contain a selection of tests and task activities, prepared with the automatic evaluation system, which allow the teacher to assess both the knowledge and the competences reached by the student. The questions of the task activities permit the insertion of answers containing literal and numeric expressions as the system is able to evaluate the answer correctness regardless of the form of the expression chosen among the innumerable possible ones. The automatic correction can provide some feedback for the student and the task activities will be accompanied by an assessment rubric that the teacher can decide to use or not.

At the end of each module some tests with automatic assessment are provided also for the teachers: they will allow them to get a rating of the proposed activities in terms of clarity, feasibility and effectiveness in order to select and update topics and contents of the didactic modules.