## Innovation & Mathematics

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Introduction. In the last years the requirement of innovative mathematical education has increased a lot. Besides the usual reasons mainly connected to learning difficulties, a new need is presented by the modern knowledge society which demands, at any level, a continuous updating of individual knowledge and skills. In order to face and solve problems and tasks of everyday life and also to carry out an aware and active role in the society, not only it is crucial to know how to use knowledge and abilities learned at school, but it is also necessary to be able to face a long-life learning.

Mathematics is strictly involved in this process, since fundamental tool for the interpretation and the understanding of real world. In particular, mathematical models - key language of scientific method - are now spreading everywhere, invading by force our everyday life. From specialized language of science and technology, modelling is becoming an efficacious tool in mass communication.

Unfortunately, the pressing request of mathematical competence collides with the learning difficulties of the discipline, which appears even increased in the last period. More and more frequently students present a great discomfort with mathematics; recent opinion pools show that they consider mathematics an abstract subject, faraway from their experience and interest, useless in everyday life. A could mountain, too hard to be climbed, so they often give up the task before starting.

This situation is confirmed by the teachers, who regret an increasing difficulty in promoting the educative process and starting a constructive dialogue. To involve students in the educative process is always more difficult, also because of the short and rare moments they usually devote to study.

A direction for innovation: education on modelling. *Innovamatica* (Innovation&Mathematics - a project of the Department of Mathematics and Informatics of the University of Perugia, promoted by the Authors of the present note) has been acting for the past twelve years with the aim of promoting the diffusion of scientific culture.

One of the main activities is *Orientamatica*, a didactical project addressed to secondary and undergraduate education, started in 1997.

The Centre PRISTEM of Bocconi University jointed to this activity in the past three years.

Orientamatica's main purpose is to bring teenagers near the possible interactions between mathematics and everyday life and to show them how a mathematical education is necessary for most of human activities. It has involved more than 6.000 students of 50 different schools in various regions in Italy (Umbria, Lombardia, Piemonte e Liguria), with the active participation of about 60 teachers interested to experimentation of innovative teaching methodology.

More precisely, the proposal's outstanding innovative content consists in *education to* mathematical modelling. Education to modelling involves a different way of approaching

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Mathematics, focalized to the description and comprehension of the real world.

The central point of the proposal is a dynamic interaction between the real world and the mathematic world.

The construction and the study of the model encourages a critical analysis of the problem that leads up to the formulation of judgements, evaluation of possible solutions and/or forecast of the future evolution.

The successive comparison of model solutions with the reality is fundamental because gives the possibility of appreciating the quality of the model itself. Improvements or variants lead up to a more and more efficient virtual prototype.

Generally, this progressive evolution requires more complex and well defined mathematical tools that provide new theories or the rediscovery of "forgotten" results.

Thanks to mathematical abstraction, the same model is able to describe different phenomena in various fields. Moreover, instruments and techniques can be assembled in order to manage with new problems, such as we do with *Lego* constructions, in which few basic elements allow to realize a great variety of structures even very complex. A great part of the modelling process power resides in this flexibility and generality.

Modelling and didactical strategies. *Orientamatica* courses have enabled us to test modelling education processes addressed to teenagers.

The success that the initiative had among students and their teachers confirmed our intuition: the education to modelling is an excellent source for didactical innovation. Our experience pointed out that connecting mathematical education with real life experience not only challenges students interest, but also encourages an active and responsible participation. Moreover it promotes an experimental attitude towards Mathematics making students aware of the potentiality of mathematic language and it consents to appreciate their own knowledge and skills.

Starting from real life situations, with the objective of giving them a mathematic formalization, we can introduce (in a very natural way) concepts and mathematical instruments that are acquired and tested during the study of model. The successive step of model validation gives the possibility of improving the instruments, reflecting on the theory and bringing up into light new needs. In his turn, the acquisition of more and more powerful mathematical instruments allows to deal with more complex problems or to operate a re-reading of those already discussed. In this way, as in a ping-pong game between the real world and the mathematical world the didactical process evolves according to an ascending helix.

Mathematics&Reality (www.matematicaerealta.it) The success of Orientamatica experience encouraged *Innovamatica* and PRISTEM to promote the new project *Mathematics&Reality* (M&R), a deep innovative education proposal, which develops and expands Orientamatica as a national project.

M&R supplies a range of opportunities:

- for a *traditional teaching*, it provides numerous elementary models which can be proposed to students as exercises;
- for a teaching supported by new technologies, it provides a great variety of models at various difficulty levels which requires information technologies to be handled;
- for a *true innovative teaching*, it provides the direction and methodology, suppoted by a lot of educational materials.

The project organizes the following main activities:

- didactic Labs hold in different schools at a national level
- courses addressed to teachers and tutors in order to project the didactic Labs
- a final meeting with the active partecipation of students and their tutors.

A periodical supervising process of the learning activity is also activated and a final test is carried out, contemporaneously in all the schools which partecipates to teh project.

In this first year (which can be considered as speriemntal) M&R coordintaes 18 Labs in 8 regions, which have involved 1600 students and 50 teachers. The aim of the present comunication is to illustrate M&R in details, together with part of the didactical material.

Finally, we wish to mention that this project do agree with the PISA (Programme for International Student Assessment - promoted by OCSE) report themes.

## REFERENCES

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