

# **SYMPOSIUM**

## **LEARNING ENVIRONMENT DESIGN FOR MODELLING ACTIVITIES IN A SOCIAL CONTEXT: THE VENTURE OF MODELLINGSPACE**

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### **INTRODUCTION**

Modelling, especially dynamic modelling, for many students of secondary education, is an extremely difficult cognitive activity. Professional tools are too hard for novices to use, user-unfriendly, and do not provide support for learners. Over the last decade, the interest in modeling activities and the possibilities offered by technology have led to the development of a number of systems addressed to young students (e.g. Model-It, SimQuest, Modellus, etc).

### **MAIN CONSIDERATIONS AND OBJECTIVES**

There are three main reasons that have led us to propose and conceive a new technology-based learning environment that promotes and support modeling and collaborative modeling activities.

*Epistemological order reasons:* Scientific activity involves to a great extend creation, validation and application of appropriate models of the phenomena, systems or situations under study. Models appear in most scientific areas (economics, history, biology, meteorology, archaeology etc.), as well as in our everyday life. Moreover, during the last years, modelling tools, provided by computer science, have considerably influenced the work of some disciplines. Computers have amplified the power of traditional models, but have also provided new representational systems and conceptual frameworks for modelling. Efficient employment and management of modelling tools appear to be key capabilities for the future citizen. Modelling and modelling with computers is what scientists do all the time, so modelling offers a more authentic view of doing science.

*Learning order reasons:* Teachers and students of all levels often conceive science education as a process of information transfer in which students accumulate whatever fact is conveyed to them by an instructor or by a textbook. Furthermore, when we present directly to students already conceived laws, formulas and models (e.g. algebraic ones), they don't appreciate the value of the model, they are not able to appreciate the significance of variables, and thus they often use models outside the conditions of their validity, or cannot evaluate the appropriateness of the results of the application of a model.

During the last decade, research in the field of science education and cognitive psychology [among others Martinand, 1992; Lemeignan & Weil-Barais, 1993; Bliss, 1994; Halloun, 1996] has indicated that the application of a modelling process could reinforce the learning process for a number of reasons:

- Through a model construction process, learners express their own ideas and mental models [Bliss, 1994] of which, in most cases, they are not aware. This expression is the first step towards the process of cognitive awareness of ideas and reasoning modes, which are often necessary for conceptual change [Vosniadou, et al. 1994].

- The graphical and iconic representations that the models can obtain enable the abstract ideas to acquire a concrete form. These representations play the role of thinking support, a role that accompanies thought and reasoning [Laborde & Vergnaud, 1994].
- The expression of thoughts through model construction can help the learning process, since the ideas become an object of communication and discussion.

Furthermore, one of the worldwide problems of the current curriculum is the fragmentation of knowledge among different subject areas. The use of models and modelling processes constitutes a common point among different disciplines. So, modelling activities could contribute to the unification of common points between different subject areas, and could promote *interdisciplinary* teaching approaches.

*Social order reasons and the dimension of a wide learning and teaching community:* Learn to communicate and collaborate is an important skill of actual life. Collaboration is integral to today's organisations, which require individuals who can work together to solve complex problems and share their own knowledge and expertise with others. Collaborative skills can be learned, and it is therefore essential to provide individuals with appropriate learning opportunities (Abrami, 1996). If learn to collaborate, must become an explicit objective of the actual education, at the same time, learning seen in a social context offers new possibilities for learning sciences, developing inquiry skills and contributing to the necessary conceptual change.

Social interaction (and interaction with the tools of technological culture) provides new cognitive resources for human cognitive accomplishment (Miyake, 1986; Slavin, 1995; 1997; Hutchins, 1995; Pea, 1993). A fundamental assumption is that interaction among children around appropriate tasks increases their mastery of critical concepts. In general, in cases of knowledge seeking inquiry, technologically sophisticated collaborative learning environments designed to follow cognitive principles could provide advanced support of social process of inquiry, facilitating advancement of a learning community's knowledge as well as transformation of the participants epistemic states (Pea, 1993).

Finally, lessons learned from a number of research studies suggest that we need to consider the school (and their members teachers and students) as a community of practice. Schooling can be improved by understanding the practices of its participants, by creating systems to help the school be a learning organization, by expanding the single local school community to a wider one, that through rich interactions could mutually support teachers, so as to extend their work to new or additional outcomes.

## **SYMPOSIUM PURPOSE**

The present symposium aims to discuss some central aspects concerning the design of ModellingSpace collaborative learning environment; a modelling environment that aims to be implemented in various European educational systems. Recent issues on technology based learning environments, lead us to consider the fact that the design of learning environments cannot be focused only on the design of the technological system itself. We assume that the whole design must be composed of three interrelated endeavors: (a) the design of a technology based system, (b) the design and development of a core learning activities set, (c) the creation of a human network (including students, teachers, researchers, etc) that promotes thinking in the context of the whole learning environment.

Thus, the design of such a learning environment constitutes a multidimensional task. This symposium presents and discusses some of its implications:

- The main design concepts and principles, for a collaborative modeling environment for sciences and mathematics, which incorporates various representational formalisms, allows collaboration among students and supports teachers. This is the object of the first paper.
- Modelling implicates several aspects related to the representation formalisms and the underlying reasoning. The second paper discusses the case of quantitative reasoning. This kind of

considerations is inherent in the design of the system, indicating our vision of the specific nature of modeling as well as on the underlying learning objectives.

- The use of various representation formalisms is also inherent in a modeling environment. The third paper presents a study exploring the appreciation by the students of the representational codes, used in the case of semi-quantitative reasoning, in an example of study related to physics.
- The role and the characteristics of a human network supporting the exchanges and development of ideas on the ways to use a learning environment, is the object of the fourth paper. This paper focuses on an appropriate framework that could allow the creation of a vibrant human network.
- Finally, into the fifth paper the reader can find concrete elements related to the main interface characteristics as well as the main functionalities of the MODELLINGSPACE technology based learning environment.

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