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The role of interactions in Science learning using three educational mediums: video, technology-based learning environment and real objects

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In this paper we discuss the interactions between students and among teacher and students. It is pedagogic delusion the thought that the work of students in groups involves automatically their collaboration (Amigues, 1988). The interaction between students depends from their personality (Kempa and Ayob, 1991). Many times, their oppositions lead them to conflicts that prevent the problem's solution (Goffard and Goffard) or a student with an error representation accomplishes to convince the other (Gomatos, 1996). Dillenbourg (1999) states that students do not learn from each other merely by solving the same problem at the same time, but because they interact (e.g. by explaining something or by negotiating about several solutions).The teacher's role as tutor is very important (Dumas-Carré & Weil-Barais, 1998).

Based on the presented theoretical framework, we discuss the interactions between students and among teacher in Science teaching. Specifically, the teaching paradigm concerns Hooke's Law using springs. The physical system we study has certain advantages: it is simple enough and represents a wide spectrum of real systems in order to make it as reusable as possible. The paradigm is designed within a socio-constructivist approach, where the student takes an active role on the construction of his/her knowledge, and it exploits three different mediums: a video in order to motivate students' interest; objects from everyday life for the experiments; the software "ModellingSpace".
First, students look at a video. A spring that is neither compressed nor extended is in its equilibrium position. The length is perturbed slightly and the spring tends to come back to the equilibrium position. As long as the deformation is elastic, the force exerted by the spring will be proportional to the amount of the stretch from equilibrium. Now, a mass is hung from the spring, it is displaced from the equilibrium position and it oscillates. They describe and explain the video, expressing their first representations. Next, they carry-out the experiment using different springs. Finally, they design and virtually run the experiment using "ModellingSpace" (Dimitracopoulou et al., 1999; Komis et al., 2001) which is an open-ended learning environment that allows students to create models, work and reflect on entities (representing objects) and their properties (representing concepts),while they construct the model of the situation using the entities (concrete or abstract), the properties and their relations.

ModellingSpace is a technology based learning environment, currently in the state of prototype (Dimitracopoulou et al., 1999; Komis et al., 2001), designed to familiarize pupils with the steps of modelling. Using this learning environment, the pupils can build models of the evolution of physical, biological, systems, etc. Concretely, the

user of the learning environment determines the constitutive entities of the system in which he is interested and the descriptors of these entities. He proposes then relations between these possible descriptors to account for the evolution of the system.
The interest of this technology based learning environment is that it makes possible to pupils to handle various semiotic systems, making possible to express the entities and their relations. By comparing the transformations of the entities (represented in a figurative way by dynamic images) associated with various expressions of the relations, it is possible to apprehend the compatibility or the incompatibility of the relational expressions. It is thus possible to exploit the possible mapping between various manners of representing the relations: graphic coding with arrows of variable size (↑↑ which means the covariation of two descriptors), logical, mathematical expression, a graph, and a table of measurements. ModellingSpace (Komis et al., 1998; Politis et al., 2001) thus make possible to pupils to connect various symbolic notations of relations between variables and thus encourage various processes of translation between the various semiotic systems (language, semi-quantitative relations, etc).

We compared the models created by the students using the ModellingSpace in the tree phases. When they:

1) work individually
2) work in groups and each group was implemented separately
3) work in groups which was implemented separately and their teacher participate also to the processus.

Students attended first grade of higher-secondary school (15-16 years old). Each group consisted of three students. The developed teaching approach was implemented with 15 students in the first phase, 5 groups (or 15 students) in the second phase and 5 groups (or 15 students) and their teachers in the third phase. The duration of the implementation was 20-30 minutes for each individu while the duration of the implementation was 30 - 40 minutes for each group. The students had volunteered to participate. The implementation of the paradigm was video-recorded, while some of them were also interviewed afterwards.

Results show that the use of three media and the cooperation between students and among teacher and students facilitates students' understanding in a more intuitive way, particularly concerning the meaning of abstract concepts. When they work in groups, the most of the times it helps them positively and they arrive to agree ant to mesure the elongation from the correct position. Of course, the interactions between the students as well as the role that each student plays in the team are very interesting. Nevertheless, exist some teams (minimal) where a student has the role of leader or there are disagreements and they don't arrive in the correct result. When in the process participates their professor, prompts them to experiment more times and "carefully'. The teacher ask them many questions but also helps them when the students answer by a falshe response. For exemple "*do you remind anything… we have taught it in the book…* Or they say: *it exists in a frame with the spring and the dynamometer in the chapter 2… I help you*"; "*Beautifully! you have meet it in the lower secondary school and you have have given it also a name*". We conclude that when they work in groups positively and the teacher participates to the process the models are more complicated and arrive to the scientific model.