

## Editorial

### QUALITY OF SCIENCE EDUCATION (V)

#### Calidad de la educación en ciencias (V)

There is a question of special interest among different innovations that attracts the attention of teachers and researchers of Science Education. It is the implementation of research methods in teaching. We understand as a “research method of teaching and learning” a methodology in which the teacher uses some of the elements of the common research methods in the class or independent student work to improve students the knowledge and abilities and to increase their motivation.

It is common knowledge that the main parts of the research methodology are : handling a hypothesis, planning the research, planning and working out the experiments, data processing and analysis, making conclusions and so on. . There is a lot of evidence in science educational literature and practice about the application of different parts of this methodology in the teaching and learning process.

The first step of practicing the research methodology in science education is the design of the truly scientific curriculum of Physics, Chemistry and Biology (Orlik 2000). Unfortunately many examples, in which the curriculum for the secondary school and University doesn't fulfill the necessary standards of modern Science education exist. The modern curriculum has to provide students with opportunities to study Science based on selected contents to develop high order cognitive skills: analysis, creativity, planning the experiment, taking the part in the group work, explaining the way to solve the problem, to search and correct errors, and so on (Orlik 2002).

There are two principal parts in the implementation of research methodology: the teacher-researcher and student-researcher. The role of the teacher is very difficult here: he/she has to be creative using several methods and strategies for doing science in the class room. One of these simple but effective methods here is to use Questions as a powerful educational tool. To ask and to answer questions is the historic way of the Science development and it has to be widely presented in classes for developing the thinking and high capacities of students. The teacher must use different forms of questions, including chains of questions to continue the investigations of the specific theme of the class (Eslava de Aja, Eslava 2000). Furthermore, the modern form of evaluation and assessment has been built based on high quality questions . In the classwork students have to design their own questions and this activity strongly develops the high level capacities and skills (Using students evaluations 1997).

It's also possible to use the research methods directly in classes, but it's not easy to do it. For example, one of the variants is the inquiry method (Bunce 1997), that consists in the identification of questions and concepts for research, designing and working out the research to use computer technology and mathematics, to explain results scientifically and to use models, the logic and the evidence to have capacities to express and to defend scientific arguments. There are different examples to use these methods in the laboratory instruction in Science (Bell 1997, Lloyd 1994). Another way of implementing

scientific methods is to rediscover important concepts and laws in the classroom and there are examples of such activities in the different themes on Chemistry and Physics : Periodic Law, Newton law and others .

The problem-based method is also one of the best ways to develop the scientific skills of the student. The teacher presents a problem situation in class and solves it together with students, as the first stage of the implementing of such a method. There are other steps of implementing this methodology: the preparation to the problem perception, the raising of the problem situation, the formulation of the problem, its resolution and, the checking out of the solution (including the science experiment) (Mahmutov 1975; Ram 1999; Dods 1996).

All parts of science subjects have a lot of theoretic concepts that can be studied better based on abstract and mental models. For example, the teacher can build these models together with students in this way: to analyze and reveal the main properties of the object or the science phenomena ; to build the model based on these properties; to investigate the mental model from different points of view; to go back from the model to the real object or phenomena; finally to organize the experimental revision of results of building of the mental model. Frequently these models have direct connections to the schematic representation of the theoretic material of the subject (Goodwin, Orlik 2000; Bhushan, Rosenfeld 1996).

The student is another and more important part of the educational system in science education. What capacities and skills should the student-researcher have?. First of all, he/she has to study science subjects with the interest, the high responsibility for it's own knowledge and abilities. Sometimes teachers complain about the lack of motivation of students, but the student himself is responsible for his/her own motivation. To be motivated it is necessary to read more books and articles, to ask more questions trying to look for their own answers, to spend more time in the library and Internet looking for interesting information in Physics, Chemistry, Biology and Mathematics. **It is exiting!** Teachers should help students to understand the beauty of this work and BEAUTY OF SCIENCE.

In this way teachers have to do a lot of efforts for the strong motivation of students in class and the independent work. Several methods and strategies suit for that, but the best one is if the teacher him/herself is strongly motivated, because he/she can manage different active methods of teaching, doing his/her own research in laboratories and classes. In this case students of different ages study and discover Science with a true pleasure, enjoying this activity.

Fortunately we have a lot of examples when students-researchers in undergraduate programs of the university and sometimes at high school take part in Olympiads, spend their free time in university research laboratories and libraries, and even publish their first research work with tutors in scientific journals. This educational work develops the creativity, critical abilities and other capacities of high level and allow students to be better prepared for the amazing and difficult work in Science. The same knowledge, capacities and abilities are very necessary for Life.

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