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Optics education in the frame of the Comenius "Hands-on Science" project

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Summary

In the Society of our days there is a major increasing need of an in depth quality education in Science and Technology. Science teaching at school should be generalized aiming not only the sound establishment of a "Science" culture in our societies but also to guarantee a steady basis for the improvement of Science and its technological applications. The European Commission, under the program Socrates, Comenus 3 action (project nº. 110157-CP-1-2003-1-PT-COMENIUS-C3) supports the network "Hands-on Science". The activities of our network focus on the development and or diffusion at European scale of positive hands-on experimental practices on teaching science at basic secondary and vocational training schools, by leading the students to an active volunteer and committed participation in the teaching/learning process through hands-on practice and experimentation, making intensive use of the new instruments and resources of the Information Society.

Physics education is one of the main field of interest of the project, so, education on optics has the place it deserves in our activities. The paper presents some of our major achievements in this direction, in Portugal and Romania.

In Portugal a country wide project for the improvement of optics teaching had started. In this frame, students begin *looking* and discussing different sources of light from the sun to sodium fluorescein. Light dispersion with Newton prisms was next. A short analysis of the human visual system was performed. The color vision and color matching were then introduced. Definitely enchanted students performed several simple experiments. Some optical illusions have been observed and discussed. Next they entered the domain of the basics of geometrical optics. Simple ray tracing experiments were done. The mirrors and lenses were introduced. The microscope and the telescope become rather popular! Other topics like spectroscopy, optical sensors, diffraction concept, holography and fiber optics were also included. Along the years the material, guides and experiments involved were improved and enlarged trying to establish bridges to other fields of knowledge in an interdisciplinary way. We also included more advanced approaches to topics like optical sensors, fiber optics and telecommunications in interdisciplinary ways involving not only physics teachers and students but also electronics or chemistry teachers and students in a project were the focus is on the spectroscopy and its applications. The very positive way the project evolved on the classroom's experimental activities was confirmed by the assessment of the students' *knowledge* improvement on these matters. But, above all, the interest of this kind of actions was marked by the students opinion expressed on voluntary surveys the students filled by the end of the action. 98% of the students was very pleased with the action and expressed their desire of seeing it continued. A important majority stressed the importance of hands on experimental work on learning physics. But perhaps more important is that the students soon began organizing their own activities. Even with younger students from pre-school or elementary (5 to 8 years old) this kind of action have a striking positive effect. The basics of some subjects are easily understood: addition of colors (often older students take longer to understand the process because they are used to the subtractive ink's color mixing), reflection of light and internal total reflection (a piece of sweet flavored jelly may act as an *wonderful...* light guide!), refractive bending of light (the coin in the *bottom*

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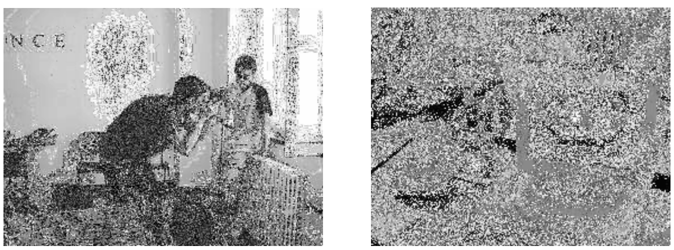
of a plastic cup; a trip to a rivers' shore may become an highly productive and pleasant experience!).

In Romania different activities were organized in the frame of newly created science club across the country (Figure 1 a), where very young students debated various aspects of optics learning through poster sessions (Figure 1 b – optics history), teaching aids they built (Figure 2 a – a telescope), or more sophisticated experiments (Figure 2 b). The project assists both school students (Figure 3 a) and the graduate ones (Figure 3 b).

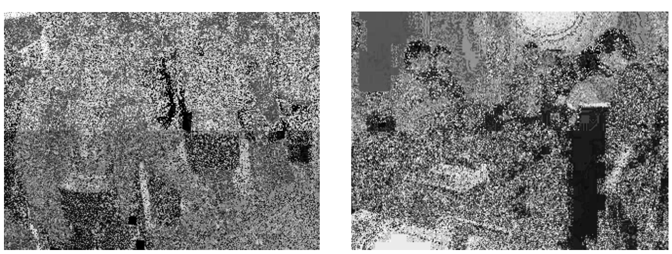
a b

Figure 1. A Saturday science club in Bucharest (a); poster session on "life and activity of Albert Einstein" (b).



a b

Figure 2. The telescope – the first award to a science contest in a Bucharest high school (a); Image processing in biological investigations (b).



a b

Figure 3. Demo session in a primary school with rroma students in Romania (a); training young scientists in the frame of a European project (b).