

LABORATORY EXPERIMENTS OF MODERN PHYSICS IN PERMANENT EDUCATION OF PHYSICS TEACHERS

Luka Mandic, *Department of physics and ecology, Technical faculty, Rijeka, Croatia*

Dubravka Kotnik-Karuza, Mariza Sarta-Dekovic, *Physics department, Faculty of philosophy, Rijeka, Croatia*

We live in atomic era, the era of atomic physics and nano technologies. They are in cyclic relation: new knowledge give arise to new technologies which makes possible new researches and discoveries. The cycle period is getting shorter and shorter. People are exposed to so many informations about new technologies. These technologies are based on the branches of science which are not naturally exposed to human eye or other senses. The outcome of that is a new challenge for physics teachers: to maintain the consciousness about the world in which we live and and to follow the way leading us into the future. Here arises one significant problem. One could easily imagine a situation in which a pupil demands from his teacher some explanation on thematics that he read yesterday on internet, and the teacher isn't able to give correct answer because his knowledge is restricted to what he learned 10 years ago. The only way to solve this problem is an organized and permanent education of all present physics teachers, no matter to which generation they belong. This responsible job must be carried out by universities or institutes of physics. It must become an ethic obligation for universtiy teachers. Here comes our team story.

Many physics teachers have graduated in our institution, the Faculty of Philosophy (University of Rijeka, Croatia), during the last 40 years. Because of the financial deficits, our state couldn't always support educational programs of modern physics with adequate but expensive equipment for laboratory exercises. "Blackboard and chalk" was a catchword (motto) for a very long time in this area of physics. We had to put an end to this . According to constructivistic theory one of the most efficient methods of active acquirement of knowledge is experiment, and we have to keep that agreement. Thanks to a big effort and enthusiasm of our team members, we managed to supply our laboratory with new equipment, and as a result, we have today six laboratory experiments of modern physics. Beside the education of our students, we intend to organize permanent education for present teachers who have had until now no practical experience regarding the phenomena on microscopic scale.

We have started this work by analyzing the contents of physics textbooks intended for the fourth year of learning physics in the secondary grammar schools in Croatia which cover practically all subjects of modern physics. We have found them extremely rich in subjects covering different fields of modern physics and divided in obligatory, extended and facultative parts. However, the subject matter is given in a very concise, mostly descriptive way. Such books are useless to the pupils without a skilled teacher as a mediator able to choose from offered, to reduce or to give a detailed explanation . Such high level skills may be gained only by use of a methodical experiment which should become unavoidable component of teachers' education.

Interviews with high-school graduates have led us to the following conclusions: in spite of extensive school books, teaching about this issue is very poor. The concepts are not clear. The pupils neither see nor feel anything but statements on the blackboard which is pretty far from real understanding. In order to pass exams, the pupils have to learn by heart to acquire knowledge of the lowest degree, without any systematic concept. It is not their fault, but teacher's. He is not able to present these subjects in appropriate way because of their own misconceptions. Anyway, our criticism should not be too severe. It is not easy for a school teacher to keep "top fit" after many years of work in primary or secondary schools. The lectures on modern physics are mainly presented in the fourth year of the secondary grammar school. Hence the time given is fairly short. This can and should be improved by permanent education of the teachers.

We hope for good will of croatian school teachers to visit our laboratory and participate in laboratory demonstrations and educational researches which should become a usual practice. Beside

the professional and scientific development of physics teachers, there is also another possibility of cooperation between school and university. The talented pupils of secondary school could do their final or competition work related to these experiments which are available now.

On this example one could see how important is to have adequate equipment, not only for scientific research but also for education. Unfortunately, many schools and universities are not able to equip themselves at high or even mediocre quality level.