2.7 Physics teachers' nuclear in-service training in Hungary

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When I was a child, at school we had to make pictures or school compositions with the title „What will the year 2000 be like?" We had futuristic ideas: many people will live in Mars, our cars will fly, there will be eternal peace on the Earth, the cancer wont dangerous any more, we'll be able to produce pure unlimited energy, all the people will live more than hundred years.

This magic date is here now, here is the moment of the truth.
What do we have? We have fast computers, Internet, big jets, lots of cars, we have very effective weapons, global economy. On the other hand we have ozone hole, we have destroying rainforests, we have AIDS and we are afraid of global warming. I think the balance is neither positive, nor negative. But the most significant phenomena is the very quick change of technology, of knowledge, the accelerating time (George Marx). One thing is sure: The role of science, and the role of science education remain very important.

Our Country, Hungary is a very small country. The country occupies a territory of about 93 000 square kilometres. It has a population of about 10 million. We have good soils for crops and vegeteables but because of the agricultural overproduction all over the world it is difficult to find any market. Unfortunately we have no mineral resources, there are only a few oil-wells, we have no diamond and gold mines.

If we want to compete with the world's countries we can only rely on people, human understanding and creativity. The teacher has to bring to the surface, unearth this creativity and he/she must has to develop the found talent.

Teaching of science subjects, among them physics, demands revision and renewal syllabuses and methods. It is a banality to talk about the rapid increase of factual knowledge, abuot the progress of science at a quick pace. In our country the shift of social system adds to these things. These things cause anxiety because the future is uncertain and our knowledge is limited.

But the experiences show that hard times cultivate clever people, geniuses. There is an other thing against fear that who becomes a teacher, has to be always renewed. He/she has to

be renewed because he/she has to face clever young people full of critical sense, has to hand his/her knowledge over to them.

The theme of this conference is the nuclear education. But please allow me to say some words about the past. I would like to talk about, how the modern physics got to Hungarian schools, what kinds of methods the physics teachers used for their in-service training and what was their success by these methods.

Leon Lederman writes about Martians in his book „The God Particle":
„These extraterrestrials achieved great results in science, they had strange, even fantastic ideas. Because they could not learn English without an alien accent, they claim to be Hungarians. Such Martians were Edward Teller, Eugene Wigner, Jonh von Neumann, Theodor von Kármán, Leo Szilárd. Nevertheless they became suspect because all they arrived in America from the same district of Budapest and moreover several of them attended the same grammar school. (Past decade two more joined this exclusive club: John C. Harsányi, economic Nobel laureate and George Oláh, chemical Nobel laureate.)
The man who as the Minister of Public Education established „the basis of the Martians" — the grammar schools of Budapest, himself was a worthy of them physicist, Baron Roland Eötvös. Every physicist and physics teacher knows his incredibily accurate gravitational measurements, the torsion pendulum made by him."
Overview Eötvös' scientific achievement is not my present task.

More than hundred years ago, in 1891 Roland Eötvös invited mathematics and physics teachers with the aim of founding a society for the study of a continous self-education.
This Mathematics and Physics Society later adopted its founder's name; and is the present Eötvös Society.
We, Hungarian physicists and physics teachers believe, that organization of a self education forum, the Physical Society (1891), establishment of Eötvös College (1894) and the first Hungarian teacher training workshop (1905) are also very important part of his life-work.
Due to this activity the physics teachers can have the most active professional life and they have the best contacts with the scientists and university professors.

A historical example for the connection of modern science and education.

At the end of 1895 Conrad Röntgen, Rector of Würzburg University discovered X-rays. The first newspaper article about this discovery was published in Wienna early in 1896.
Hungarian Natural Scientific Journal reported on this discovery in January 1896. This article was illustrated with an X-ray photograph made at Budapest University. The photograph depicted Roland Eötvös'hand.
On 18 th January X-rays were produced also at grammar school of a provincial town. The photograph was published in the school yearbook. The school leavers (17-18 years old) took part in making X-rays photographs.
Virgil Klatt, a grammar school teacher from Pozsony (the teacher of to be Nobel prize winner Philip Lenard) worked out experimentally photoluminescent materials which were used for making fluorescent screen.
Secondary school physics teachers were so enthusiastic that on their own initiative they equipped X-ray laboratories in physics equipment stores. In two towns sick persons had been examined for decades in these laboratories. The creator of one of these laboratories, Josephus Ireneus Károly took part in above mentioned first Hungarian trainingsseminar (1895). The X-ray laboratory established on money collected by him already worked in December 1896 (one year after discovery!).

Unfortunately today we cannot hope for such a direct connection between science and education. But every teacher who wants to do his job well has to inquire about contemporary scientific problems, mainly because his/her students are much more interested in the future then in the past. This demands a permanent self-education from all of us.

Physics teachers' in service training in Hungary

In 1985 the Hungarian government decided on the teacher in service training reform. It introduced the system of intensive courses. According to this plan every teacher has to take part in an in-service training at a given time for a year. The courses ended with a thesis, and an examination. Depending on their results the participants received wage-increase.

Nuclear physics intensive course

Physics teachers had a possibility to be absorbed in a topic on the nuclear physics intensive course of Nuclear Physics Departement at Eötvös University. This kind of training was exciting, it evoked the teachers' large interest.

Though nuclear physics was not born these days nevertheless, now it represents the most advanced technology, in connection with environmental protection and energy supply. The students' experienced interest also motivates the teacher to be well-informed of this field.

The curriculum was the following:

- Nuclear physics theoretical lectures	10 hours
- Nucleonics	10 hours
- Nuclear energetics	10 hours
- Radioprotection	20 hours
- Nuclear demonstration experiments	10 hours
- Nucleonics and radiatation protection measurements	40 hours
	100 hours

Topics of laboratory practice:

- Dosimetry
- Measuring thermal neutron flux in active zone of reactor
- Neutron activation analysis
- Nuclear spectroscopy
- Computational simulation
- Practical reactor operation

Lectures were given by professors of Eötvös University and Technical University.

Practice mostly was carried out in the reactor of the Technical University in Budapest. The greatest experience for the teachers was the praxis in the operation of swimming pool type reactor. We had possibility start, run and stop a reactor.

The course ended with a ground-level examination on radiation protection controlled by state. The participants of courses after their succesful examinations received Geiger counters and simple radioactive sources for their schools as a present. The high popularity of this course is

due to the teachers good connection with the University, with its Nuclear Physics Departement. We often go back with our students for school excursions to see the reactor.

Some dissertations of the course:

- Simulation of neutron scattering with computer
- Investigation of cosmic radiation with a Geiger counters in coincidence
- Measuring of lead content in air
- Observation of acid rain
- Indoor radon survey
- Radon in my village
- Investigation of heavy metal content of leaves with snapshots of gamma spectrum

The teachers took special visits in power plants, laboratories, mines, deposits of nuclear wasts, universities or research institutes.

Nuclear excursions

Not only the participants of course, but the interested Hungarian teachers had possibility to see Chernobil and Three Mile Island, the teachers and the best students visited the laboratories of CERN, we saw the heavy water factory in Turnu Severin, in Romania and we went down to the mine of uranium in Hungary.

I would like to mention an interesting and well established training form of Unversity of Debrecen. Each year one teacher can work at the Nuclear Research Institut getting a research scholarship. With a consultant's help he/she can engage in a real, daily research, he/she can solve a part of research problem. After one year the sponsored teacher gives an account of his/her finished work. If this account has a quite high level the theacher has an opportunity to improve it on as a PHD.

From these „nuclear teachers" a country-wide network has been created not only for inservice training of secondary school teachers, but for the dissemination of actual information as well. For example: Intended location of radioactive waste deposits, CO2 green house situation, international agreements and manifests about SO2, NOX, CO2, nuclear releases, future limitations, software for energy production, environmental models and risk education.

At least in half of the counties this network is alive, organizes seminars, visits the nuclear plant. Eight years ago these teachers formed the Teacher Branch of Hungarian Nuclear Society. Nowadays the most important task of the Teacher Branch is to organize the Leo Szilárd Nuclear Physics competition.

The start of Leo Szilard competition

At the centenary of Leo Szilard, in 1998 the Eötvös Physical Society proposed a countrywide student competition of secondary school graduates in nuclear physics.
The interest exceeded all our hopes. Each year over **400** students participate from dozens of schools, from all over the country.
(This means more than one percent of secondary school graduates of the year.) Even some younger students from grades 8,9,10, 11 (of the age 13, 14, 15, 16) participate.

Selecting Competitions

From the selecting competitions – organized locally in the schools - those had the chance to go to the final competition, who solved over **60 %** of the problems. (For juniors below the age of 16 a success rate of **40 %** was the threshold for participating the final competition.)

Final competitions

The final competitions are arranged in Paks, in the Energy Industry College of the Nuclear Power Plant.
At final competition

- the solution of ten more demanding theoretical problems (in 2 hours),
- one computer assisted problem (1 hour) Bemutatni egyet!!
- one experimental problem (2 hours) are the tasks.

About the results of competition

The encouraging fact is that these tasks are not exaggerated: each problem was solved perfectly well by a one or two students.
The success rate: above **60%** at senior students, near to **50 %** at junior students.
About the selective power of the Leo Szilárd Competion: in last year one of the winners brought home also a medal from the International Physics Student Olympiad.

The competition is made more attractive by the fact that in each year the **5 best students get free entrance** to the Hungarian universities.

The organizers

The Leo Szilard Student Competition is organized by an unselfish group of professors representing leading Hungarian universities and teacher training colleges, furthermore of secondary school teachers, under the umbrella of the Eötvös Physical Society and Hungarian Nuclear Society.

Autumn universities

On George Marx professors initiative in 1972 was born the tradition of autumn university.
The themes of these universities were energy, environment, global problems. The issues showed that we had to find connections with other natural sciences. These meetings had less participants, generally about 100 of the most active and innovative Hungarian physics teachers.

Titles of the Autumn Universities were:

- Energy and education
- Nuclear energy (Visiting the nuclear power plant in Paks, measuring here)
- After Rio's environment conference
- Global way of thinking, global responsibility
- The Gaia model
- Life in physics-physics in life (biophysics)

Famous lecturers from abroad and the most famous Hungarian professors spent time together with the physics teachers.

Not only physics teachers took part in these programs but biology and chemistry teachers were interested as well. This kind of training gave the experiences of real scientific conferences to the participants.

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